International Conference
on
Sustainable Approaches in Food Engineering and Technology

SAFETy 2021

24th-25th June, 2021

SOUVENIR

ORGANIZERS

Department of Food Engineering & Technology, Tezpur University, Assam, India

Department of Food Science & Technology, University of Georgia, Georgia (US)

IN ASSOCIATION WITH

Association of Food Scientists & Technologists (India) Tezpur Chapter

AFSTI Empowering the Food Professional | Tezpur Chapter

Message from Vice-Chancellor

Tezpur University
(A Central University)
Tezpur 784028, Assam
India

- *Visitor's Best University Award 2016*
- *NIRF India Rankings 2016: 05*
- *Accredited with 'A' Grade by NAAC*
- *THE Asia Rankings 2018: 100*

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Professor V. K. Jain, D. Phil.(UK)
Vice - Chancellor

Message from Vice Chancellor

I am pleased to know that the Department of Food Engineering Technology, Tezpur University in collaboration with the Department of Food Science & Technology, College of Agricultural & Environmental Sciences, University of Georgia, USA and AFST(I) Tezpur Chapter (Assam) is organizing an International Conference on "***Sustainable Approaches in Food Engineering and Technology (SAFETy)"*** in virtual mode, during June 24-25, 2021.

In the backdrop of ever-growing population of the world including that of our country and the spectre of climate change, food security for all continues to be one of the major challenges of this century. Food, apart from being a defining attribute of many a culture and societies, is so critical to the general well being and good health of entire humanity. It goes without saying that we as a nation have moral responsibility to provide safe and nutritious food to every section of our society and for which the role of Food Engineering and Technology in providing some sustainable approaches for food processing is absolutely necessary.

The solutions to the various problems of the food processing industries require judicious engagement of experts from all fields of Science and Engineering in order to contribute to the current needs of safe and nutritious food of the people. In this context, I am pleased that the organisers have chosen an appropriate theme - ***Sustainable Approaches in Food Engineering and Technology*** for deliberations during the International Conference to be held during June 24-25, 2021.

As a patron to the conference, I convey my warm greetings to the organisers behind this endeavor and to all the participants of the conference.

I wish **SAFETy-2021** a grand success.

(V.K. Jain)
Vice Chancellor

Message from Chairman

It's a matter of pride to note that Department of Food Engineering and Technology, Tezpur University is hosting its International Conference on Sustainable Approaches in Food Engineering and Technology (SAFETy 2021) in association with Department of Food Science and Technology, University of Georgia on 24th and 25th of June 2021.

Department of Food engineering and Technology at Tezpur University is one of the six constituent department under school of Engineering. Department of Food Engineering and Technology provides offers courses such as B.Tech (NBA Approved), M.Tech (AICTE approved) and PhD programs. The department has been immensely involved in research for many years right from its commencement in the field of Food engineering and technology. It has been recognized as state level technical institute of Assam, Meghalaya under PM-FME scheme of Ministry of food processing Industries (MOFPI), New Delhi. With the support of Ministry of Food processing Industries, a food quality control laboratory was started, which was NABL accredited. It was established for the Northeastern states of India. The department has also awarded with many grants such as AICTE –NEQIP, DST-FIST, UGC SAP DRS-I etc.

Amidst of pandemic, organizing such an event at this point of time reinforces the aim of creating a platform to exchange the ideas towards the development of new and sustainable technology. Food is an integral component of life and human existence. Since the beginning of time, humans have had to eat for their survival. In earlier time when human population was much smaller resources were abundant and there was less need for food processing and storage but with the growth of population leads to raise the requirement of sustainable approaches for meeting today's world requirement. Without increased attention to the role of food processing and food engineers or food technologists for maintaining a food supply, we are unlikely to succeed in addressing mounting challenges in delivering sustainable and safe diets for all the people. Therefore, I wish the conference would be able to deliberate on current issues and convey my warm greetings to the organizing committee and the participants and extend my best wishes for the success of the conference.

Nandan Sit
Chairman

Message from President, AFSTI, Tezpur Chapter (Assam) India

I on my personal behalf and as a President of the AFSTI, Tezpur Chapter (Assam) is extremely privileged to inform all of you that the Department of Food Engineering & Technology, Tezpur University, Assam, India, and Department of Food Science & Technology, University of Georgia, Georgia (US) in association with the former are hosting a virtual International Conference on "Sustainable Approaches in Food Engineering and Technology" (SAFETy-2021) wef 24th and 25th June 2021. I do believe this international conference is a special one because even in the COVID-19 pandemic our faculty members are going ahead in their professional life. I have gone through the SAFETy-2021 International Conference content and it is primarily focusing on sustainable approaches in food engineering and technology to cater the need of the current situation, which is a commendable step. There are ten (10) interesting themes and I am confident it has covered all the aspects of modern-day food engineering & technology and expect that the Organizing Committee will receive huge numbers of abstracts on these aspects and there will be very effective and pragmatic deliberations. The objective of the events is three-pronged and it is very crispy and clear which I am hopeful the Organizers will be successful to achieve it. In fact, for the first time, we are going to organize this digital international conference in the Department of Food Engineering & Technology and it is located in one of the most greenery and beautiful campuses of the Northeastern Region of the country. At this moment I have no words to express my heartfelt feelings but nonetheless give a great pleasure to see the names of a galaxy of learned speakers who will share their knowledge and expertise during the two days of the conference. Currently researchers, academicians, industrialists as well as policy makers have realized that apart from food and nutritional security, sustainable approaches in food engineering & technology are very critical and needs to be prioritized and which is a demand of the present generation across the entire world. Northeastern Region of India continues to be 'organic' and practicing traditional methods of farming far away from green revolution. For instance, the Assam tea, various joha rice varieties of Assam, turmeric of Meghalaya, large cardamom and ginger of Sikkim, black rice and lemon of Manipur, "Bhut Jalakia" & chilies of Northeast including Mizoram, orange of Arunachal Pradesh, passion fruit of Meghalaya and pineapple of Tripura are grown in this part of the country, and which are yet to be fully explored. The Ministry of Development of Northeastern Region has set up the "mission organic farming" to expand the traditional technique of organic farming. The Ministry of Agriculture and Farmers' Welfare has also launched the scheme- "mission organic value chain development for Northeastern Region". Even the Ministry of Food Processing Industries, New Delhi is also putting huge effort on our bio-resources to harness maximum economy.

Despite these initiatives, organic production and exports from this region are still scanty and one of the main challenges in the organic food market is the awareness and poor supply chain management of organic produce. In addition, the crucial areas in the manufacturing of organic food product are packaging, because the packaging material must be recyclable, degradable, and produced with renewable resources and in some cases edible. However, with the demand of organic products, sustainable novel technologies are expected for solving these problems. I truly believe that the various discussions and presentations that will take place over numbers of technical sessions in these two days (June 24-25, 2021) will help us in finding out the best way to select the roadmap for future sustainable agro-processing and integrating novel technologies for bringing organic wellness to this region and the country as well. I further believe that all the eminent invited speakers and young and hugely talented digital poster presenters would facilitate in achieving sustainable approaches for food engineering and technology which would be safe and healthy to India and at the global level as well. In addition, I am also confident that this conference will unleash an informative and scientific experience and shall be a gift to all of us which can be articulated in our future professional life for the betterment of our society. I personally and on behalf of the AFSTI, Tezpur Chapter congratulate both the Organizing Secretaries Dr. Amit Baran Das, Department of Food Engineering and Technology, Tezpur University, Assam, India and Dr. Abhinav Mishra, Department of Food Science & Technology, University of Georgia, Georgia, USA for their relentless effort in organizing this event very successfully. I also sincerely thank one and all including Tezpur University and University of Georgia towards extending maximum possible support and also all the stakeholders. Wishing a grand success of this international conference and I firmly believe “Yes, We Can.”

Prof. Sankar Chandra Deka, FRSC
President, AFSTI, Tezpur Chapter (Assam) India

Few words from organizing secretaries

The organizing team cherishes hosting the experts, professionals and participates and the dignitaries on the occasions of the International Conference on '*Sustainable Approaches in Food Engineering and Technology (SAFETy-2021)*' on virtual mode during 24th-25th June 2021. The conference is hosted by the Department of Food Engineering and Technology, Tezpur University, Assam, India in collaboration with the Department of Food Science & Technology, University of Georgia, USA in association with the Association of Food Scientists & Technologists (India), Tezpur Chapter.

With the transitioning of the human civilization from the pre-digital industrial age to the IT-age and beyond, accompanied by the technological mega trends of the 21st century, the focus in food design and development is now shifting more towards health benefit and safety. The conference SAFETy-2021 aims at providing a platform to academicians, scientists, students and young researchers, entrepreneurs, and industry personals to deliberate on and discuss the recent research sustainable trends and technological developments in food processing with due concern for health benefits and safety.

We are hopeful that the conference will offer a venue where all contributors coming from different parts of the globe from different backgrounds will have deliberations and extensive discussions on the recent practices and development trends. The conference will also provide an opportunity for networking and collaboration among the participants. In the process, the hosting institutes will receive a deserving boost to their morale.

Greetings and warm wishes to all.

Amit Baran Das

Abhinav Mishra

June 2021

DEPARTMENT OF FOOD ENGINEERING AND TECHNOLOGY
TEZPUR UNIVERSITY

The Department of Food Engineering and Technology (FET) was established in the year 2006 with the aim of creating skilled human resources in the engineering aspect of food processing in order to cater to the needs of the rapidly growing food processing sector. Since its inception the Department has been imparting Post Graduate education in the area of food processing and technology. The B. Tech. programme in Food Engineering and Technology (FET) is approved by the All-India Council for Technical Education (AICTE) and has the accreditation of the National Board of Accreditation (NBA) as a Tier-I programme. The M. Tech. in Food Engineering and Technology (FET) is also approved by the AICTE. AICTE offers PG Scholarship to GATE qualified students joining the M.Tech. programme of the Department. The Department also offers Ph. D. in Food Engineering and Technology and students may take admission through AICTE Doctoral Fellowship (ADF), NET/JRF, GATE etc.

The department has well developed laboratories for teaching and research created from grants received from various agencies viz., HRD grant from the Ministry of Food Processing Industries (MoFPI), Govt. of India, grant under the FIST programme (Level I) from the Department of Science and Technology (DST), grant under the UGC- SAP (DRS-I) programme of the University Grant Commission, and grant under the NEQIP Scheme of the AICTE. To cater the requirements of testing nutritional parameters of various food items by food industries and with the support from the MoFPI, the Department has established NABL accredited Food Quality Control Laboratory (FQCL). The Department has been recognized as the State Level Technical Institute (SLTI) for Assam and Meghalaya under the PM-FME scheme (PM Formalisation of Micro food processing Enterprises Scheme) of Ministry of Food Processing Industries (MoFPI), GoI, New Delhi.

Research activities at the Department are supported by sponsoring agencies like UGC, MoFPI, DST, DBT, DRDO, ICAR, AICTE, MSME, ASTEC, etc. Various projects carried out at the Department aims at developing effective and low-cost technologies for the society. Some developed food products and processes have also been patented by the faculties. Workshops, conferences and seminars are organized regularly in the Department for knowledge sharing among peers as well as for motivating local youths to start their own enterprises.

UGA Food Science

The University of Georgia is located in Athens, Georgia, 70 miles northeast of Atlanta (http://www.uga.edu/). The university, a land-grant/sea-grant university, is ranked among the top 15 public universities in U.S. News & World Report's 2021 edition of America's Best Colleges. The university is recognized as a research-intensive and community-engaged institution by the Carnegie Foundation. The Department of Food Science and Technology (http://www.foodscience.caes.uga.edu/) is a unit of the College of Agricultural and Environmental Sciences. Athens offers a rich cultural environment interconnected with the university and is perennially identified as one of America's most livable cities (http://www.visitathensga.com/about-athens/)

About SAFETy-2021

The Department of Food Engineering & Technology, Tezpur University, Assam, India, and Department of Food Science & Technology, University of Georgia, Georgia (US) are hosting a virtual International Conference on "*Sustainable Approaches in Food Engineering and Technology*" (SAFETy-2021) on 24th and 25th June 2021.

As we understand the COVID-19 pandemic has led to an unparalleled loss of human life worldwide and presents an unprecedented challenge to public health, food systems, and the world of work. As suggested by World Health Organization (WHO), eating a healthy diet is very important and can be considered as a regimen during the COVID-19 pandemic. What we eat and drink can affect our body's ability to prevent, fight and recover from infections. While no foods or dietary supplements can prevent or cure COVID-19 infection, healthy diets are important for supporting immune systems. Safe food handling practices and procedures are therefore implemented at every stage of the food production life cycle to alleviate these risks and prevent harm to consumers

The SAFETy-2021 International Conference is primarily focused on sustainable approaches in food engineering and technology to cater the need of the current situation. The sustainable approaches in the food system help to deliver food security and nutrition in an equitable manner for all in such a way that the economic, social, and environmental bases to generate food security and nutrition for future generations are not compromised. The organizers are quite confident that this conference will help to addresses the limitations of many traditional approaches to improving food security and nutrition. The sustainable approaches in food engineering and technology will be covered with the following subthemes.

Objectives of the event

1. To provide an opportunity to disseminate information among the stakeholders on wider aspects of food processing with a view to integrate industries-academia for best practices.
2. To highlight and analyze new technological and engineering developments in post-harvest handling and processing operations of agricultural produces.
3. To strengthen the linkage of the university with international organizations related to food engineering and technology.

Themes

1. Innovative approaches in food processing
2. Quality, safety and hygiene in food processing
3. Functional, nutraceutical and health foods
4. Modeling and simulation approaches in food processing
5. Engineering aspects in food processing
6. Food biotechnology and bioprocessing
7. Food packaging and shelf life
8. Food microbiology
9. biochemical engineering
10. Waste utilization and management in food processing

SAFETy- 2021 : Team

Chief-Patrons

Prof. Vinod Kumar Jain
Vice-Chancellor, Tezpur University

Advisors

Dr. C. Anandharamakrishnan
Director, IIFPT, Thanjavur, Tamil Nadu
Dr. Trilochan Mohapatra
Director General, ICAR, New Delhi
Prof. H. N. Mishra
Department of Agricultural & Food Engineering, IIT Kharagpur
Dr. K.S.M.S. Raghava Rao
Professor, Indian Institute of Technology Tirupati
Prof. Suvendu Bhattacharya
Former Scientist CFTRI, Mysore
Prof. R.S. Singhal
Dean, Research Consultancy and Resource Mobilisation, ICT, Mumbai
Prof. MD Shafiur Rahman
Professor · Sultan Qaboos University
Dr. Vijay Juneja
USDA-ARS Eastern Regional Research Center, Wyndmoor, Pennsylvania, USA
Prof. Charu Lata Mahanta
Professor, Tezpur University
Prof. Sankar Chandra Deka
Professor, Tezpur University

Patrons

Prof. Dhruba Kumar Bhattacharrya
Pro Vice-Chancellor, Tezpur University
Prof. Smriti Kumar Sinha
Dean, School of Engineering, Tezpur University

Chairman

Prof. Nandan Sit
Department of Food Engineering and Technology, Tezpur University

Organizing Secretaries

Dr. Amit Baran Das
Department of Food Engineering and Technology,
Tezpur University, Napaam, Assam, India

Dr. Abhinav Mishra
Food Science and Technology
University of Georgia

Conveners

Dr. Laxmikant S. Badwaik, Tezpur University

Dr. Poonam Mishra, Tezpur University

Dr. Govindaraj Dev Kumar, University of Georgia

Members

Prof. Manuj Kumar Hazarika, Tezpur University

Prof. Brijesh Srivastava, Tezpur University

Dr. Nishant R. Swami Hulle, Tezpur University

Dr. Sourav Chakraborty, Tezpur University

Dr. Tabli Ghosh, Tezpur University

Dr. Dipankar Kalita, Tezpur University

Dr. Arup Jyoti Das, Tezpur University

Mr. Labadeep Kalita, Tezpur University

Ms. Swdwmsri Mashahary, Tezpur University

Student Members

Arun Kumar Gupta

Avinash Kumar Jha

Sonam Kumari

Ruchi Rani

Tapasya Kumari

Payel Dhar

Somya Singhal

Mohit Singla

Amardeep Kumar

W. Zimik

Thoithoi Tongbram

Monica Yumnam

Bhaskar Jyoti Kalita

Swapnil P. Gautam

TECHNICAL AND POSTER SESSIONS - at a glance

Date: 24/06/2021 (Day-1)				
9:30-10:30 Hrs	Inaugural Function			
10:30-11:15 Hrs	Keynote address: By Dr. C. Anandharama krishnan, Director, IIFPT, Thanjavur			
11:15-11:30 Hrs	Springer: Dr Naren Aggarwal, Editorial Director, Asia and Dr Madhurima Kahali, Editor, Biomedicine			
11:30-14:00 Hrs	**Technical Session-1** Engineering Aspects in Food Processing	**Technical Session-2** Engineering Aspects in Food Processing	Poster Session-1 Innovative Approaches in Food Processing	*****
14:00-16:30 Hrs	**Technical Session-3** Engineering aspects in food processing	**Technical Session-4** Food Microbiology and Bioprocessing	**Technical Session-5** Food Microbiology and Bioprocessing	Poster Session-2 Quality, Safety and Hygiene in Food Processing-1
16:30-18:30 Hrs	**Technical Session-6** Food Packaging	**Technical Session-7** Food Packaging	**Technical Session-8** Quality, Safety and Hygiene in Food Processing	Poster Session-3 Functional, Nutraceutical and Health Foods-1
18:30-20:30 Hrs	**Technical Session-9** Quality, Safety and Hygiene in Food Processing	**Technical Session-10** Quality, Safety and Hygiene in Food Processing	Poster Session-4 Functional, Nutraceutical and Health Foods-2	Poster Session-5 Quality, Safety and Hygiene in Food Processing-2
Date: 25/06/2021 (Day-2)				
9:30-12:00 Hrs	**Technical Session-11** Waste Utilization and Management in Food Processing	**Technical Session-12** Modeling and Simulation Approaches in Food Processing	Poster Session-6 Engineering Aspects in Food Processing	Poster Session-7 Food Packaging
12:00-14:30 Hrs	**Technical Session-13** Functional, Nutraceutical and Health Foods	**Technical Session-14** Innovative Approaches in Food Processing	**Technical Session-15** Innovative Approaches in Food Processing	Poster Session-8 Waste Utilization and Management in Food Processing
14:30-17:00 Hrs	**Technical Session-16** Functional, Nutraceutical and Health Foods	**Technical Session-17** Functional, Nutraceutical and Health foods	Poster Session-9 Food Microbiology and Bioprocessing	*****
16:30-18:30 Hrs	**Technical Session-18** Functional, Nutraceutical and Health foods	*****	*****	*****
19:00-19:30 Hrs	Valedictory Function			

Day One: 24th June, 2021

TECHNICAL SESSIONS

Technical Session-1	Engineering Aspects in Food Processing	
Date: 24/06/2021	Chair	**Prof. K.S.M.S. Raghava Rao**
Time (IST)	Co-Chair	**Dr. L. S. Badwaik**
11:30-12:00 Hrs	**Invited Lecture**	
	Prof. K.S.M.S. Raghava Rao	Novel Engineering Approaches in Food Processing
12.00-13.30Hrs	**Oral Presentations**	
TS1-1	**Chandrakala Ravichandran**, Ashutosh Upadhyay	Effect of High shear Homogenization on dietary fibre and Particle size and volatiles in Pineapple pomace
TS1-2	**Manas Jyoti Barooah**, L N Sethi, A. Borah	Design and mass scale adoption of improvised Poly-house solar bulk drying system for spices and minor fruits in Assam
TS1-3	**Maanas Sharma**, Kshirod K. Dash & Laxmikant S. Badwaik	Release behaviour of phytochemical compounds based on Black Jamun pulp extracts-filled alginate hydrogel beads through Ionotropic encapsulation
TS1-4	**Satheeshkanth S S M**, Mohammed A Bareen, Preeti singh, Sukirti Joshi, Jatindra K Sahu	Printability assessment of protein rich formulations : development of legume based 3D printed dysphagia foods
TS1-5	**Kajol Chauhan**, Vivek Kumar	Effect of different drying techniques on the quality characteristics of yoghurt powder
TS1-6	**Gupta, A.K.**, Sahu, P.P. & Mishra, P.	Fabrication of lab scale batch type device for debittering of bitter citrus juice: Impact on chemical, bioactive and bitter compounds
TS1-7	**Radhika Jain**. & Sangeeta Goomer.	Effect of Particle size, Barrel Temperature on Physical properties and Limiting amino acids in Extruded Snack
TS1-8	**Priyanka Dubey** and Owais Yousuf	Ozonation: A sustainable advancement in Food Processing

Technical Session-2	Engineering Aspects in Food Processing	
Date:24/06/2021	Chair	**Prof. Suvendu Bhattacharya**
Time (IST)	Co-Chair	**Dr. Poonam Mishra**
11:30-12:00 Hrs	**Invited Lecture**	
	Prof. Suvendu Bhattacharya	**Snack foods: The present status**
12.00-13.30	**Oral Presentations**	
TS2-1	**Chowdhury, B.**, Maitra, S., Das, M. & Krishna, K.	Design and analysis of a water pumping device - A solution for hilly terrains
TS2-2	**Mythili S,** John Don Bosco.	Effect of drying methods on chemical composition, physicochemical and structural properties of underutilized cauliflower leaves (Brassica oleracea var. botrytis)
TS2-3	**Kohli, D.**, Champawat, P. S., Jain, S. K. & Mudgal V. D.	Advances in Peeling methods of Agricultural Commodities
TS2-4	**Kumar, A.,** Zimik, W., Begum, A. & Srivastava, B.	Enzyme inactivation and physico-chemical changes in pineapple juice in batch type ohmic heating system
TS2-5	**Ankita Sanam**, Rajesh Harsh, Tapas Bhuiya, Bhaskara Naik, Pranita Mane	Advanced EM Technology based system for Warehouse Management
TS2-6	**Rahul Kumar Rout**, Dhritiman Saha, (Late) Dr. S. K. Nanda	Shelf-Life Study of Groundnut Milk Powder Using Spray-Drying Technology
TS2-7	**D. Ravindra Babu**, R.C.Verma, Navneet Kumar Agrawal and Isha Suwalka	Comparison of Adapted and Improved Feature Extraction Techniques of Different Potatoes Types using Image Processing
TS2-8	**Anmol Dhillon**, Gazal Sharma	Impact of Various Drying Methods on Moisture Ratio and Rehydration of florets of Banana Inflorescence of Musa paradiscia L.
TS2-9	**Ramandeep Kaur** and Kamaljit Kaur	Effect of yellow sweet pepper powder and puree on the dough rheology and bread quality attributes

Technical Session-3	Engineering Aspects in Food Processing	
Date: 24/06/2021	Chair	**Prof. P. K. Nema**
Time (IST)	Co-Chair	**Dr. Nishant Rachayya Swami Hulle**
14:00-14:30 Hrs	**Invited Lecture**	
	Prof. P.K. Nema	Superheated steam drying of fruits and vegetables
14:30-16:00Hrs	**Oral Presentations**	
TS3-1	**Qazi Showkat Ashraf**, Darakshan Majeed, B.N Dar, Hilal A. Makroo, Jahangir Ahmad Rather,	Drying of whole lotus (Nelumbo nucifera Gaertn) rhizome slices: Effect of drying condition on various powder characteristics
TS3-2	**Vijay Sarode**, Sushama Choudhari, Anil Patil, Shambhu Hegde	Microwave Assisted Variable High Power System for Tea Processing
TS3-3	Dr. **Satadru Kashyap**	Weathering of natural fibre composites
TS3-4	**Mathanghi, S.K**, Kanchana, S., Perasiriyan, V. & Hemalatha, G	Impact of freeze-drying on physical and chemical characteristics of Palmyra palm Tender Fruit Endosperm
TS3-5	**Saadiya**	SPRAY – FREEZE – DRYING. An alternative approach for drying of foods and allied products
TS3-6	**S. K. Swain** S. K. Sial, S. Panda D. Behera R. N. Nayak A. K. Mohapatra A. K. Dash	A study on the functional requirement and nutritional characteristics of OUAT ragi thresher cum pearler
TS3-7	**Jayshree Majumdar** and Hari Niwas Mishra	Study of extrusion process parameters on the physico-chemical, morphological, rheological and sensory characteristics of a novel cooked extruded lentil : Essential Amino Acid Balanced Nutri Lentil
TS3-8	**Sonam Kumari**, Olympica Das, Arpita Boiragi & Manouj Kumar Hazarika	Improving quality of no cooking rice by Instant Controlled Pressure Drop Technology

Technical Session-4	Food Microbiology and Bioprocessing	
Date: 24/06/2021	Chair	**Prof. Paramjit S Panesar**
Time (IST)	Co-Chair	**Prof. Nandan Sit**
14:00-14:30 Hrs	**Invited Lecture**	
	Prof. Paramjit S Panesar	Valorization Of Agro-Industrial By-Products For Bio-pigment Production
14:30-16:30Hrs	**Oral Presentations**	
TS4-1	**Sujit Das**, Subrota Hati , B.K. Mishra , & J. B. Prajapati	Fermented rice beverage (Chubitchi) in management of Antibiotic Associated Diarrhoea
TS4-2	**Deka, A.K**, Deka, D.C.	Fermentation kinetics, its optimization, kinetics, and Sustainable Compounds in Ethnic Food Beverage Joubidwi
TS4-3	**Kumar, S.** , Nema, P.K. , Kumar, S. , Chandra A.	Effect of storage conditions on viability and physicochemical properties of spray dried probiotic powder
TS4-4	**Sharma, R.**, Sharma, S. & Singh, B.	Anti-nutritional factors, molecular interactions and phytochemical composition of proso millet (Panicum miliaceum L.) as influenced by biological processing treatments
TS4-5	**Naithani, S.**,Dhiman, N. And Arora, S.	Refused by man, refused by microbes : From waste to single cell protein
TS4-6	**Gope. S**, Darphang. J, Das.B.A	Indigenous Method for the Preparation of Rice Beer by Tiwa Community of Morigaon District.
TS4-7	**Bishnoi, A.** and Arora, S.	Bacterial proteases from root vegetables : a sustainable way to alleviate wheat disorders
TS4-8	**Dhanavath Srinu** and D. Baskaran	Glycemic Index And A-Glucosidase Inhibition Of Chocolate Incorporated With Spices
TS4-9	**Radha Kushwaha**	Chemical modification and characterization of jackfruit seed starch using organic and inorganic acid

Technical Session-5	Food Microbiology and Bioprocessing	
Date:24/06/2021	Chair	**Prof. S.C.Deka**
Time (IST)	Co-Chair	**Dr. Devinder Dhingra**
14:00-14:30 Hrs	**Invited Lecture**	
	Prof. S.C.Deka	Pineapple and its waste utilization vis-à-vis its nutritional value, bioactive functional food and health benefits
	Devinder Dhingra	Food grain preservation by cooling – A sustainable approach to extend shelf-life
14:30-16:00Hrs	**Oral Presentations**	
TS5-1	**Dr Shatabhisa Sarkar**	Kinetics of enzymatic hydrolysis of Guar gum
TS5-2	**Bhaskar Jyoti Kalita**, Nandan Sit	Effect of various substrates on production of cellulase by fungal species isolated from rice beer cake
TS5-3	**Yakubu, C.M.** , Sharma, R., Sharma, S. & Singh, B.	Effects of alkaline fermentation time on anti-nutrients, structural interactions and bioactive profile of locust bean (Parkia biglobosa)
TS5-4	**Yadav, D.K.**, Wadikar, D.D., Patki, P.E., Semwal, A.D.	Microwave processing technology and stabilization of Dry Army Ration (Bengal gram flour, semolina, and Green gram) commodities
TS5-5	**Dhanashri. Atiwadkar**., Yuthika. Ahiwale	Utilization of Corn Silk to inhibit activity of Aspergillus flavus in cereals and cereal products.
TS5-6	**Saxena, S.**, Ganguly, S., Khetra Y., and Sasmal, S.	Rheological study of curd prepared by plant rennet isolates of Cucurbita and Artocarpus seeds: Initials towards vegetarian cheese
TS5-7	**Saumya Jaidka,** Vivek Kumar, Alak Kumar Singh	Studies on effect of lactic acid fermentation on quality of rancid ghee

Technical Session-6	Food Packaging	
Date: 24/06/2021	Chair	**Prof. Uday S. Annapure**
Time (IST)	Co-Chair	**Dr. L. S. Badwaik**
16:30-17:00 Hrs	**Invited Lecture**	
	Prof. Uday S. Annapure	Cold Plasma: An Emerging Non-thermal Technology for Food Processing
	Prof. Henriette Monteiro Cordeiro De Azeredo	Approaches on food waste valorization for packaging materials
17.30-19.30	**Oral Presentations**	
TS6-1	**Dr. Gayatri Vaidya**	Necessity of innovation in sustainable food packaging technology for food security and safety
TS6-2	**Tabli Ghosh**, Vimal Katiyar	Fabrication of nanodisc shaped silk dispersed chitosan based nanocomposite for targeted edible coating application: Analysis of structure-property-performance relationships
TS6-3	**Pankaj Jha**	Preparation and characterization of corn starch-chitosan incorporated with different ratio of grapefruit seed extract bionanocomposite films for food packaging
TS6-4	**Archana Mahapatra**, Ashok Kumar Bharimalla, Sharmila Patil, Jyoti Dhakane- Lad, Manoj Kumar	Cellulose nanocrystal- Sodium Alginate Pickering Emulsion based Edible Coating for Fruits and its Effect on Storability of Guava
TS6-5	**Sharmila Patil**, A. Mahapatra, J. Dhakane-Lad, A. K. Bharimalla, P. K. Mandhyan	Bionanocomposites for food packaging applications
TS6-6	Sandeep Kumar Rejeti, S. **Anandakumar** Abinaya Venkatesh, B.K Yadav and Tito Anand	Development of active packaging system and real time IoT based quality monitoring device for tomatoes
TS6-7	**Thangsei N. Baite**, Bishnupada Mandal, Mihir Kumar Purkait	Plant extract mediated green synthesis of zinc oxide nanoparticles as a food packaging additive
TS6-8	**Payel Dasgupta**, Chavan Mukund Ashok rao, Dr JayeetaMitra	Storage study of Vacuum dried onion Powder using Different Packaging Materials
TS6-9	**Raveena Kargwal**, Rinku Grover, Praveen Saini, M.K. Garg	Effect of Perforations on Quality Characteristics and Shelf Life of Cucumber under Modified Atmosphere Packaging (MAP)
TS6-10	**Anjana**, Saswata Goswami	Significance of polyhydroxybutyrate based biocomposites in food packaging
TS6-11	**Owais Yousuf** and Anupama Singh	Achieving Sustainable Solution in Food supply chain via Technological Intervention

Technical Session-7	Food Packaging	
Date:24/06/2021	Chair	**Dr. P.P.Srivastav**
Time (IST)	Co-Chair	**Dr. Govindaraj Dev Kumar**
16:30-17:00 Hrs	**Invited Lecture**	
	Dr. P.P.Srivastav	Food waste valorization as a potent source of Nutraceuticals
17:00-19:00Hrs	**Oral Presentations**	
TS7-1	**Vidhi Gupta**, Kirtiraj K. Gaikwad	Novel Active Antioxidant Films Based on Biopolymer with Coconut Shell Extract and Sepiolite Clay to Control the Oxidative Stability of Lipid-Based Food
TS7-2	**Sazzadur Rahman**, Dr. Devasish Chowdhury	Topic: Polysaccharide based composite film as an alternative of packaging material.
TS7-3	**Ruchi Rani** & Laxmikant S. Badwaik	Study the effect of mustard, soybean and flaxseed meal blends on the properties of biopolymers
TS7-4	**Monica N.**, Rather M.A. Debbarma M and Srivastava B.	Antimicrobial activity of cinnamon and ginger extract and Physico-chemical changes in cinnamon dipped fresh-cut pineapple during storage
TS7-5	**Jyoti** Bhaswati Bhattacharya	Antiviral food packaging: An emerging and sustainable approach for improving food safety and quality
TS7-6	Rahul Paul Abraham**, Ankit Sinha** and Dr. Nilesh B.Kardile	Packing Alternatives for a Sustainable Future
TS7-7	**Ditimoni Dutta**, Nandan Sit	Effect of native and hydrothermally modified potato starches on properties of developed starch films
TS7-8	**Kajal**, Vivek Kumar, Anjali Srivastava	Performance improvisation of starch based composite film by incorporation of biofillers and antimicrobial agents
TS7-9	**Somya Neekhra**	Active & Intelligent Packaging of Cheese: Developments & Future Scope
TS7-10	**Aakash Upadhyay**, Kirtiraj k. gaikwad	Ethylene scavenging active nanocomposite films based on corn starch-gum Arabic with sepiolite clay for fresh produce packaging

Technical Session-8	Quality, Safety and Hygiene in Food Processing	
Date :24/06/2021	Chair	**Prof. Brijesh Srivastava**
Time (IST)	Co-Chair	**Dr R. Chetana**
16:30-17:10 Hrs	**Invited Lecture**	
	Prof. Brijesh Srivastava	Electrical Field Assisted Enzyme Inactivation and Surface Disinfection in Fruits and Vegetables
	Dr R. Chetana	Technology transfer from laboratory to industries
17.10-19.00Hrs	**Oral Presentations**	
TS8-1	**Soumitra Banerjee**	Protein Isolation from Underutilized Legume Macrotyloma uniflorum, and its Fortification
TS8-2	**AK Pandey,** OP Chauhan, Ravi , Rudra Gauda PG	Influence of combination treatments (hydrocolloids, freezing and centrifugation) on quality attributes of vacuum fried papaya chips (Carica papaya L)
TS8-3	Vivek Kumar, **Vikram Vishal Choudhury,**Anant Sekhar, Soumya Sasmal	Characterization and Comparison of Lipid Profile in Ghee (heat clarified milk fat) Using NIR Spectroscopy
TS8-4	**Kumar, S.**, Nema, P.K., Kumar, S., Chandra A.	Effect of storage conditions on viability and physicochemical properties of spray dried probiotic powder
TS8-5	**Ipsheta Bose** , T. Sujatha, Rahul Singh, Jai Sunder, & Gayatri Samaddar	Potential Use Of Seaweed To Improve Quality And Safety Of Poultry Meat
TS8-6	**Harpreet Singh Ghuman**, Dharmesh Verma , Rajesh Harsh	Quality investigation of rice kernels using image processing.
TS8-7	**Vidula B. Palekar**, Alok J. Verma	Food quality analysis using photoacoustic spectroscopy

Technical Session-9	Quality, Safety and Hygiene in Food Processing	
Date:24/06/2021	Chair	**Prof. C.L.Mahanta**
Time (IST)	Co-Chair	**Dr. Abhinav Mishra**
18:30-19:10 Hrs	**Invited Lecture**	
	Prof. Rakesh Singh	New Techniques in Food Technology and Packaging
19:10-21.00Hrs	**Oral Presentations**	
TS9-1	**Sowmya R S**, Warke Vishal G, MahajanGirish B, AnnapureUday S	Comparative studies of microbial and heavy metal safety assessment of the herbs cultivated in hydroponically and regular soil system
TS9-2	**Aradhya Tiwari**, Vivek Kumar, Alak Kumar Singh	Characterization of Cinnamon Quality Attributes from Different Locations.
TS9-3	**Saini, S,** Saxena, S., Sasmal, S.	Culinary impact assessment on Millets
TS9-4	**Awanish Singh**, Nandan Sit	Composition and functional properties of protein isolates obtained from Manila tamarind seed flour
TS9-5	**Jatinder Pal Singh**, Amritpal Kaur and Balwinder Singh	Influence of black cumin incorporation on the physicochemical characteristics of sesame oil
TS9-6	**Zainab Sultan**, SI Anwar, Pragati Singh	Quality evaluation of natural protein enriched value added jaggery
TS9-7	**Das, J.** &Mishra, H.N.	Nanocellulose as unique immobilization matrix for the development of biosensor for fish spoilage monitoring
TS9-8	**Yumnam, M.,** Hatiboruah, D. , Nath, P & Mishra, P.	Development of smartphone-based sensor for monitoring fish spoilage during storage at room temperature

Technical Session-10	Quality, Safety and Hygiene in Food Processing	
Date:24/06/2021	Chair	**Dr. Vijay Juneja**
Time (IST)	Co-Chair	**Dr. Nishant R. Swami Hulle**
18:30-19:10 Hrs	**Invited Lecture**	
	Dr. Vijay Juneja	
	Dr. Anand Mohan	Innovations in Value-addition of Food Waste
19:10-20:30	**Oral Presentations**	
TS10-1	**Shivangi Srivastava**, Dr. S.I Anwar	Development Of Spinach Based Value Added Jaggery By Raising Iron Content
TS10-2	**Poornima Singh**, Owais Yousuf, Zainab Sultan, and Tanzeel Hasan	Effect of Date Sugar and Jaggery on Fat, Protein and SNF of Ice-cream
TS10-3	**Alka Kumari**, Chakkaravarthi Sarvanan, Bhaswati Bhattacharya, Tripti Agarwal, Vijay Paul	Acrylamide quantification in potato-based Indian traditional snack
TS10-4	**Supriya Kumari,** Amritpal Kaur and Balwinder Singh	Development And Quality Evaluation Of Papad Prepared From Cereals And Under-Utilized Crops
TS10-5	**Penchalaraju, M.,** John Don Bosco,	Evaluation of yield, protein recovery, protein purity and physicochemical properties of pulse protein concentrates produced by wet processing methods
TS10-6	**Mrinmoy Roy** , S Shanmugasundaram	An ultrafast study on flash gas chromatography based electronic nose for the detection of adulteration in ghee
TS10-7	**Shyam Sundar,** Amritpal Kaur, Balwinder Singh	Effect of spices (ginger and garlic) and Indian gooseberry extract addition on the physicochemical characteristics and oxidative stability of different edible oils
TS10-8	**Debbarma M.**, Monica N. and Srivastava B.	Natural plant extracts as preservative for shelf-life enhancement of fresh-cut pineapple and its quality evaluation

Day Two: 25th June, 2021

TECHNICAL SESSIONS

Technical Session-11	Waste Utilization and Management in Food Processing	
Date :25/06/2021	Chair	**Dr. Mihiri Gunathilake Vanniarachchy**
Time (IST)	Co-Chair	**Dr. Poonam Mishra**
9:30-10:00 Hrs	**Invited Lecture**	
	Dr. Mihiri Gunathilake Vanniarachchy	Utilization of seaweeds in development of edible coatings and for value additions in Food products
10:00-12:00Hrs	**Oral Presentations**	
TS11-1	**Dutta, H.**, Rashid, S. & Shahi, A.K.	Physiochemical characterization of extracted almond shell cellulose and its nano-sized physical derivative for multifaceted use in the food industry
TS11-2	**Harshdeep Rana**, Saswata Goswami	Valorization of horticultural waste to legnocellulosic nanofibrils: a sustainable approach towards waste management
TS11-3	**Dakuri Ramakanth**, Kirtiraj K. Gaikwad, Pradip K. Maji	Extraction of Cellulose nanocrystals from Indian Gooseberry (Amla) Pomace: Food processing waste to value added product
TS11-4	**Jahangir A. Rather**, B N Dar, Qazi A. Shawkat & H A Makroo	Recovery of Gelatin from Poultry Waste: Characteristics of the Gelatin and Lotus Starch-based Coating Material and Its Application in Shelf-Life Enhancement of Fresh Cherry Tomato
TS11-5	**Shristy Chettri** and Dr. Ashish M. Mohite	Valorisation of food processing wastes; Okara and Lima bean peels
TS11-6	**Varee Tyagi**, Bhaswati Bhattacharya	Waste utilization of sorghum through green and sustainable technology for futuristic food safety applications
TS11-7	**Puletipalli Babu**, Mounika E and Sivamma P	Value Addition and Waste Utilization of Dragon Fruit
TS11-8	**Ravindra R Salve**, Subhajit Ray. Ravindra R Salve,	Pineapple Peel as a Potential Resource for the Extraction of Antioxidants
TS11-9	**Anusha Mishra**, Ranjitha Gracy T.K. and Uday.S. Annapure	By-product utilization of dried mango pulp fibre in the ready to eat extruded products
TS11-10	**Hemanta Kr. Pathak**, Prof. Nayan Barua	Study into Effective Supply Chain Management Aiming at Zero Food Wastage for a Sustainable Dairy Industry
TS11-11	**Mohit Singla**, Nandan Sit	Effects of microwave and enzymatic pretreatments on ultrasonic extraction of polyphenols from papaya peels

Technical Session-12	Modeling and Simulation Approaches in Food Processing	
Date :25/06/2021	Chair	**Prof. M. K. Hazarika**
Time (IST)	Co-Chair	**Dr. Sourav Chakraborty**
9:30-10:00 Hrs	**Invited Lecture**	
	Prof. M.K Hazarika	Physics Inspired Machine Learning in Food Process Engineering
	Dr. Chris Sannito	Utilization of Collagen Rich Alaskan Seafood By-Products for Pet Treats
10.00-12:00 Hrs	**Oral Presentations**	
TS12-1	**Chirasmita Panigrahi**, Hari Niwas Mishra, and Sirshendu De	Identification and Optimization of Process Conditions for Ozone treatment of Ultrafiltered Sugarcane Juice using Multi-objective Genetic Algorithm
TS12-2	**Vishwakarma, S.** , Dalbhagat, C.G. , & Mishra, H.N.	Computational fluid dynamic simulation of the twin screw extruder for fortified rice dough
TS12-3	**Muchahary, S.**, Deka, S.C. & Mattaparthy, V.S.K.	Docking simulation of chitosan-alginate complex in encapsulation of quercetin rich fraction and its optimization using RSM-BBD and ANN
TS12-4	**Pattnaik, M**., Mishra, H. N.	Molecular Dynamics Study of the Phase Behaviour in Lipid Bilayer Mixture
TS12-5	**Saumya Shrivastava**, Yashi Srivastava, Pirbi Ronghangpi	Mathematical modelling on Microwave and Conventional drying and rehydration kinetics of Ridge Gourd and Snake Gourd slices
TS12-6	**Rizwana, S.** & Hazarika, M.K.	Implementation of Machine Learning tool for Near Infrared based rapid identification of low amylose rice variety
TS12-7	**Chakraborty, S**. & Hazarika M.K.	Neuro-fuzzy interface system and biot number based unsteady state approach for the simulation of instant decompression assisted paddy steaming process

Technical Session-13	Functional, Nutraceutical and Health Foods	
Date:25/06/2021	Chair	**Prof. Anil Kumar Anal**
Time (IST)	Co-Chair	**Dr. Laxmikant S. Badwaik**
12:00-12:30 Hrs	**Invited Lecture**	
	Prof. Anil Kumar Anal	Valorization of Food Waste and By-Products as Potential Bioresources: Opportunities, Interventions, and Implications
12:30-14:30Hrs	**Oral Presentations**	
TS13-1	**Pandey, P**., Grover, K., Dhillon, T.S., Kaur A & Javed, M.	Evaluation of polyphenols enriched bread developed by incorporating black carrot (Daucus carota L.) powder
TS13-2	Bonita Mahanta; Manab Deka, **Vasudeva Singh**	Preparation Of Different Types Of Weaning Foods And Their Physico-Chemical Properties
TS13-3	**Pankaj Saikia**	Antioxidant Activity and Phenolic Content of some Non-conventional Vegetables of Assam
TS13-4	**Simran Sharma**, S. Chakkaravarthi, Bhaswati Bhattacharya	Nanoemulsion-based encapsulation: An emerging natural antioxidant delivering approach to replace synthetic antioxidant in edible oil
TS13-5	**Perraulta Lavanya. J,** Narayanasamy Sangeetha	Study on the suitability of sorghum (Sorghum bicolor (L.) grain variety for the development of gluten-free cracker
TS13-6	**Priyanka kundu**, Prerna Gupta	Comparative analysis of phytochemical extraction potential of three different solvents from Chenopodium album leaves.
TS13-7	**Vinita Puranik**, Reshma Saroj	Wheat bran: A valuable byproduct of processing
TS13-8	**Rachna Gupta** & Dr. Murlidhar Meghwal	Pigmented Wheat: A Nutritional Security
TS13-9	**Mitharwal, S.**, Chauhan, K.	Effect of germination process on germination efficacy of black soybean (Glycine max L. Merr.) grains and physicochemical characteristics of flour
TS13-10	**Gitanjali Gautam**, Sima Kumari, Sanjay K Banerjee, V S K Mattaparthi, Charu Lata Mahanta	Fabrication of hydrophobic starch nanoparticles for the enhancement of tocotrienol stability and permeability: Focusing on dyslipidemia

Technical Session-14	Innovative Approaches in Food Processing	
Date 25/06/2021	Chair	**Prof. Rajesh Harsh**
Time (IST)	Co-Chair	**Prof. Anupama Singh**
12:00-12:30 Hrs	**Invited Lecture**	
	Prof. Rajesh Harsh	
	Prof. Anupama Singh	Comparative evaluation of different extraction techniques for effective valorization of Citrus reticulate L. (Kinnow) peel
12:30-14:30Hrs	**Oral Presentations**	
TS14-1	**Makrooa, H. A.,** Rastogib N. K., & Srivastava B.	Ohmic Heating of Different Fruit Materials: Study of Heating Behavior and Energy Performance
TS14-2	**Jayawardena, J. A.E.C.,** Vanniarachchy, M.P.G, & Wansapala, M.A.J.	Pasteurization of progressive freeze concentrated coconut water using ultraviolet-C radiation, ultra sonication and thermal pasteurization method
TS14-3	**G.P. Tagalpallewar**, S. H. Akbari, H.G.Bhatt	Effect of Irradiation on Aflatoxins and Bio active Compounds of Deoiled Peanut Cake
TS14-4	**S. H. Akbari** , G.P.Tagalpallewar	Effect of Microwave on Aflatoxins and Bio active Compounds of Deoiled Peanut Cake
TS14-5	**Chopra, Sangeeta**, Beaudry, R., Mueller, N., Indra Mani	Farm SunFridge – an off-grid, battery less, solar refrigerated-evaporatively cooled structure for storage of perishables
TS14-6	**Gourab Chatterjee,** Asit Kumar Saha and Mahua Ghosh	Overview on super critical CO_2 extraction of functional bioactive from Flaxseeds and its in-vitro antioxidant, antimicrobial and therapeutic efficacy

Technical Session-15	Innovative Approaches in Food Processing	
Date:25/06/2021	Chair	**Dr. Navin Kumar Rastogi**
Time (IST)	Co-Chair	**Dr. Nandan Sit**
12:00-12:30 Hrs	**Invited Lecture**	
	Dr. Navin Kumar Rastogi	Opportunities And Challenges In Application Of Forward Osmosis In Food Processing
12:30-14:30Hrs	**Oral Presentations**	
TS15-1	**Shaikh, A.E.Y.** & Mishra, H.N.	Electrohydrodynamic Drying: An Innovative Approach for Sustainable Food Processing
TS15-2	**Rishab Dhar**, Snehasis Chakraborty	Microwave Treatment of Bael Juice in comparison with pulsed light and thermal processing
TS15-3	**Zimik W.,** Kumar A., Begum A., Das A. &Srivastava B.	Non-Thermal Cold Plasma treatment for shelf-life enhancement of Fresh Strawberries (Sweet Charlie) for Improving Commerciality
TS15-4	**Shriya Rajendra Siraskar**, Ankita Sanam, Rajesh Harsh	Radio Frequency based disinfestation System
TS15-5	**Mukut Senapati** and Partha P. Sahu	Rapid determination of fish freshness (Tenualosa Ilisha) using Ag doped SnO2 patch electrode low cost sensor
TS15-6	**Haroon Maqbool Wani,** Paras Sharma, Idrees Ahmed Wani, Shanker Lal Kothari & Ali Abas Wani	Influence of γ-irradiation on antioxidant, thermal and rheological properties of native and irradiated whole grain millet flours
TS15-7	**Kiran Khandare,** Saswata Goswami	Synthesis of kaempferol nanoparticles by using Moringaoliefera leaf extract ,extracted with CO2 supercritical fluid extractor: a green technology
TS15-8	**Joshi, S.**, Sahu, J.K. & Prakash, S	3D printing as novel production to development of heat desiccated dairy functional products

Technical Session-16	Functional, Nutraceutical and Health Foods	
Date : 25/06/2021	Chair	**Prof. H. N. Mishra**
Time (IST)	Co-Chair	**Dr. Shilpi Sharma**
14:30-15:10 Hrs	**Invited Lecture**	
	Prof. H. N. Mishra	Food Tech Startup: Opportunities, Challenges and Novel Concepts
	Dr. Shilpi Sharma	A comparative study of effect of oyster mushroom on glycemia, lipid profile and quality of life in type-2 diabetic patients
15:10-17:00	**Oral Presentations**	
TS16-1	Ashish M. Mohite, Umexi Rani, Arpan Ray, **Neha Sharma**	Utilization of neem products and its bioactive compounds in Pharmaceutical and Food Industry
TS16-2	**Dr. Devinder Kaur**	Dragon Fruit: Nutritional, antioxidative health benefits
TS16-3	**Ojha**, **A.**, Dhavan, A.	Development of Nutraceutically Improved Indian Savory Snacks using Okara
TS16-4	**Yukti Choubey**, Kiran Kishor Khandare, Saswata Goswami	Nutraceutical functions of Lagerstroemia speciosa derived bioactive material Corosolic acid
TS16-5	**Manpreet Kaur**, Amy Masih, Barinderjit Singh	Effect of Processing on the Physico-chemical & Functional Properties of Muskmelon (Cucumis melo.)
TS16-6	Puri, S., **Bhambri, N.** and Arora, S.	Ice cream remade : a sustainable, cruelty free approach
TS16-7	**Praveen Saini**, Raveena Kargwal, Rinku Grover	Nutritional and Antioxidant Composition of Hemp Seed Extracts

Technical Session-17	Functional, Nutraceutical and Health Foods	
Date:25/06/2021	Chair	**Prof. Vaibhav V. Goud**
Time (IST)	Co-Chair	**Prof. M.K. Hazarika**
14:30-15:00 Hrs	**Invited Lecture**	
	Prof. Vaibhav V. Goud	Application of Supercritical Fluid in the Food Processing
15:00-17:00Hrs	**Oral Presentations**	
TS17-1	**Veena, N.**, Surendra Nath, B.	Development and Evaluation of Functional Milk Fortified with Omega-3 Fatty Acids, Phytosterols and Soluble Dietary Fibre
TS17-2	**Babu RM Ray**, Bala Narasaiah, T and Challa Suresh	Jack Fruit Functional Candy-lollypops
TS17-3	**Priyanka Sharma** and Ms Vandana Garg	Development of herbal tea using bael leaves and determining the nutritional and organoleptic properties of developed product
TS17-4	**Jha, A.K.** & Sit, N.	Extraction of bioactive compounds from Terminalia chebula (Haritaki) using Novel technologies and Development of functional food (yoghurt) using encapsulated powder
TS17-5	**Amy Masih**, Manpreet Kaur, Barinderjit Singh	Effect of Processing on The Physicochemical &Functional Properties ofmWatermelon
TS17-6	**Vishal Singh** and Kaiser Younis	Development of Sweet Curd (Dahi) incorporated with Beet Root Juice
TS17-7	**Akshay Pandey** and Dr Gazal Sharma	Comparative study of Functional Properties of different flour samples prepared using bracts of Banana Inflorescence of Musa accuminata Colla. dried under different conditions
TS17-8	**Devani, B.M.**, Jani, B.L.	Processing for the improvement in functionality of peanut protein – An important plant-based protein: A Review

Technical Session-18	Functional, Nutraceutical and Health Foods	
Date:25/06/2021	Chair	**Prof. Brijesh K Tiwari**
Time (IST)	Co-Chair	**Dr. Nishant R. Swami Hulle**
16:30-17:00 Hrs	**Invited Lecture**	
	Prof. Brijesh K Tiwari	Sustainable hybrid technologies for food safety and shelf life
	Dr. Kartik Pondicherry	Sensory Perception through Instrumentation: Rheology through Tribology
17:00-18:30Hrs	**Oral Presentations**	
TS18-1	**Khan T. N**.	Dietary approach for management of over nutrition among obese women
TS18-2	**Pritam Sekhar Sarma**, Prakash Kumar Nayak, Radhakrishnan Kesavan	Physical, Textural And Thermal Properties Of Bor-Thekera (Garcinia Pendunculata) Fruit
TS18-3	**Muhammed Navaf M**, D.r. K.V Sunooj	Effect of chemical modifications on morphological, pasting and crystalline properties of Talipot palm (Corypha umbraculifera) starch, a nonconventional source of starch
TS18-4	**Sunshri Basumatary,** AnamikaKalita Deka	Exploring Polyphenols and bioactive compounds identified by HPLC from methanol extract of leafy edible plant Antidesma acidum, Kokrajhar, Assam, India
TS18-5	**Qudsiya Ayaz**, H.R.Naik	Nutraceuticals and dietary supplements: A possible preventive measure to improve efficacy against covid-19.
TS18-6	**Rajashree G. Mavinkurve,** Dr. H. S. Ravikumar Patil	Health Benefit Potential of Major Indian Food Ingredients

Day One: 24th June, 2021

POSTER SESSIONS

Poster Session-1	Innovative Approaches in Food Processing	
Date 24/06/2021	Chair	**Prof. B. Srivastava**
	Co-Chair	**Dr. Erandya Jayawardena,**
Time (IST)	Co-Chair	**Mrs. Sushama Choudhary**
11:30-14:00 Hrs		
PS1-1	**Monirul Rahaman**, Dr. Mousumi Saha (Ghosh), Dr. Lakshmishri Roy Shimak Roy	Studies on the Processing and Preservation of Dragon Fruit by Formulating Low Calorie, Jam/Jelly
PS1-2	**Ujala Rout**, Dr. Lakshmishri Roy	Is Cultured Meat – A solution to Covid 19 calls for alternative protein source?
PS1-3	**Hemanta Chutia** & Charu Lata Mahanta	Effect of high pressure homogenization on particle size, bioactive compounds and oxidative stability of nanoemulsion of passion fruit peel extract
PS1-4	**Lourembam Monika Devi**, Laxmikant S. Badwaik	Effect of ultrasound-assisted extraction on phyto chemicals and antioxidant activity of pigmented rice bran extract
PS1-5	**Shubham Kumar Rai**, Anit Kumar and Alak Kumar Singh	Development of Wine and Grape Juice Powder Using Ultrasonication and Analysis of Wine Powder Via Market Survey: A Review
PS1-6	**Duyi Samyor** and Amit Baran Das	Ozone Processing: An innovative non-thermal techniques in food processing
PS1-7	**Rohit Apurva**, Bhaskara Naik, Tapas Bhuiya, Rajesh Harsh	Advanced Microwave Assisted Pasteurization System for Efficient Food Processing
PS1-8	**Payel Dhar**, Amit Baran Das, Sankar Chandra Deka	Ultrasound-assisted extraction of dietary fiber from pineapple waste and its physical properties
PS1-9	**Bhaskara Naik S**, Rajesh Harsh	Microwave freeze drying system for fruits & vegetables
PS1-10	**Shreya Dutta,** Dr. Mousumi Saha (Ghosh), Dr. Lakshmishri Roy	"SWEET SPOON"-THE SUSTAINABLE VEGAN YOGHURT
PS1-11	**Satyajit Das**, Snigdha Ranee Das and Partha Pratim Sahu	Detection of Limonin for the measurement of delayed bitterness of citrus fruit juice using Magnesium silicate based capcitive sensor
PS1-12	**Chakraborty, P.**, Basu, S.	Spectroscopic Investigation of Heat-Acid Induced Coagulation Mechanism of Whole Milk Systems with Mapping of Macroscale Physical Properties of Coagulated Product (Chhana)

PS1-13	**Monisha Neopane**, Nandan Sit	Effect of dual modification by dry heating and ultrasonication on physicochemical properties of black kidney bean starch
PS1-14	**Arjuara Begum**, Amardeep Kumar & Brijesh Srivastava	Cold Plasma assisted inhibition of Enzymatic Browning in pineapple pulp and Modelling inactivation kinetics.
PS1-15	**Pavankumar R. More**, Shalini S. Arya	Extraction and separation of bioactive compounds from pomegranate peel using pulsed ultrasound assisted cloud point extraction (PUA-CPE).
PS1-16	**Ranjitha Gracy T K**, Gunaseelan Eazhumalai, Anusha Mishra, Uday S Annapure	Rheological modification of Mango seed kernel starch with Atmospheric pressure Non-thermal Plasma
PS1-17	**Alweera Ashfaq,** Rayees-ul-Islam, Nazia Khursheed, Zayeema Anjum	Extraction of plant based proteins by Ultrasonication
PS1-18	**Karnika Singh,** Dr. Anuradha Mishra, Dr. Jatindra K Sahu	Optimization of Ultrasound Assisted Extraction (UAE) and Soxhlet Extraction of Oil from Chironji Seed
PS1- 19	**Plachikkattu parambil Akhila**, Kappat Valiyapeediyekkal Sunooj	Physicochemical properties of Hausa potato (Plectranthus rotundifolius) starch oxidized by sodium hypochlorite

Poster Session-2	Quality, Safety and Hygiene in Food Processing	
Date: 24/06/2021	Chair	**Prof. H. N. Mishra**
	Co-Chair	**Dr. Jayati Pal Chattopadhyay**
Time (IST)	Co-Chair	**Dr. Vasudha Sharma**
14:00-16:30 Hrs		
PS2-1	**Katiyar, S.**, Kumar, A. & Singh, A.K.	A detail study on Bio-adsorption for the removal of metals in water and consumer survey for filter using bio-adsorbent: A Review
PS2-2	**Kharkongor, R** & Shylla-Passah, G.R	Identification of Critical Control Points of The Popular Street Foods In Shillong City
PS2-3	**Divya Singh**	Sustainable Approaches in Food Engineering and Technology
PS2-4	**Himadri Das**, Manab Deka and Vasudeva Singh	Hydration behaviour, Viscography profile and Physico-chemical properties of different types of Pitha (Adai) – a traditional product
PS2-5	**Kaur, T.** , Sodhi, N.S., Dhillon, B. & Sodhi, K.S.	To study the reproducibility of chewing behaviour in human subjects for different textured Basmati rice cultivars by electromyography (EMG)
PS2-6	Irshaan, S., Parwez, A.S., **Sathvika, K.,** Krishna, V.L, Tharun, G.S	Effect of Processing Techniques on Sensory Characteristics of Millet based Snack Bar
PS2-7	**Dipanshu Ranjan** , Prof. Dr. Alak Kumar Singh, Dhawal Asthana	Study On Preparation Characterization And Quality Analysis Of Extruded Food Prepared By Replacement Of Wheat Flour With Green Banana Flour: A Review
PS2-8	**Warepam S.C** and Jena.S	Textural Analysis of Osmo-Dried Chayote (Sechium edule)
PS2-9	**Pradeep Kumar Panda**, Pranjyan Dash	Effect of molecular weight on the modification of chitosan by fumaric acid
PS2-10	**Nandita**, Anit Kumar and Alak Kumar Singh	Formulation, consumer acceptance and future trend for oil powder: a review

PS2-11	**Hema, K**., Velayutham, P.,Mohan, C.O., Sukumar, D., Sundaramoorthy, B., Athithan, S., Sugumar, G, Ravishankar, C.N and Ashok Kumar, K	Development of Shelf stable imitated shrimp product from lizard fish (Saurida tumbil) in retort pouches
PS2-12	**Christeena Borah**	Effect of anti-nutritional factors present in plant-based foods on human health and their minimization strategies using processing
PS2-13	**B. Mohanta** & S.L. Shrivastava	Storage study of rasogolla- an Indian diary product
PS2-14	Susmita Chandra, Jayati Pal Chattopadhyay, **Ahana Roy**	Value addition to Indian sweetmeat with Ashwaghandha and honey
PS2-15	**Das Trishitman**, Pradeep Singh Negi and Navin Kumar Rastogi	Physical, chemical, microbiological properties and shelf-life kinetic of forward osmosis concentrated beetroot juice during storage
PS2-16	Kumar, A., **Yadav, D.K**., Wadikar, D.D., Lakshman, J.H., Murugan, M., Semwal, A.D.	Studies on the standardization and quality evaluation of stabilized combo meals as light weight ration
PS2-17	**Yogesh kumar**, Prarabdh C Badgujar	Assessment of antioxidant activity, and quantitative estimation of polyphenols using LC-MS/MS in edible macroalgae
PS2-18	**Kanchan Suri,**, Amritpal Kaur and Balwinder Singh	Physicochemical and quality characteristics of co-extracted nigella seed and flaxseed oils at different incorporation levels in peanut oil
PS2-19	**Swarnima Dey**, Alok Saxena	Studies on rheology, thermal, and functional properties of kodo and kutki millet flour
PS2-20	**Rahul Thakur,** Vivek Gupta, Tabli Ghosh & Amit Baran Das	Anthocyanin rich natural deep eutectic solvent (NADES) aided poly (vinyl alcohol) based edible films for targeted use as pH indicator for food quality monitoring

Poster Session-3	Functional, Nutraceutical and Health Foods	
Date 24/06/2021	Chair	**Prof. Tasneem Naheed N.I.**
	Co-Chair	**Dr. Shatabhisa Sarkar**
Time (IST)	Co-Chair	**Dr. Sourav Chakraborty**
16:30-18:30 Hrs		
PS3-1	**Indrani Chetia** & Laxmikant S. Badwaik	Exploring the nutritional properties of selected edible flowers of Assam
PS3-2	**Barsha Saikia**, Birendra Kumar Mishra	Study on Developing Technology of Functional Fermented Whey-Based Herbal Beverage Using *Plumbago zeylanica* Extract and Lactobacillus strains.
PS3-3	**Silpa Borah**, Manab Deka and Vasudeva Singh	"Development of germinated multigrain instant beverage mix with Bhim kol (Musa balbasiana") and study of their physicochemical, functional and neutraceutical properties
PS3-4	**Subhrajit Ghosh**, Aditi Roy Chowdhury	Development of vitamin fortified herbal ghee
PS3-5	**Hingankar, S.** & Rattu, G.	Plant-based non-dairy alternative milk on the food industry
PS3-6	**Goutam Gupta**, Alokananda Dey, Dr. Mousumi Saha (Ghosh)	Study on resistant starch rich gluten free bars as functional food for celiac disease patients
PS3-7	Dr. Jayati Pal, Sadhwi Jha, **Aditi Karmakar**	Development of breakfast foods utilizing exotic plant protein source
PS3-8	**Gunjana Deka**, Manab Deka, Vasudeva Singh	Studies on the phytochemical and functional properties of noodles prepared from red rice, by incorporation of carrot
PS3-9	**Das, M.J.**, Deka, S.C.	Prebiotic potential of bottle gourd dietary fiber and its encapsulation with probiotics for development of a probiotic juice
PS3-10	Jayati Pal Chattopadhyay, **Sautik Samui**	Comparative evaluation of non-conventional sources with respect to a functional phytocomponent
PS3-11	**Pratibha patel**, Vivek Kumar and Alak Kumar singh	Comparison of medicinal plants kwath and Spices based kwath benefits: A Review

PS3-12	**Maske Sachin** V, Dr. John David	Development of instant UPMA mix with incorporation of Bengal gram and soy flour
PS3-13	Susmita Chandra, **Subhankar Das**	Study of the parameters for fibre enriched cookies and their consumer acceptability
PS3-14	**Jaiswal, S.,** Dhillon, B., Sogi, D.S. & Sodhi, N.S.	Physico-chemical, antioxidant, textural and sensory analysis of fruit bars formulated with the incorporation of beetroot extract and guava pectin
PS3-15	**Abhirami Panoth**	Preparation of an herbal healthy drink from Clitoria ternatea (Butterfly pea) and Hibiscus rosa-sinensis (Hibiscus) flower petals
PS3-16	**Gyanendra Tripathi,** Suhail Ahmad, Arbab Hussain, Alvina Farooqui	Spirulina as a Dietary Supplement to combat malnutrition
PS3-17	**Stephy George**, Anupriya Mazumder, Sandanamudi Anudeep	Formulation Of Instant Milkshake Powder
PS3-18	**Swapnil Prashant Gautam**, Sourav Chakraborty, M. K. Hazarika	Application of instant decompression assisted steam curing for improving turmeric (Curcuma longa L)quality

Poster Session-4	Functional, Nutraceutical and Health Foods	
Date: 24/06/2021	Chair	**Dr. Ashok Kumar C**
	Co-Chair	**Dr. Anand K. Sugumar**
Time (IST)	Co-Chair	**Dr. Tabli Ghose**
18:30-20:30 Hrs	**Poster Presentation**	
PS4-1	**Srivastav, S**. and Awasthi, M.	A study on nutrition labelling usage by working women population of Varanasi, India
PS4-2	**Monirul Rahaman** , Dr. Mousumi Saha (Ghosh)	Studies on the Processing and Preservation of Dragon Fruit by Formulating Low Calorie, Jam/Jelly
PS4-3	**Shraddha Tripathi**, Anit Kumar and Alak Kumar Singh	ProteinEnriched Fruit Bar Using Different Source of Plant and Animal Protein and Analysis of Consumer View on Protein Enriched Fruit Bar: A Review
PS4-4	**Moushumi Roy**, Aditi Roy Chowdhury	Development of yoghurt using pomegranate and dates extract and its characteristics studies
PS4-5	**Nagajothisre S M**	Feasibility study on Chia (Salvia hispanica) as a potential textural modifier : Plant based egg alternative ingredient
PS4-6	**Sarma, M.** & Hazarika M.K.	Development of flaxseed and rice flour based gluten free cookies and its industrialization
PS4-7	**Rashim Kumari**, Mahesh Gupta	Physicochemical, functional, textural and organoleptic properties of pasta prepared from traditional Himalayan crops viz. Barley and Buckwheat
PS4-8	**ShriyaBhatt** , Mahesh Gupta	Physicochemical, structural & textural characteristics of insoluble dietary fiber incorporated instant noodles
PS4-9	**Samarpita Das** , Dr. Lakshmishri Roy	Convenient Speciality Food Breakfast Solutions.
PS4-10	**Kumar, A**., Yadav, D.K., Wadikar, D.D., Lakshman, J.H., Murugan, M., Semwal, A.D.	Studies on the standardization and quality evaluation of stabilized combo meals as light weight ration
PS4-11	Susmita Chandra, Jayati Pal Chattopadhyay, **Ahana Roy**	Value addition to Indian sweetmeat with Ashwaghandha and honey

PS4-12	**Basheer Aaliya**, KappatValiyapeediyekkal Sunooj	Esterification of non-conventional talipot starch for improving the functionality and resistant starch content
PS4-13	Jennifer Daimari, **AnamikaKalitaDeka**	Polyherbal formulations (PHFs) for therapeutic uses: A review
PS4-14	**Shipra Jha**, Supriya Kumari , Dr. Anupam Roy	Formulation and characterization of nanoemulsion incorporating orange oil
PS4-15	Bhaskar Barman, **Anamika Kalita Deka**, Arunendu Mondal	Camellia sinensis as a feedstock for antioxidants and therapeutics: A review
PS4-16	**Bansal**, Manoj; Chutani, Doll; Kaur, Lovepreet; Singh, Pratibha and Yadav, BK	Physico-Chemical and Sensory Evaluation of Honey based Whey Drink
PS4-17	**Ambreen Fatima Safvi**, Owais Yousuf, Alisha Ahmed, Bareera Siddiqui	Energy bar production using underutilized Chironji seeds (Buchanania Lanzan)

Poster Session-5	Quality, Safety and Hygiene in Food Processing	
Date: 24/06/2021	Chair	**Dr. Prashant Singh**
	Co-Chair	**Dr. Ravinder Nagpal**
Time (IST)	Co-Chair	**Dr. Pankaj Patahre**
18:30-20:30 Hrs		
PS5-1	**Divyani Panwar**, Parmjit S. Panesar and Harish K. Chopra	Upgrading the value of Citrus limetta peels as a potential source of pectin and its characterization
PS5-2	**Xinran Xu**, Michael J. Rothrock Jr., Abhinav Mishra	Using LASSO and Classification and Regression Tree to predict E. coli Prevalence in Pasture Poultry Farms in Southeastern United States
PS5-3	Susmita Chandra, Aditi Roy Chowdhury, **Mahima Rahaman**	Preservation of functional component in grated coconut kernel
PS5-4	**Birhang Basumatary**, Prakash Kumar Nayak & *Radha krishnan Kesavan*	A study on the Physico-chemical, Nutritional, Functional and Thermal Properties of Pomelo (Citrus maxima)
PS5-5	**Bhuyashi Boruah**, Prakash Kumar Nayak, K. Radha Krishnan	Monitoring of changes in composition of sunflower oil during deep-fat frying with elephant apple slices
PS5-6	**Manpreet Kaur**, Amritpal Kaur and Balwinder Singh	Amino acid profile, mineral composition, antioxidant and functional properties of different oilseed cakes
PS5-7	**Pushpesh Verma**, Vivek Sachan and Alak Kumar Singh	Effect of drying methods on quality of amla powder: a review
PS5-8	**Boruah, A** and Baishya, S.	Quality of elephant apple (Dillenia indica L.) powder as affected by drying methods
PS5-9	Aditi Roy Chowdhury, Susmita Chandra, **Pabitra Saha,** Ayan Banerjee, Samudraneel Basu	Healthy Freeze-Dried Fruit Juice Powder for Astronaut in Microgravity
PS5-10	**C. Ashokkumar** , B. Murugan , D. Baskaran	Oxidative stability and sensory acceptance of microencapsulated olive oil powder incorporated ice cream
PS5-11	**Sayantan Sarkar**, Ishon Mollick, Dolanchapa Sikdar	Utilizing essential oils as an effective way for food preservation
PS5-12	**Tapas K. Bhuiya**,	Adulteration checking of liquid food products such as oil, honey, ghee, milk etc by sensing dielectric property

PS5-13	**Yumnam Nandan**, Nongmaithem Sophia Devi and Nishant R Swami Hulle	Effects of alkaline salts and pigmented rice on quality characteristics of rice noodle
PS5-14	**Maibam Baby Devi** & Sankar Chandra Deka	Effect of Euryale ferox seed shell extract on antioxidant, textural, and sensory properties of bread
PS5-15	**Kaur, Lovepreet;** Bansal, Manoj; Chutani, Doll; Singh, Pratibha and Yadav, BK	Development and Evaluation of Physico-Chemical and Sensory Characteristics of Kinnow Jelly
PS5-16	**Nithya, A.,** Dalbhagat, C. G. & Mishra, H. N.	Development of extraction and analytical method for determining folic acid and cyanocobalamin in fortified rice kernels by HPLC
PS5-17	**Shubham Rohilla**, Charu Lata Mahanta	Effect of thermal treatment and addition of olive oil on the antioxidant properties of tamarillo puree

Day Two: 25th June, 2021

POSTER SESSIONS

Poster Session-6	Engineering Aspects in Food Processing	
Date:25/06/2021	Chair	**Dr. Suvendu Bhattacharya**
Time (IST)	Co-Chair	**Prof. Brijesh Srivastava**
09:30-12:00 Hrs	Co-Chair	**Dr. Sourav Chakraborty**
PS6-1	Ravi, D.K., **Cortés-Higareda, M**.	Quality kinetics and storage stability of mango juice with ultrasound combined with ultraviolet treatment
PS6-2	**Anita kumari**, Anamika, Anand Kumar	sustainability Approaches in Food Engineering and technology through Algae
PS6-3	Vikalp Pratap Singh, **Tapas K. Bhuiya**, Bhaskara Naik, Rajesh Harsh & Naresh Panchal	Microwave Technology based BRIX Meter for Sugar Industry
PS6-4	**Aman Dixit**, Anit Kumar and Alak Kumar Singh	Production of fruit juice powder by Refractance Window drying method and cosumer view on packed view vs fresh juice: a review
PS6-5	**Mandliya, S.** & Mishra, H. N.	A comparative study of preprocessing on microwave and freeze drying of mycelium
PS6-6	**Gunaseelan Eazhumalai**, Ranjitha Gracy T K, Anusha Mishra, Uday S. Annapure	Atmospheric pressure non-thermal pin to plate plasma system for the microbial decontamination of Oat-milk
PS6-7	**Sivamma**, P., Mounika, E., Babu, P. & Jagannadha Rao, P.V.K.	Intensification of vaporization by decompression to vacuum: A reconstitution and texturing method for defatted kernels
PS6-8	**Bhaskara Naik S**, Rajesh Harsh	Precision agriculture with integrated microwave systems
PS6-9	**Zayeema Anjum**, Nazia Khursheed, Alweera Ashfaq, and Kaiser Younis	3D printing technology: a boon to the food industry
PS6-10	**Athawale G.H.**, Devkatte A.N., Akbari S.H., Pawar V.N.Raichurkar S.J., Dagadkhair R.A.	Effect of extruder variables on bulk density and expansion ratio of horsegram extruded product

PS6-11	**Somya Singhal** and Nishant Rachayya Swami Hulle	Optimization of conventional and microwave assisted extraction of pectin from Assam lemon (Citrus limonBurm F.) peel
PS6-12	**L Susmita Devi**, Dr. Amit Baran Das	Development of Starch Ionic Gel and its Effect on Phase Transition, Kinetics and Physicochemical Properties
PS6-13	**Sibo Boro** and Sandeep Das	Optimization of development of high fibre fortified mushroom(Volveriella sp.) biscuit using Response Surface Methodology (RSM)
PS6-14	Aishi Mukherjee, Indraneel Pal, **Dr.Lakshmishri Roy**	Deep learning and Machine Vision intervention for combating Covid 19 challenges in Bakery sector
PS6-15	**Choudhary, A.K.**, Hazarika, M.K.	Impact of Solar Greenhouse Drying for Agricultural Produces
PS6-16	**Thakuria, A**., Das, B. , Hazarika, M.K.	Application of Transfer Learning in Sorting Assam Lemons Based On Their Weights

Poster Session-7	Food Packaging	
Date:25/06/2021	Chair	**Dr. P.P. Srivastav**
	Co-Chair	**Dr. S. H. Akbari**
Time (IST)	Co-Chair	**Dr. Tabli Ghose**
09:30-12:00 Hrs		
PS7-1	**Vivek Gupta**, Rahul Thakur, Tabli Ghosh, & Amit Baran Das	Effects of an Edible Coating of Natural Deep Eutectic Solvents and cold Storage on Shelf-life and Microbiological Quality of Strawberry
PS7-2	**Biswajyoti Neog, Jitul Kumar Das**, Akhila V. & L. S. Badwaik	Development of Jujube puree-pectin based edible film
PS7-3	**Shylla-Passah, G.R**	Determination of Shelf life of the Value added Rice-based-snacks of the Khasi tribe
PS7-4	**Kumar, S**., Nema, P.K., Kumar S,& Chandra, A.	Effect on quality parameters of Khaja during storage
PS7-5	**MariyaNayeem**, AasimaRafiq and Bushra Manzoor	Evolution of Anti-microbial Agents in Food Packaging Systems
PS7-6	**Akhila V**. & Laxmikant S. Badwaik	Recent advancements in smart packaging using natural indicators: A review
PS7-7	**Pardeep Kumar**, Kirtiraj K. Gaikwad	Biodegradable active antioxidant packaging material containing pineapple peel extract: A waste to wealth approach
PS7-8	**K. Nithyadevi** and V. Pandiyan	Effect of IR heating on physical and mechanical strength of potato starch film
PS7-9	**Bushra Manzoor** ,Aasima Rafiq and Bushra Bashir	Sustainable Packaging in foods
PS7-10	**Rohit Tanwar**, Kirtiraj K Gaikwad	High barrier k- carrageenan based bio-nanocomposite films reinforced with cellulose nanocrystals derived from Indian gooseberry
PS7-11	**Sachan, S.**, Kumar, A. & Singh, A.K.	A detail study on development and market survey of edible film using potato peel
PS7-12	**Ishon Mollick**, Sayantan Sarkar, Dolanchapa Sikdar	Edible gum coating to increase the shelf life of some tropical fruits and vegetables: A review
PS7-13	**Jyoti Dhakane-Lad**, A. Mahapatra, S. Patil, P. Sakare,A. K. Bharimalla, M. Ambare& S. Saxena	Effect of pulping conditions and surface coatings on properties of bananafibre based dense paper

PS7-14	**Saliha Begum S N**, Anupriya Mazumder, Nandan M	Preparation of Lemon Flavoured Paneer Whey Drink and Its Shelf Life Study
PS7-15	**Bhagya Raj, G.V.S.**, Nishant, R.S.H., Dash, K.K.	Degradation kinetics of encapsulated product from dragon fruit (Hylocereus undatus) peel during storage
PS7-16	**Avinash Kumar**, Vidhi Gupta, Suman Singh, Kirtiraj K. Gaikwad	Pine needles lignocellulosic ethylene scavenging paper incorporated with nanozeolite for active packaging applications

Poster Session-8	Waste Utilization and Management in Food Processing	
Date:25/06/2021	Chair	**Prof. C. L. Mahanta**
Time (IST)	Co-Chair	**Dr. Himjoti Dutta**
12:30-14:30 Hrs	Co-Chair	**Dr. Ankur Ojha**
PS8-1	**Tapasya Kumari**, AmitBaran Das, Sankar Chandra Deka	A comparative study of extraction and modification of insoluble dietary fibre from pea peel using different techniques
PS8-2	**Samandeep Kaur**, Parmjit Singh Panesar &Harish Kumar Chopra	Green Approaches for Extraction of Bioactive compounds from Citrus By-products
PS8-3	Menonjyoti Kalita, Dr. Pradip Baishya and **Golam Imran Hussain**	Production of Biofuel from Hotel Food Waste
PS8-4	**Rinku Grover**, Raveena Kangwal, Parveen Saini	Utilization of Waste and By-Products in Food Processing Industries: A Review
PS8-5	**Akhila Konala**, Suman Singh	Waste Valorization of Pinecones Through Extraction of Microfibrillated Cellulose and it's Characterization
PS8-6	**Samrin Kabir**, Suhani P.K.Pradhan, Aditi Roy Chowdhury	Waste utilization of fruit and oilseed industry for the development of plant based meat analogue
PS8-7	**Pheiroijam Manojkumar Singh**, Yumlembam Binita, Payel Dhar, Sankar Chandra Deka	Development of fibre enriched black rice (Oryza sativa) cookies using "kew" variety pineapple (Ananas comosus) waste
PS8-8	**Nilam Newar**	Waste Utilization and Management in Food Processing
PS8-9	Brahmeet Kaur, Parmjit S. Panesar and Anil Kumar Anal	Ultrasonication extraction as an effective green technique for the recovery of phenolic compounds from mango seed kernel
PS8-10	**Debabrata Sarma**, Pritam Sekhar Sarma	Utilization of Fruits and Vegetables waste as a dietary supplement in baking of Cake
PS8-11	**Yumlembam Binita Devi**, Pheiroijam Manojkumar Singh, Payel Dhar, Sankar Chandra Deka	Development of protein-fibre enriched pasta using soyflour and extracted dietary fibre from pineapple pomace (Ananas comosus)

PS8-12	**Namratha Kollu**, Dr. Neha Sharma	Energy Conservation in Malting Industry – A Sustainable approach
PS8-13	**Alisha Ahmad,** Owais Yousuf, Ambreen Fatima Safvi, Bareera Siddiqui	Utilization of Agro Waste for Biopolymer Film Development
PS8-14	**Athulya C P,** Anupriya Mazumder, Sandanamudi Anudeep	Utilization of Agricultural Waste to Produce Biodegradable Eating Plates
PS8-15	**Sundus Nida**, J.A. Moses, C. Anandharamakrishnan	3D printing of sugarcane bagasse for the development of biodegradable food package casing
PS8-16	**Sneha Merin Mathew,** Anupriya Mazumder, Haseena. M	The Effect Of Various Solvents On The Extraction Of Cashew Nut Shell Liquid (Cnsl) And Isolation Of Major Phenolic Constituents (Anacardic Acid And Cardanol) From Extracted Cnsl
PS8-17	**Bareera Siddiqui,** Owais Yousuf	Utilization of Agro Waste through the Development of Edible Cutlery

Poster Session-9	Food Microbiology and Bioprocessing	
Date:25/06/2021		
	Chair	**Dr. Poonam Mishra**
	Co-Chair	**Dr. Vasudha Sharma**
Time (IST)	Co-Chair	**Dr. Aditi Roy Chowdhury**
14:30-17:00 Hrs		
PS9-1	**Mai Al-Dairi**; Pankaj B. Pathare	Influence of Bruising Damage and Storage Temperature on Banana Respiration and Ethylene Production Rate
PS9-2	**Munmi Borah**, Ajay Kumar Manhar, Manabendra Mandal	Assessment of Anti-inflammatory activity of probiotic strains Lactobacillus plantarum AMD6 and Lactobacillus plantarum MBS17 isolated from fermented foods in lipopolysaccharide - induced CaCO-2 cells
PS9-3	Sivasankar, C, **Singh, J,** and Shetty PK	Characterization and evaluation of bacteriocin produced by bacterial isolates from fermented foods
PS9-4	**Bethsheba Basaiawmoit** , Birendra Kumar Mishra & Subrota Hati	Bio-Functional and Microbial analysis of traditional rice cake of Khasi and Jaintia hills of Meghalaya using S. cerevisiae and Pearl millet
PS9-5	**Thoithoi Tongbram**, Laxmikant S. Badwaik	The interplay of amylose and amylopectin in starch gels for in vitro digestion studies
PS9-6	**Manika**, P. Bruntha Devi, Prathapkumar Halady Shetty	Isolation and characterization of bacterial γ-PGA (gamma poly-glutamic acid) and its application
PS9-7	**Bandela Dayakar**, K.A. Martin Xavier, Amjad Khansaheb Balange, Layana Porayil, Binaya Bhushan Nayak	Sustainable methods for utilizing the Vannamei shell waste for carotenoprotein recovery using biotechnological interventions
PS9-8	**Nazia Khursheed**, Alweera Ashfaq, Zayeema Anjum and Kaiser Younis	Conventional and non-conventional methods for animal-based protein extraction
PS9-9	**Mounika, E.**, Sivamma, P.	Mega ultrasound technology for oil extraction: A review
PS9-10	**Deshpande H.W**., Katke S.D. and Toshniwal D.D.	Exploration of Red Yeast Rice Powder as Food Colorant in Buttermilk and Lemon RTS

PS9-11	**Amrutha T A** & A K Beena	Cell Surface Properties of Lactobacillus fermentum Isolated from Vechur Cow Milk
PS9-12	**Katke S.D**., Deshpande H.W. and Hashmi S.A.S.	Process Standardization of Fibre Rich Probiotic Basundi
PS9-13	**Kashmiri Begum** and B.K. Mishra	Development of functional whey based health drink fermented with *Saccharomyces cerevisiae* and Lactobacillus plantarum isolated from Traditional fermented foods of Meghalaya
PS9-14	**Likhitha, R.,** Latha, B.V. & Chethan Kumar M.	Metal chelating bioenhancer protein hydrolysate from fermented milk of Citrullus lanatus seed, as functional food
PS9-15	**Manzoor E.** , Sharma V.	Growth Studies of Potentially Probiotic Lactic Acid Bacteria (*L.acidophilus*, *L.plantarum*, *L.rhamnosus*) in Buransh (*Rhododendron arboreum*) concentrate
PS9-16	**Pritika Sharma**, Vasudha Sharma	Unstructured kinetic modelling of growth and lactic acid production by lactic acid bacteria during fermentation of Aegle marmelos
PS9-17	**Dagadkhair R. A**.,Pawar V.N., Sharma A. K., Devkatte A. N., RaichurkarS. J.	Addressing the Challenges in Probiotication of Phenols and Anthocyanin Rich Grape Juice by Using Natural Prebiotics
PS9-18	**Saharia, B.R.**, Deka, M., & Mahnot, N.K.	Suitability of Olive (Elaeocarpus serratus) pickle as a delivery matrix for probiotic bacteria Lactobacillus sakei ATCC 15521
PS9-19	**Sivasankar, C**, Singh, J, and Shetty PK	Characterization and evaluation of bacteriocin produced by bacterial isolates from fermented foods

Keynote Address:

Sustainability strategies for the food industry

C. Anandharamakrishnan

Indian Institute of Food Processing Technology, India

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The food processing sector is one of the mainstays of the global economy which leap forward in technological capabilities. The Indian food processing market is on assured track of growth and expected to double from US$ 263 billion (2019-20) to US$ 535 billion (2025) (KPMG, 2021). India's food processing sector, in recent years, has been known for its high-growth and high-profits, thus, increasing its contribution to the world food trade every year. Today's consumers have unique personal and nutritional health goals and looking for customizable foods and beverages. Transformative changes in the face of modern consumer megatrends and heaping food demands are required to sustain in the dynamic global food system. Food technology opens up many possibilities for mitigating the global malnutrition as well as hidden hunger challenges. The emergence of 3-D food printing technology, nanofood technology, and next-generation food processing and packaging technologies are projected to accelerate food customization considering individual nutritional requirements. For the food processing industries, the following strategies will be key for improving the sustainability of food systems: Implementing novel food process engineering/designer foods with enhanced nutritional benefits; understanding the consumer preferences and the role of food structure, digestion, and health; consideration of market demands and development of functional foods convenient for global consumers. Furthermore, the food industries should be able to implement IoT technologies such as block chain for better food supply chain management and adaptability to global food safety regulations, traceability, and labelling requirements. This treatise will be focused on current food processing scenario, technological advancements, avenues of future food research and sustainable strategies for food industries.

Invited Lectures:

Novel Engineering Approaches in Food Processing

Prof. KSMS Raghavarao

Indian Institute of Technology Tirupati, India

Food is a complex material with different components such as proteins, fat, vitamins, carbohydrates etc. besides moisture. Unlike other products food products are for human consumption. Hence attention has to be paid to sensorial quality of the product such as color, texture, mouth feel etc. besides nutrition retention. Further, moisture changes during processing so all the physico-chemical and thermal properties such as porosity, density, viscosity, ionic strength, thermal conductivity, also will change. This makes the mathematical modelling for the prior prediction of performance becomes very challenging. Hence there is need to be on lookout for Novel engineering approaches in food processing, which forms the crux of this presentation.

For instance, Drying is one of the most energy intensive unit operations. In place of conventional drying, external field assisted drying methods will enable to achieve certain tasks which are otherwise not feasible effectively. For example, external fields such as ultrasonication, IR, MW, RF etc will be very useful. Double encapsulation using suitable carrier materials with is effective to preserve the bioactive and nutritional properties of compounds when spray dried. Vibro-fluidized bed and spouted bed drying are very energy efficient modifications and cost-effective alternatives to conventional equipment. Liquid food concentration is another widely used energy consuming unit operation. In order to overcome the drawbacks of conventional membrane processes such as reverse osmosis Osmotic membrane distillation and membrane distillations are very attractive alternate membrane processes. For heat labile products with close boiling points, molecular distillation is highly suitable. Heat and mass transfer analysis in designing of food processing equipment, especially for the Indian traditional foods. All these aspects will be presented in the talk with suitable examples and case studies.

Snack foods: The present status

Dr Suvendu Bhattacharya

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Snack foods, eaten in between major meals, are an integral component of the lifestyle and culture. Though snack foods are habitually meant for enjoyment, they offer several nutrients apart from providing food energy. The important surveys conducted on snack foods in different countries have indicated the usefulness of snacking, health benefits as well as health-related problems. Snack food is a multifaceted subject wherein technology, industry, trade and social issues are enormously integrated to offer products possessing consumer satisfaction as well as business success. Possibly, all ingredients are employed to develop snack foods though cereals as whole grains, milled kernel, flour and dough/paste, nuts, fish, egg and meat are more common than other major ingredients. Among the minor ingredients, salt is mandatory and other flavoring and taste improving items are frequently used to make the product attractive to consumers; free-flowing liquids, thin or thick batters and powder are employed in such cases. Like many other foods, overeating of snacks may lead to health problems due to the addition of extra food energy (calorie) and oil/fat, particularly from fried and baked products. Advanced areas of snack processing are the use of robots, 3-D printing and marked reduction of oil, sugar and salt. The problem is expected to be solved by developing healthy products and restricted consumption of snack foods by individuals. The presentation discusses the general aspects of snack processing with indications to develop healthy snacks.

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Superheated steam drying of fruits and vegetables

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Drying of agricultural commodities is a simple process and has been in practice from very ancient times to extend the shelf life of commodities. Other advantages are increased availability of the product, change in qualitative properties as well as reduction in volume hence eases in handling, storage and transportation.

In the beginning sun drying was most commonly used to reduce the moisture content. But, with time the problems with sun drying were realized as contamination of commodities from dust dirt, non-availability of sun rays throughout the year, intermittent drying due to non-availability of sun rays during night hour. Another issue was growth of aflatoxin due to intermittent drying in absence of sunrays as fungus used to easily thrive on the commodities. Then conventional drying becomes popular as these problems of sun drying were overcome by the conventional drying. But in this case the losses of nutritional quality due to oxidation and thermal degradation as well as uneven drying was observed.

In the recent time, increase in awareness and health consciousness among consumer has boosted the demand of minimally processed products with maximum nutrient and safety. Freeze drying is one solution to retain the quality of commodities but it is not economical viable for agricultural produce due to batch operation, longer drying time and consume huge amount of energy. Although, freeze drying is successful in pharmaceuticals industries as well as for niche products.

Development of technology is very important as drying is very energy intensive process. Meantime drying by superheated steam (SSD) has become very popular due to high heat transfer rate, high thermal conductivity of superheated steam, less energy consumption if operated in close circuit. Superheated steam drying is similar to hot air drying but instead of hot air superheated steam is used as drying medium. The temperature of superheated steam is

above the saturation temperature of the water at a particular pressure. It will not condense till the temperature of superheated steam temperature is above saturation temperature.

Superheated steam dryer can be operated in three modes i.e at atmospheric pressure, below atmospheric pressure called as low pressure superheated steam drying (LPSSD) and above atmospheric superheated steam drying known as high pressure superheated steam drying (HPSSD). Atmospheric SSD, LPSSD and HPSSD is generally carried out at 101 kPA, 5kPA to 30 kPA and 500–2500 kPa (5-25 bar) respectively. Several studies were conducted at atmospheric SSD but still loss of qualities was reported. So, superheated steam drying was carried out under vacuum i.e LPSSD on several products. Several benefits on quality, product and on environment were reported using LPSSD. Among those best qualities were retention of bioactive components like β-carotene, ascorbic acid, antioxidants and total phenols. It was also observed that environment inside the chamber was oxygen free so, several reactions like maillard reaction, enzymatic reactions and oxidation was restricted. Studies reported that LPSSD results in complete microbial inactivation and helps in achieving safe products. Moreover, it also helps in creating ecofriendly environment as toxic, bioactive compounds or medium are directly not release in to environment as these are first condensed and then recovered. The energy can save by using the superheated steam in closed circuit also energy from exhaust steam can be used elsewhere for effective energy utilization which leads to decrease in energy consumption.

To conclude low pressure superheated steam drying has several benefits associated with it i.e. product, energy and environment. Need of the hour is to take the technology to pilot and industrial level. In this presentation LPSSD has been explained for clear understanding of the concept by the researchers and students.

Valorization of agro-industrial by-products for biopigment production

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Due to increase in the consumer demand of processed foods, there is rapid increase in the number of agro-processing industries with subsequent increase in the quantity of byproducts generation. These byproducts are major concern to the industry as well liability to food processors in view of the stringent environmental legislations. In view of that, the industries are exploring various methods to treat or utilize these byproducts. With the advancement in research in the area of Food Biotechnology, new possibilities for the utilization of agro-industrial byproducts for the production of value-added products has been investigated. The environmental and consumer issues regarding human safety have evoked the search for natural sources of colors due to toxic, hazardous and environmental effects of synthetic colors. Microorganisms are generally preferred sources for the production of various value-added products due to their high growth rate, ease of handling and absence of seasonal variations. Different microorganisms (bacteria, yeast and mold) have been explored for the production of biopigments. However, much work has been carried out on *Rhodotorula, Achromobacter, Blakeslea* and *Monascus* sp. During microbial production of biopigments, the nature of microbe, media components and process conditions play a very important role. Biopigments have also shown wide range of applications in food, textile and pharmaceutical industries.

Pineapple and its waste utilization vis-à-vis its nutritional value, bioactive functional food and health benefits

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The gradual evolution of bioactive functional foods and herbal medicine has frothed many researchers to explore lots of the novel plant sources. Pineapple (*Ananas comosus*) appears to be one of the most highly relished tropical fruits for its unique aroma and sweet taste and also due to its nutritional and bioactive compounds. It ranked third after banana and citrus and the demand for pineapple has greatly increased at the national and international markets. It is renowned as a flavorful fruit since it contains a number of volatile compounds in small amounts and complex mixtures. Pineapple is a rich source of minerals and vitamins that offers a number of health benefits. The growth of the pineapple industry in the utilization of pineapple food-based processing products as well as waste processing has progressed rapidly worldwide. It contains considerable amounts of bioactive compounds, dietary fiber, minerals, and nutrients. In addition, pineapple has been proven to have various health benefits including anti-inflammatory, antioxidant activity, monitoring nervous system function, and healing bowel movement. Pineapple and its waste are a sustainable substrate in developing functional foods and pharmaceuticals as it is ladened with number of important phytochemicals. The industrial processing of pineapple generates a huge quantity of by-products. To reduce the environmental impact of these by-products it is important to characterize and valorize this waste, converting them into high value-added products. Therefore, the pineapple waste processing has immense potential for high value-added products including functional foods and in developing agricultural and food industries.

Food grain preservation by cooling – A sustainable approach to extend shelf-life

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Cereal grains are the basis of staple food in most of the developing nations. Production of rice, wheat, maize and pulses in India was 110.15, 98.38, 26.26 and 22.95 million tonnes respectively during the year 2016-17. It totals to 257.74 million metric tonnes. Post-harvest losses among cereals, pulses and oilseeds were observed to be in the range of 3.08 – 9.96% as per an all-India survey conducted in the year 2014. Use of scientific storage methods can reduce these losses to as low as 1%–2%. Food grains are major contributor of energy on calorific basis among all agricultural commodities. More than 60% of energy in our daily food is contributed by food grains.

Insects, microorganisms, fungi, rodents, birds etc. damage the food grains. Physical and chemical methods are used during storage in controlling these agents. Majority of the known major and minor insect pests of stored grains and pulses cannot survive at a temperature less than or equal to 13^{o}C. In general, cooling of grain mass to temperatures in the range of 13-17^{o}C has been observed by the scientists to result in complete control of insects and pests. The benefits due to reduction in post-harvest losses and the cost incurred on application of chemicals will offset the investment on grain cooling system. Vapor compression refrigeration or liquid nitrogen can cool the grains. Technologies are available in the country and need to be adapted to suit farmers, traders, processors, and grain storage agencies. Grain cooling is also an excellent method for preserving organic cereals, pulses, and oilseeds, where use of chemicals is prohibited. Grain cooling preserves the food grains, without the fear of chemical residues and development of resistance by insects / pests to chemicals. The paper discusses the requirements and methods of cooling of food grains and their comparative advantages.

Keywords: Cereals, pulses, storage, insects, fungi, post-harvest loss.

Cold Plasma: An Emerging Non-Thermal Technology for Food Processing

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With increasing world population there is a need for innovative approaches for food production and processing to meet the global demand. The greatest challenge is to produce safe food with high quality considering the new risks encountered during the food production because of emerging pathogens and viruses. There is an increase in demand from the consumers for the minimally processed foods with low preservatives and improved food quality. Non-thermal food processing technologies could be the alternative methods for food preservation, minimizing the negative effect on the nutritional profile. Some of the non-thermal processing technologies which are already employed in the food processing industries to extend the shelf-life. Cold plasma, an emerging non-thermal process may be a sustainable approach which is chemical free, and eco-friendly.

Cold plasma technology is considered as modern non-conventional technique for altering the surface, physical and chemical properties of various materials such as starches, polysaccharidees, proteins etc. Besides this, it is also used to alter the germination rate of seeds. Plasma treatment of water, termed as plasma activated water (PAW), creates an acidic environment which results in changes of the redox potential, conductivity and in the formation of reactive oxygen (ROS) and nitrogen species (RNS). It is an eco-friendly process which is used in the preservation of food and other potential applications as an alternative to common techniques.

Approaches on food waste valorization for packaging materials

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Food losses and wastes (FLW) occur in all steps of the food production chain, with a variety of socioeconomic and environmental consequences. FLW may be preventable in some cases, but sometimes valorization is the best strategy. Valorization may be focused on e.g. animal feed, energy, platform chemicals, and materials. The presentation will be focused on three basic approaches to obtain materials (especially biodegradable packaging films) from FLW, namely: from molecules directly extracted from FLW, from molecules obtained via bioprocesses on FLW, and from bulk FLW. Advantages and limitations of each approach will be addressed, as well as examples of recent studies by the group.

Food waste valorization as a potent source of Nutraceuticals

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The one third of global food production is lost or wasted amounting to 1.3 billion tonnes per year, which has become challenging field for researchers. A number of by-products are produced at different stages of food supply chain, starting from agricultural production, to post-harvest processing including handling, storage, processing, distribution and consumption. These by-products are inexpensive and rich source of valuable substances, viz; starch, fat, crude fiber, minerals, vitamins, pectin, pigments, phenolics and flavonoids and can be valorised using different extraction tools. Recently, microwave assisted, ultrasound assisted and supercritical fluid extraction have become efficient techniques for the extraction of phenolic compounds. Various chromatographic methods can be employed for further purification of targeted compounds and purified compounds could be used ultimately as nutraceuticals or for food fortification. Waste utilization is a promising measure, from both; an environmental and economic point of view. Hence, food industries can take the opportunity to recover and utilize the valuable compounds from agricultural by-products which in turn reduce hazards due to waste.

Electrical Field Assisted Enzyme Inactivation and Surface Disinfection in Fruits and Vegetables

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Enzyme and microbial inactivation in fruits and vegetable processing are the most important preservation and shelf-life enhancement parameters. Thermal treatment, the combination of time and temperature (lethal), causes the denaturation of proteins (enzymes), has been widely used to inactivate quality degrading enzymes, and has drawbacks viz. effluent production, slow and non-uniform heating, and leaching etc. Therefore, emerging technologies based on the electric field are also gaining attention as per current research trends. High electric field-based technology includes cold plasma (CP), and pulsed electric field (PEF), which is non-thermal and moderate to low electric field-based technology includes ohmic heating (OH), which is thermal.

During OH, the electrically conductive food material is kept between two electrodes to allow an electric current to flow through it by applying an electric voltage. Cold plasma uses energetic and reactive gases to inactivates the contaminating microbes. Moreover, the relatively low discharged plasmas make their use suitable for heat-sensitive products.

The studies on enzyme inactivation by OH in sugarcane juice, tomato; litchi; watermelon and mango were successfully achieved in the laboratory for enhanced shelf life. Furthermore, inactivation kinetic parameters such as D-value, inactivation rate constant (k), z-values of different enzymes in various food items have also proven that OH causes higher enzyme inactivation than conventional heating. Furthermore, complete inactivation of yeast and moulds was possible only by the OH-treatment compared with the conventional treatment.

Studies showed that CP and OH treatment successfully inactivates the enzymes and enhanced microbial safety while maintaining the quality of the fruits and vegetables. The efficacy of cold plasma depends on types of plasma source and different plasma characteristics parameters such as applied voltage, gas type, treatment time, direct or indirect plasma exposure and relative humidity. The enzyme activity and microbial loads on fruits and vegetables were reduced significantly with increased treatment voltage and time. Similarly, the ohmic heating showed that the come-up time is significantly reduced for attaining target temperature and its efficacy in enzyme inactivation. Thus, these electric field-based process technologies can improve/enhance the shelf life of fruits and vegetables by reducing the enzymes and microbial load.

Keywords: Cold plasma, ohmic heating, enzyme inactivation, microbial

Technology transfer from laboratory to industries

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Research and development studies are the focus of innovative activities and creating commercially applicable knowledge. Technology transfers from R&D institutions generate positive spillovers and enhance internal capabilities. Knowledge generated in CSIR-CFTRI, Mysore has made important contributions to the economic growth of the country through technology transfers. The steps involved are initial laboratory trials, scale-up the processes, examining the suitability for large-scale production, preparation of technology dossier, transfer of technology and demonstration of the technology in presence of the entrepreneurs. It is obvious that the process technology dossier includes the specification of products, shelf-life studies, packaging requirements, machinery needed and cost-benefit calculations. Thus, there is a requirement to establish the scientific, technical and human capitals which are the sum of a researchers' professional network, technical skills and resources.

CSIR-CFTRI has developed technologies for several commercially attractive, nutritionally superior and safe food products for adoption by small, medium and large food processing industries. Several value-added convenient foods have been formulated and transferred to industries. Many formulations from traditional foods, sucrose-free convenience foods, fortified cereal bars, value-added confections and chocolates have been formulated, standardized and these optimized technologies have been successfully transferred to entrepreneurs and industries. Several of them are now available in the market. A few NGOs and SHGs have been roped in for rural employment generation and production of nutritional and healthy food products. One example is *chikki* with added spirulina that has been distributed through women and child welfare organizations. These process know-hows are simple to be implemented in the Indian food industries while maintaining good product quality and adequate shelf-life. The specific advantages of the developed processes are that they employ cost-effective indigenous machinery. Most of these technologies have generated good revenue for the entrepreneurs along with employment generation in both urban and rural areas. The present lecture addresses the technology transfers from lab to industries citing specific examples.

New Techniques in Food Technology and Packaging

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The quality of any food is directly related to the attributes of the food and packaging material. Most food products deteriorate in quality due to mass transfer phenomena, such as moisture absorption, oxygen invasion, flavor loss, undesirable odor absorption, and the migration of packaging components into the food. These phenomena can occur between the food product and the atmospheric environment, between the food and the packaging materials, or among the heterogeneous ingredients in the food product itself. Besides the traditional thermal treatments for food preservation, many other new thermal and nonthermal processing technologies have been developed recently. These include irradiation, high-pressure processes, pulsed electric fields, UV treatments, cold plasma, and antimicrobial packaging. Some of these processes have been commercially approved by regulatory agencies for food packaging purposes. These new technologies generally require new packaging materials and new design parameters in order to have optimum processing efficiency. For example, packages that undergo an irradiation process are required to possess chemical resistance against high energy to prevent polymer degradation, those that undergo UV treatments require UV light transmittable packaging materials, and retortable pouches should resist pressure changes and maintain seal strength.

Innovations in Value-addition of Food Waste

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The food waste is produced across the globe creating an immediate and significant impact to our livelihood and for the future generations. Food waste is the most critical issue humankind is facing across the worldwide. The food waste generated is usually incinerated or dumped in open areas which may cause severe health and environmental issues. However, food waste is generally considered a biodegradable waste and has the potentials of value-addition by converting the waste into value-added food products. One of the most effective and efficient way to manage food waste is by conversion to different value-added products. Regardless of the final product's destination, scientific community must strive for ways to create value-added products for nutritional properties, innovations to add value to food waste far beyond its usual profitability, and develop new technological applications and to continue innovation towards advanced value-addition of food waste.

Utilization of seaweeds in development of edible coatings and for value additions in Food products

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Seaweeds are underutilized marine resources in Sri Lanka. The research studied about the application of alginate based edible coatings on pre-cut Jack fruit and cheese. The study also studied about the incorporation of *ulva fasciata* in enriching the nutritional quality of pie crusts. Jack fruit (*artocarpus heterophyllus Lam*) is difficult to peel. Therefore, consumers prefer to buy it ready to eat. Thus, the effect of application of a 1% alginate based edible coating with $CaCl_2$ on quality parameters of pre-cut jack fruit within the storage period of 5 days under refrigerated conditions was studied. Results revealed a lesser weight loss and better-quality values for total soluble solids, titratable acidity and pH could be obtained for jack fruit coated with 1% alginate. Losses occur in cheese during storage due to spoilage microbes. Hence, an alginate based antimicrobial coating developed by incorporating the essential oil *cinnamomum zeylanicum* was applied to study the effectiveness within a storage period of 40 days. As results, cheese coated with 2% alginate, 0.2% essential oil, 0.5% glycerol with 5% $CaCl_2$ was successful in preventing the growth of *coliform* while maintaining yeasts, molds and total mesophilic aerobic bacteria counts in accepted safe levels throughout the 40 days. As a seaweed incorporated product, pie crusts were developed by incorporating 0%, 10%, 20% and 30% of *ulva fasciata* powder. Sensory analysis revealed that the 20% incorporated pie crust was the best. Proximate analysis results revealed that, incorporation of *ulva fasciata* can enhance the nutritional profile of pie crust.

Keywords: Seaweeds, alginate, edible coating, antimicrobial coating, Pie crust, nutritional profile

Physics Inspired Machine Learning in Food Process Engineering

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The tasks of food product and process development need to take cognition of the biological, and behavioural sciences at one end, and physical sciences on the other. In recent times, machine learning is getting recognized as a tool for developing models for biological systems and human behaviour. On the other hand, physical sciences rely more on physics-based knowledge to develop models involving governing equations and boundary conditions. The computational efforts for obtaining model solutions are different in these two approaches. A newer concept named physics inspired machine learning is getting developed where in machine learning integrates with physics-based models to take benefits from both the domains of modelling. A brief account of the state of the art of combining machine learning with physics-based models, applications and opportunities, and challenges and limitations is presented. Also, examples are taken from drying of food as thin layers and food grains in deep beds, with available physics-based models. The neural network learning algorithms are implemented to identify system dynamics and obtain parameters which are considered as variable specific to material being dried. The physics inspired machine learning may prove to be quite useful tool in food process engineering for process model development.

Keywords: Machine Learning, Physics-based knowledge, neural network learning, process development

Utilization of Collagen Rich Alaskan Seafood By-Products for Pet Treats

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The Alaska pollock fishery is the largest commercial fishery in the US at over 1.4 million metric tons annually. By-products are mostly converted to fishmeal or ground and discharged at sea. The collagen rich components of this material make an excellent canvas for nutritious and highly desirable pet treats through the use of twin screw extrusion technology. Tests have been conducted on both Clextral and Wenger twin screw extruders with promising results. Commercialization of this research is being carefully studied by various entities.

Valorization of Food Waste and By-Products as Potential Bioresources: Opportunities, Interventions, and Implications

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Food industries are growing rapidly to huge numbers due to globalization and population increase and are providing a wider range of food products to satisfy the needs of the consumers. Considering the challenges in the area of food industry, efforts are to be made to optimize food-processing technology to minimize the amounts of by-product waste. Food industry is generating increasing amounts of by-products all along the chain of food production and transformation. Those by-products could be generated on the one hand before the production of the finished product. Environmental regulations and high waste discharge costs have forced food processors to find the ways to better treat and utilize processing wastes. Environmental legislation agencies have significantly contributed to the introduction of sustainable waste management practices throughout the world. Efficient utilization of food processing by-products is important for the profitability of the food industry. By-products and wastes of food processing, which represent a major disposal problem for the industry concerned, are very promising sources of value-added substances, with particular emphasis being given to the retrieval of bioactive compounds and technologically important secondary metabolites. This makes them very suitable as raw materials for the production of secondary metabolites of industrial significance. The nutritional composition of such food waste is rich in sugars, vitamins, minerals and various health beneficial bioactive chemicals (polyphenols, carotenoids, polyacetylenes, glucosinolates, sesquiterpene lactones, alkaloids, coumarins, terpenoids, proteins, peptides, dietary fibers, fatty acids etc). The current trend in the world today is to utilize and convert waste into useful products and to recycle waste product as means of achieving sustainable development. It is estimated that about 795 million people of 7.3 billion people in the world are suffering from chronic under-nourishment, mostly in developing and under-developed countries. On the other hand, global food waste and loss is 1.3 billion tonnes per year, which is one-third of the total produce. These two contrary statistics prove the urgency and necessity of addressing towards recovery and utilization of nutrients and bioactive compounds from those agro-industrial by-products and wastes. To maintain the sustainability, efforts need to be centred zero waste or exploitation of materials before they get wasted. Exploitation of co-products can take advantage of greater collaboration between research institutions, industry, adaptation and use of already existing technologies and plants for the recovery of biomolecules from co-products, and the application of economies of scale needed for the treatment of large volumes of biomass as by-products.

Radio Frequency based disinfestation System

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Considering the rise in pests & insects during storage of food products, the aim is to design a RF based disinfecting system. The exchange of electromagnetic energy in the process of RF heating is mainly used to generate heat within the product acting as a dielectric between the electrodes, initiating volumetric heating due to frictional interaction between molecules. The continuous change in polarity of electrodes causes, the molecules try to realign themselves with the electric field by flip-flop motion. The resulting kinetic energy and friction caused by colliding neighbouring molecules generate heat within the product. The main challenging part is to have diffential heating between pathogens and grains to achieve objective of disinfection of grain without damaging it as well as provide sufficient isolation RF radiation produced from outside environment. This thermal energy utilization for disinfestation operates in 27-12 MHz frequency of ISM band and maximum power achieved in case of solid-state approach is 2.5kW. The generated power monitoring is done through electronics, sent to an independent control panel for displaying data from different sensors such as grain temperature, power levels, and other sensors, operating of the system features and interlocking purpose.

The main advantages of the above system include reduction in overall drying and disintestation operating costs, suitable for all types of embroyic stages of insects and effective in removing low moisture levels. Seed treatments, pasteurization, food preservation and food quality control are some of its major field related applications.

Comparative evaluation of different extraction techniques for effective valorization of *Citrus reticulate* L. (Kinnow) peel

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Kinnow (*Citrus reticulate* L.) peel waste corresponds to approx. 35-40% of the fruit mass and is the chief waste component after juice processing. Being the richest sources of polyphenolic bioactive compounds and pectin, it has got a huge potential in food industry. The present study aims to select the appropriate extraction technique for effective valorization of kinnow peel. Designed experiments using response surface methodology were conducted considering various independent parameters w.r.t extraction technologies chosen for the study. The effect of these parameters were studied on extraction yield. Various extraction technologies i.e. Soxhlet extraction (SE) (90°C, 2-3hr), Ultrasound Assisted extraction (UAE) (100% power, 30min), Microwave Assisted extraction (MAE) (480W, 3-5 min) and Sequential Ultrasound-Microwave Assisted extraction (UMAE) [(100% power, 30min) + (480 W, 3-5 min)] were used for the extraction of kinnow peel extract. For all extraction techniques, two levels of particle size (0.5mm and 1.0 mm) and seven solvents viz, methanol, ethanol, propanol, hexane, acetone, petroleum ether and water were used. The study results revealed that UMAE led to high extract yield ranging from 3.58 to 35.43% (for 0.5mm particle size) and 2.33 to 21.24% (for 1.0 mm Particle size) upon extraction using different solvents. However, SE gave the lowest extract yield. In addition, methanol stood out as the best solvent as the extract yield ranged from 8.96 (from SE) to 35.43% (from UMAE). Methanol was followed by ethanol with the extract yield ranging from 7.82 (SE) to 21.25% (from UMAE). The other solvents of propanol, hexane, acetone and petroleum ether showed less yield in comparison to methanol and ethanol while, water as a solvent was not found feasible as the results were found to be negative.

Keywords: Citrus by products; Kinnow (*Citrus reticulate* L.); Extraction techniques; Waste utilization

Opportunities and challenges in application of forward osmosis in food processing

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Food processing and preservation technologies must maintain the fresh like characteristics of the food while providing an acceptable and convenient shelf life as well as assuring safety and nutritional value. Besides, the consumers demand for highest quality convenience foods in terms of natural flavor and taste, free from additives and preservatives necessitated the development of a number of membranes based nonthermal approaches to the concentration of liquid foods, of which forward osmosis has proven to be most valuable. A series of recent publications in scientific journals have demonstrated novel and diverse uses of this technology for food processing, desalination, pharmaceuticals as well as for power generation. Its novel features, which include the concentration of liquid foods as at ambient temperature and pressure without significant fouling of membrane made the technology commercially attractive. The paper identifies the opportunities and challenges associated with this technology. At the same time, it presents a comprehensive account of recent advances in forward osmosis technology as related to the major issues of concern in its rapidly growing applications in food processing such as concentration of fruits and vegetables juices (grape, pineapple, red raspberry, orange, tomato Juice and red radish juices) and natural food colorants (anthocyanin and betalains extracts). Several vibrant and vital issues such as recent developments in the forward osmosis membrane and concentration polarization aspects have also been addressed. The asymmetric membrane used for forward osmosis poses newer challenges to account both external and internal concentration polarization leading to significant reduction in flux. The recent advances and developments in forward osmosis membrane processes, mechanism of water transport, characteristics of draw solution and membranes as well as applications of forward osmosis in food processing have been discussed.

Food Tech Startup: Opportunities, Challenges and Novel Concepts

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Indian food market, growing at 20 % CAGR is the 6th largest food market globally. It is estimated to attract $33 billion investments and generate employment for 9 million people by 2024. The food ecosystem includes every step from the production of food to consumption by the consumers, which presents itself with unique challenges and opportunities for innovation. The major area of focus is the reduction of quantitative and qualitative loss of food produces during harvesting, post-harvest management, processing, storage, and distribution. It was estimated that about 12 to 16 MMT of durable crops were lost each year which translates to a monetary loss of Rs. 50,000 crores per year. There is also an increasing double burden of malnutrition among Indians as well as the global population which demands innovative formulations and value addition of existing food categories. Novel technologies to reduce the environmental impact of food processing, green technologies, food waste valorization are few other requirements faced by the food industry to reduce its carbon footprint.

The ways to overcome the challenges of food loss are promoting startups in the area of innovative farm preservation systems, improved packaging solutions, adequate storage, supply chain, processing infrastructure, design and development of processing machinery. Similarly, developing a standardized system for Indian traditional foods, processing of consumer-driven fortified health foods and beverages, design of products and processes from safety, quality and affordability perspectives, and development of food quality testing labs and equipment, etc, helps to address the issues on nutrition security. Novel processing and green technologies such as ohmic heating, pulsed electric field heating, high pressure processing, ultrasonication, microwave processing, etc, are still in research stage and in need to be commercialized. Application of AI and automation in PHM such as Agribot for fruit harvesting, robotic vision system for sorting of fruits and vegetables, and rapid non-destructive quality monitoring techniques like e-nose, hyperspectral imaging, etc, opens up a huge area of potential.

Another lucrative startup option with government backing is the fortified food market worth Rs. 3,000 crores. Technology for food fortification such as extrusion for fortified rice kernels, encapsulation for oil, dosing and blenders for wheat flour, and process techniques for food-to-food fortification are available which needs to be scaled up. Plant-based meat, non-dairy yogurt and ice-cream, etc, are upcoming sustainable trends that are gaining importance among the consumers. With these numerous available opportunities, the Indian government has introduced more than 50 start-up schemes with the mission to boost the Indian startup ecosystem. In the end, it is the ability to identify a specific problem, exploring possible solutions, coming up with a business plan and effective utilization of the government and private resources available for funding, marketing, licensing results in a successful startup.

A comparative study of effect of oyster mushroom on glycemia, lipid profile and quality of life in type-2 diabetic patients

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The aim of the study was to evaluate efficacy of oyster mushroom (pleurotus spp.) on glycemic control, lipid profile and diabetic quality of life in type-2 diabetic patients. Total 150 type-2 newly onset diabetics were recruited. After 1 month stabilization period, 120 randomly selected patients were divided into three groups Group-1,2,3 given type A, B, C biscuits respectively blindly. All three groups were also given conventional treatment i.e. diet, exercise for 3 months. Anthropometric parameters, FBS and BP were recorded weekly and HbA1c, lipid profile, diabetic quality of life questionnaire was performed before and after treatment. After 3 months decoding was done and concluded that type A, B, C biscuits were Ajwain, Ajwain+Mushroom and Mushroom biscuits respectively. After 3 months period blood sugar (225.41±3.35 to 113.83±4.03; $p<0.005$), HbA1c (8.47±0.17 to 7.27±0.14; $p<0.02$) and blood pressure reduced in ajwain+mushroom group as well as in mushroom group (Fasting blood sugar 212.9±4.29 to 112±1.37; $p<0.005$; HbA1c 8.00±0.13 to 6.99±0.12; $p<0.05$). Significant improvement in lipid profile was also observed in same groups (ajwain+mushroom group 190.69±4.39 to 166.83±2.47; $p<0.001$; mushroom group 186.77±3.43 to 157.39±2.32; $p<0.05$). Diabetes quality of life also improved significantly. No extra effect was observed due to supplementation of Ajwain. Oyster mushroom (pleurotus spp.) consumption appears to be effective in controlling glycemic control, lipid profile and diabetic quality of life.

Keywords: Oyster mushroom, Diabetes mellitus, Fasting blood glucose

Application of Supercritical Fluid in the Food Processing

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Conventional extraction techniques are still the most common methods for the extraction of natural agents and valuable compounds from plant materials. These methods are however associated with major drawbacks such as complex processes involving multiple unit operations (extraction, separation etc.), high operating temperatures which cause degradative changes to major active compounds and their yields. Apart from this, the use of organic solvents has been reported to be hazardous on health while some solvents have shown carcinogenic effects. Supercritical carbon di-oxide is a latest technology for extraction of herbal plants and has emerged as an attractive extraction technique for the food and pharmaceutical industries because heat sensitive compounds can be extracted by it without any degradation and it is an environmentally acceptable solvent which does not introduce any trace of harmful chemicals. Moreover, the solventing power of supercritical CO2 can be adjusted easily by slight change in temperature and pressure making it possible to extract particular compound of interest. With the addition of polar co-solvents, even non polar material can be extracted. Hence, it is attempted to develop a green process for selective extraction of antioxidants, pigments, flavors, essential oils etc. from plant matrix.

Sustainable hybrid technologies for food safety and shelf life

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Conventional and emerging food processing technologies utilises significant amount of energy, water and labour to provide safe, nutritious and healthy foods. Ensuring sustainability of food processes is important considering the environment is an exhaustible resource. A range of emerging technologies has evolved and majority of these technologies have shown potential for agri-food application. However, hybrid technologies involving the combination of emerging with other conventional or innovative techniques can overcome several limitations posed by conventional processing. Hybrid technologies are capable of reducing energy/water consumption whilst improving the shelf life of processed foods. Various emerging techniques including high pressure processing, pulsed electric field, ultrasonics, light-based technologies, plasma technologies alone or in combinations with other innovative techniques will be outlined. The principles and applications of these combined innovative techniques as well as their advantages and limitations will be compared. This presentation will provide new insights into advances in hybrid techniques and their application at research and industrial level in modern food systems.

Sensory Perception through Instrumentation: Rheology through Tribology

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Food and beverages are subjected to various stresses and strains during their lifetime. This is not only limited to the processing, packing, and transportation, but also includes processing of food in the human oral cavity. How these samples behave under these conditions in terms of flow and textural characteristics, determines the process efficiency and also the mouthfeel of food and beverages during consumption. In this talk, we will be focusing on the rheological aspects – flow and deformation behaviour – of food and beverage samples. The talk will cover basics of rheology, instrumentation, and examples from real-life scenarios covering samples ranging from dairy products to ketchup. The key aspects include thixotropy, storage-stability, mouthfeel, etc. Additionally, we will also be looking at an emerging field of tribology which deals with friction, wear, and lubrication. Over the past decade, there has been a surge in applying tribology to food and beverage samples to correlate their friction behaviour to certain mouthfeel attributes. This talk will conclusively demonstrate the advantages of applying rheology in order to improve not just efficiency of the industrial processes, but also the “human” aspects of food oral processing.

Technical Sessions

Technical Session-1
Engineering Aspects in Food Processing

TS1-1

Effect of High shear Homogenization on dietary fibre and Particle size and volatiles in Pineapple pomace

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In recent years, by-product utilization is becoming an emerging concern as the valuable compounds are dumped as waste posing a serious environmental threat. This study proposes to undertake the modification through mechanical grinding whereby shear and cavitation forces could induce changes in pineapple pomace. The high shear homogenization technique is employed at three levels of rotor speed (5000, 15000, 30000 rpm) for three levels of treatment time (5, 10, and 15 min). The response studied reveals that the shear speed of 15000 rpm for 10 min showed a moderate color change in comparison to control with a 48% increase in Soluble dietary fiber SDF in homogenized pineapple pomace. The particle size was reduced from 2 mm to 400 μm after homogenization at 15000 rpm for 15 min. The optical microscopy images revealed that control pomace were larger cell fragments, fibrous, dense hairy mass has resulted in disruption into smaller cell fragments. The shear speed of 15000 rpm for 10 min has triggered the release of volatiles from the pineapple pomace tissues, whereas at higher rpm and time resulted in degradation. There was a significant increase ($P<0.05$) in volatile esters in homogenized samples than in control. Moreover, from our study, it can be said that the intensity of homogenization and homogenization duration also affect aroma concentration. Therefore, shear homogenization could act as an efficient technique for modification of Pineapple pomace with retained volatiles with improved Soluble dietary fiber content.

Keywords: Pineapple pomace, Shear homogenization, Particle size distribution, Volatile compounds, Dietary fiber.

TS1-2

Design and mass scale adoption of improvised Poly-house solar bulk drying system for spices and minor fruits in Assam

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In India, Assam annually produces spices like Ginger (167 thousand tons), Turmeric (19.17 thousand tons) and minor fruits like Indian Gooseberry (17.76 thousand tons), Elephant apple which are marketable surplus and underutilized, respectively. Primary processing systems are scarce in all districts. Thus, present study explored environment friendly drying system for process standardization and value addition of produce.

Considering climatic condition and physic-chemical properties of harvested spices and minor fruits, Poly-house solar dryer is one of the cost effective, bulk drying systems, among various systems. Where existing structural design dimension are improvised and system automated to attain higher hot air circulation, thermal efficiency, economic return with stability against annual wind storm.

The existing structural system is standardized from segmented to hemi-cylindrical section of span 10.2 m and radius 2 m of capacity 1000 kg (with racks), moisture reducing silica gel embedded sponge fitted square air inlets, insulated heat storage and rubber cladding for outlets.

Preliminary trial under no load test exhibits that system generates hot air ranging from 42.70 to 54.32 ˚C at an ambient temperature of 28.50 to 34.60 ˚C. Sliced spices, minor fruits drying accomplished in 14 to 26 hours, initial and final moisture content range of 78 – 89% to 10 – 11% respectively. At average solar radiation 521.46 watt/m^2, thermal efficiency was 24.89%. The dryer has payback period of 2.5 and 3.5 years for Turmeric and Ginger respectively. Thus, dryer is techno-economically feasible for mass scale adoption in Assam through demonstration and extension activities.

Keywords: Poly-house dryer, Minor citrus fruits, Embedded sponge, Thermal efficiency, Payback period.

TS1-3

Release behaviour of phytochemical compounds based on Black Jamun pulp extracts-filled alginate hydrogel beads through Ionotropic encapsulation

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Black Jamun (*Syzygium cumini*) is a purple-blackish coloured fruit that contains polyphenols such as flavonoids, anthocyanin, and some macro and micronutrients. Jamun contains five anthocyanin compounds, having various therapeutic health benefits and antioxidant potential. However, Jamun extracts have limits in the use of bioactive components in various food items because of their limited stability under environmental and gastrointestinal circumstances. The purpose of the study was to evaluate the release profile of total phenolic and monomeric anthocyanin from Black Jamun encapsulated beads under simulated gastrointestinal conditions. Jamun extract-based hydrogel beads were prepared by external ionic gelation through a calcium alginate system. Jamun extract (85%) with dual core-shell mixtures were used in encapsulation using Buchi B-390 Encapsulator, nozzle diameter of 300 µm, vibration frequency of 100 Hz, electrode tension of 400 V, air pressure of 200 mbar followed by freeze-drying. The prepared hydrogel beads were evaluated for release behaviour of total phenolic (TPC) and total anthocyanin content (TAC). The release profile of different core-shell material based Ionic gelation encapsulates of Black Jamun extracts was varied from 20-30 mg GAE g-1 of TPC and 5-7 mg g-1 of C-3-G of TAC at 120 min. Overall, results shown the encapsulated Jamun beads have the better agro-industrial utility in the form of phytochemical compounds based on microparticles, holding decent antioxidant potential.

Keywords: Ionic gelation, Encapsulation, Phytochemical, Release profile, Anthocyanin, Jamun

TS1-4

Printability assessment of protein rich formulations: development of legume-based 3D printed dysphagia foods

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The nutritional prerequisite and oral physiology of dysphagia food is of prime concern in many countries. Extrusion based 3D food printing is an emerging texturing technique that can be applied in development of customized meals for dysphagia patients. In this study, the printability of high protein horse gram-based formulations with characteristic texture suitability for dysphagia patients was assessed. The steady and dynamic shear properties of the formulations as a bio-ink was analysed, considering their behaviour during printing (established by yield stress and thixotropy) and shear-recovery post printing (established by storage modulus G' and hysteresis), respectively. Also, the textural characterization of all the formulations was performed through Texture Profile Analyzer and International Dysphagia Diet Standardisation Initiative (IDDSI) Framework. Addition of hydrocolloids greatly reduced the hardness, chewiness, and cohesiveness making it more suitable for 3D printing. Results of 3D printing experiments of the formulations elucidate their potential as high-protein soft food with enriched nutrition dysphagia foods.

Keywords: Dysphagia, 3D printing, Protein rich formulations, IDDSI

TS1-5

Effect of different drying techniques on the quality characteristics of yoghurt powder

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The conversion of yoghurt into its powdered form is done to make it shelf stable at room temperature with no need of refrigeration. In order to convert it into the dried form different drying techniques are used. At commercial level, yoghurt powder is produced by spray drying process. Various other alternative drying processes like freeze drying, foam mat drying, refractance window drying can also be used. Using different processes results into the change in bulk (bulk and tapped density, flowability, porosity, degree of caking etc.) as well as reconstitutional (dispersability, solubility, wettability etc) properties of powder. Apart from this, operating different processes for different time and temperature also results into the change in morphological properties as well as change in the quality characteristics of powder. Our study aims at the comparison between different drying processes and then using the more convenient process for powder production having low cost with higher degree of quality characteristics.

Keywords: Yoghurt powder, Spray drying, Freeze drying, Foam mat drying, Refractance window drying.

TS1-6

Fabrication of lab scale batch type device for debittering of bitter citrus juice: Impact on chemical, bioactive and bitter compounds

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Bitterness removal from citrus juice is always been a challenging task for the researcher and industries to introduce a shelf-stable juice with maximum bioactive compounds and a hint of bitterness. In the present effort, a batch type lab-scale debittering device has been developed using Interdigitated electrode (IDE), macroporous resin, and enzyme. The naringinase enzyme was entrapped in the resin which was further deposited on an IDE patterned PCB substrate. The fabricated device is efficient to handle 60 ml of pomelo juice in a batch manner. The juice was treated for 160 min at 60 ℃ to determine the optimum time for a minimum level of naringin with maximum vital nutrients. In addition, treated juice was also compared with the juice obtained from activated and non-activated resin embedded devices. Juice collected after treatment was analysed for bitter compounds, chemical composition, and bioactive compounds. A decreased level in naringin (52%) and limonin (>41%) while increased naringenin was noticed as a time of exposure increased. Juice treated for 100 min had a significantly lower amount of naringin (>40%) with maximum vital nutrients. On the other hand, juice treated with other devices had a significant amount of bitter compounds and decreased level of bioactive compounds. The present study concludes that the fabricated device reduced the bitterness up to a certain level with the minimum loss of other vital nutrients. Further study is needed to increase the handling capacity of juice and to study the storage stability of treated juice.

Keywords: Bitterness, Naringin, Debittering device, Citrus fruit, Interdigitated electrode (IDE), macroporous resin

TS1-7

Effect of Particle size, Barrel Temperature on Physical properties and Limiting amino acids in Extruded Snack

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Extrusion technology is a well-known process for significant transformation of feed mixture in order to develop innovative healthy and taste captivating products. The vitality of protein quality in current lifestyle needs to be addressed with nutritionally supplemented Ready-to-Eat convenience based products. The concept of limiting essential amino acids is attributed to the absorption of all the amino acids in human system. Therefore, the present study focuses on the optimisation of extrusion parameters such as moisture content, barrel temperature, screw speed etc. to retain maximum nutritional value. Physical parameters such as expansion ratio, specific length, bulk density, water absorption index, water solubility index, fat absorption capacity etc. were conducted. Proximate parameters such as moisture, ash, fat, protein and amino acid profiling using HPLC were analysed. Also, consumer preference trials were conducted to optimise the sensory characteristic of the developed product. The developed product is extruded with an aim to provide sustainability in terms of nutrition, health as well as environment and commercial viability.

Keywords: Limiting Amino acids, Ready-to-Eat products, Protein Quality, Sustainability

TS1-8

Ozonation: A sustainable advancement in Food Processing

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The development of technologies in food industries intended for the manufacturing of food products is currently facing challenges in delivering safe, healthy, minimal processed and high-quality foods. Constant monitoring at each step of food supply chain is required to resolve the issue of food safety and consumer acceptance. In order to attain all these parameters and to meet consumer expectations, emergence of advanced technology with greener method are most preferred these days due to environmental concern. Focus is now on ozonation (ozone treatment) that assists in the enhancement of food product quality while maintaining maximum safety due to its active sporicidal activity and antimicrobial properties. It is believed that ozonation may stand on the expectations of the Food industries, regulation authorities and consumer's acceptance. The multifunctionality and zero by product production makes it a promising food processing technique. Corona discharge, Ultraviolet radiation and electrolysis methods can be used to produce ozone. Ozone due to its oxidative property has been widely used in sanitising, washing, odour removal, water treatment, and in equipment, fruits, vegetable and meat processing disinfection. The treatment of ozone to food is done in such a way that no nutritional, sensory and physicochemical characteristics are altered. In this paper, we review the Impact and contribution of ozonation in the overall food processing chain.

Keywords: Food processing, Ozonation, Corona Discharge, Ultraviolet radiation, Electrolysis, Sanitizing, and disinfection.

Technical Session-2
Engineering Aspects in Food Processing

TS2-1

Design and analysis of a water pumping device - A solution for hilly terrains

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To overcome the problem of water scarcity in hilly terrains and constraint of electricity to supply water to households or agricultural fields in the hills, the ram pump has been contemplated to be a feasible alternative. The ram pump is a water pumping device that does not consume any external power for its operation and requires minimal installation costs with negligible maintenance. It uses the kinetic energy of its flow to pump water to various heights. Hence in this paper, an effort has been made to present a generalized design methodology for hydraulic ram pump covering design parameters along with the mathematical relationships and flow analysis. The ram pump is fabricated for different configurations and experimental analysis for each is conducted to determine the optimum configuration of pump in terms of efficiency and discharge rate.

Keywords: ram pump, water pumping device, hydraulic ram.

TS2-2

Effect of drying methods on chemical composition, physicochemical and structural properties of underutilized cauliflower leaves (*Brassica oleracea var. botrytis*)

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Cauliflower (*Brassica oleracea var. botrytis*) is one of the most consumed vegetables throughout the world. Disposal portion of cauliflower, which contributes to about 45– 60% of the total weight of the vegetable. Cauliflower outer leaves have been underutilized and discarded by many consumers as food for animals or household waste. The study aimed to analyse the effect of drying methods on the chemical composition, Physicochemical properties, structural characteristics of cauliflower leaf powder. In the study, it was observed freeze dried sample has less moisture content compared to the tray dried sample. Freeze dried sample had the highest protein and ash content, while the tray dried sample exhibited the lowest. Bright green color was observed freeze dried sample followed by tray dried sample. The highest water absorption capacity and solubility were observed in tray dried sample followed by freeze dried. SEM images revealed tray dried leaf powder has a compact and irregularly shaped structure, while freeze dried sample has the least structural changes was observed. However, there was a slight significant difference observed in bulk and tapped density.

Keywords: Cauliflower leaves, tray drying, freeze drying, chemical composition, water absorption capacity,

TS2-3

Advances in Peeling methods of Agricultural Commodities

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Peeling is a one of main stage of processing of agricultural commodities. Mechanical, chemical, and manual peeling are few most adopted peelings methods. Manual peeling is the most ideal method in terms of freshness but it consumes good amount of labour and time. Mechanical method is less time-consuming method. The main concern of the lye or chemical peeling is the disposal of lye which is an environmental concern. It is an expensive method as treatment of waste is needed for disposal. So, ultrasound and ohmic heating can be used to reduce the concentration of lye. Enzymatic peeling can only be applied to fruits whose distinct separation of peel from the flesh is needed. PEF-assisted steam peeling helps to reduce cost by reducing use of steam. IR dry-peeling only heats the superficial layer of fruits and possesses minimal effect in an edible inner portion of fruit. It uses less time with low peeling loss, high peelability, high peeling yields, thin skin is peeled-off with good color properties, but need more research to justify industry implementation.

Keywords: Peeling, enzymatic peeling, mechanical peeling, enzymatic peeling, chemical peeling, infrared peeling.

TS2-4

Enzyme inactivation and physico-chemical changes in pineapple juice in batch type ohmic heating system

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Ohmic heating (OH), alternate thermal processing of fruit juice, utilizes internal resistance of food samples for heating when any electric current is passed through it. In the current study, a batch-type ohmic cell (inner diameter 2.54 cm, length 10 cm, platinized titanium electrodes) is used to treat fresh pineapple juice. The experimental studies were proceeded with electric field strength (EFS: 20, 30, 40 V/cm), time (0.5, 1.0, 2.0, 3.0 min) and temperature (60, 70, 80, 90^{o}C) and enzyme inactivation, heating parameters and its physico-chemical properties were studied. Results showed that pineapple juice heated at a faster rate at higher EFS, and it was observed that the come-up time for achieving 90^{o}C from 24^{o}C and heating rate for EFS 20, 30, 40 V/cm was found to be 137, 54, 31 s respectively and 29.18, 72.05, 128.44 ^{o}C/min respectively. The electrical conductivity of the juice during OH heating increased with temperature rise. The enzyme activity viz. polyphenol oxidase, peroxidase and bromelain of the OH treated juice was significantly reduced compared to fresh juice with temperature and time. The bromelain inactivation achieved more than 95% when treated at 90^{o}C for 3 min under all the EFS. The various physico-chemical parameters viz. pH, TSS, %titratable acidity, vitamin C and total phenolic content were also studied and observed non-significant change in almost all the parameters except vitamin C, which degraded with temperature and time. Thus, the above studies conclude the efficacy of ohmic heating as alternate thermal processing of pineapple juice.

Keywords: Ohmic heating, electrical conductivity, polyphenol oxidase, peroxidase, bromelain, vitamin C

TS2-5

Advanced EM Technology based system for Warehouse Management

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A number of methods for quality evaluation and post-harvest of agricultural products have been developed by different researchers over the past few decades. These methods is based on the detection of various physical properties which correlate well with certain quality factors of the products. This article discusses the technologies implemented for dielectric processing of agro products by using Microwave interaction with those products. A microwave measurement Signal is transmitted through the grain. The grain density and moisture content are determined from the attenuation of the measurement signal in passing through the grain. The first method implemented is development of portable non-destructive moisture measurement system using microwave resonator. The second method is an implementation of online moisture measurement system for food granaries which reduces manual intervention in the grain storage operation chain. The sophistication of non-destructive methods has evolved rapidly with modern technologies. The method also involves Radio Frequency Identification (RFID) which provides appealing opportunities to improve the management of information flow within the supply chain and security in the agri-food sector. The aim here is to analyse the current developments in RFID technology in the agri-food sector, through an operative framework which organizes the literature and facilitate a quick content analysis. This approach also has a systematic data-log feature. Another method implemented for dielectric processing is using RF applicator system for the purpose of disinfestation of food grains so as to increase shelf life since the growth of micro-organisms is reduced. Disinfestation is a necessary step in the packing chain of grains for quality maintenance and exposure to radio frequency radiation allows carrying out this operation minimizing the effect on the characteristics of food grains.

Keywords: Microwave frequency, Radio frequency, Warehouse management, RFID, Agro products, Online Measurement.

TS2-6

Shelf-Life Study of Groundnut Milk Powder Using Spray-Drying Technology

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Groundnut milk obtained from groundnut has very limited shelf life being a perishable product and also adds to the increased transportation cost of carrying the liquid milk from one place to another. The production of powder will help to eliminate the above two issues and hence increase the value of the product. The powder can be used as a supplement in various foods as a substitute for animal milk powder (especially useful for persons with lactose intolerance). Spray-drying involves the rapid removal of water from a concentrated dispersion, during which milk components are concentrated, as moisture evaporates from the droplet surface. The spray drying of groundnut milk was carried out under optimized conditions. The shelf-life study of groundnut milk powder thus produced was carried out for duration of 3 months, in which, various properties of groundnut milk powder like moisture content, water activity, free fatty acid, dispersibility, insolubility index, temperature and relative humidity of storage conditions were studied. Moreover, organoleptic evaluation of two products prepared from groundnut milk powder like condensed milk and Indian sweet (Peda) were also conducted, whose overall acceptability was very good as indicated by the sensory panelists.

Keywords: Groundnut; Spray drying; Shelf-life; Dispersibility; Insolubility index; Organoleptic evaluation

TS2-7

Comparison of Adapted and Improved Feature Extraction Techniques of Different Potatoes Types using Image Processing

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To understand the behaviour of crack, rotten, sprout, skin peel and good potatoes non destructively, an image capturing chamber was made using galvonised iron sheet dimension of 40 cm×40 cm×40 cm and four web camera's were installed on top side walls of the chamber and images were captured. The developed setup has a resolution of 0.22 mm/pixel. Images were analysed in Matlab and following observations were analysed. In an attempt to give detailed information on five feature extraction techniques such as gray level co-occurrence matrix properties (GLCMP), radon, gabor, local binary patterns (LBP) and histogram of oriented gradients (HOG) using five types of potato images. Default parameters and values (adapted method) were compared with same default parameters and their values suggested by different researchers (improved method). Gabor feature length (16) of improved method was lower compared to adapted method and improved method and it requires less time to plot gabor magnitude and spatial kernels for all potato classes. Radon feature row vector size is same for both adapted and improved methods for all potato classes but differ in column vector size because of difference in theta (θ) value. At theta value of 90° (improved method), the time taken to plot radon transforms is lower compared to adapted method (using theta value 180°). Gray level co-occurrence matrix properties (GLCMP) such as contrast, correlation, energy and homogeneity values were compared to both adapted and improved methods for all potato types. Contrast values found lower in adapted method for all potato classes compared to improved method. But remaining properties found higher in adapted method for all potato classes compared to improved method. The default values used in adapted method of HOG feature vector length (26140) is higher compared to improved method (1330) for all types of potato images. For crack and rotten potato images, an improved method required higher time to plot visualization than adapted method, while for sprout, good and skin peel images, adapted method has more visualization time because of cell size 8-by-8, compared to an improved method having cell size 1-by-1. The LBP feature length in improved method was found higher (185) compared to adapted method (59) for all potato classes. The mean time to plot squared errors in adapted and improved methods for crack images were found to be 0.6378 s and 0.6305 s respectively, for rotten images 0.2098 s and 0.2622 s, for sprout images 0.1911 s and 0.2209 s, for skin peel images 0.2197 and 0.2197 s, for good images 0.2672 and 0.2565 s.

Keywords: Histogram of Oriented Gradients, Gray Level Co-occurrence Matrix Properties, Local Binary Patterns, Gabor Features, Radon Features

TS2-8

Impact of Various Drying Methods on Moisture Ratio and Rehydration of florets of Banana Inflorescence of *Musa paradiscia* L.

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The objective of the research was to study the impact of various drying processes (hot air drying, microwave drying and freeze drying) on physicochemical properties of florets of banana blossom (*Musa paradiscia* L.) samples. The drying was done using freeze dryer, hot air chamber using 03 different temperatures (40°C, 70°C and 105°C) and microwave at 03 different powers (119 W, 462 W and 700 W). The time needed to decrease the moisture content to a given level was extremely dependent on the drying conditions. The highest value of drying time in hot air in 24 hrs at 40 °C followed by freeze dryer was 17 hrs and the lowest time has been 640 seconds in microwave at a power of 700 W. The rate of rehydration was observed higher in a sample dried by freeze drying followed by drying in hot air while least rehydration was with microwave 700W.

Keywords: Moisture ratio, Banana blossom, drying, freeze drying, rehydration

TS2-9

Effect of yellow sweet pepper powder and puree on the dough rheology and bread quality attributes

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Bread is consumed worldwide as a staple food. Wheat flour is used for bread preparation owing to its unique gluten protein that imparts excellent formation of elastic, extensible, cohesive dough and retains gas during the fermentation. Bread contributes to the intake of carbohydrates (as energy-providing food) in developing countries but still, it lacks some basic nutrients. Generally, owing to its wide consumption, the bread should be fortified and enriched with ingredients that can provide an advantage to the consumer in the context of health. In this study, the influence of yellow sweet pepper (YSP) powder (2-10 %) and puree (5-25 %) on dough rheological properties and bread quality were investigated. Bread prepared without YSP was taken as control. Dough prepared with 6 % YSP powder and 20 % YSP puree exhibited the optimal elastic (G') and viscous (G") modulus values. The hardness of powder-based bread was higher than puree-based bread. On the basis of rheological and physical characteristics, best YSP powder and puree bread were selected. Selected breads were evaluated for proximate, minerals (ICP-AES), and bioactive (total phenols, flavonoids, carotenoids, antioxidant activity) parameters. The FTIR spectrum of bread was also studied to identify the functional bonds. Bread prepared with YSP powder and puree improves its color, fiber, mineral, and bioactive properties as compared to control. Thus, YSP powder and puree show greater application potential for developing novel bread.

Technical Session-3
Engineering Aspects in Food Processing

TS3-1

Drying of whole lotus (*Nelumbo nucifera* Gaertn) rhizome slices: Effect of drying condition on various powder characteristics

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Fresh lotus rhizomes (*Nelumbo nucifera* Gaertn) were analysed for physical parameters, proximate composition, and the effect of blanching (hot water, steam, and microwave) on PPO (polyphenol oxidase) activity. Further. the effect of different drying temperatures (DT) (40 °C, 50 °C, 60 °C, 70 °C, and 80 °C) and slice thicknesses (3, 6, 9, 12 and 15 mm) on drying kinetics of microwave blanched lotus rhizome slices was studied. Investigations revealed the polynomial model as best fit for determining the drying conditions. Lotus rhizome powders (LRP) obtained after different drying treatments were analysed for quality parameters. Water activity (a_w) and color values portrayed strong dependence on DT. WAC and OAC of LRP dried at different slice thicknesses and DT changed from 4.954 to 1.680 g/g and 2.9906 to 0.5276 g/g. For all the drying conditions, dynamic mechanical properties i.e; storage modulus (G′) was greater than loss modulus (G″) and therefore tan δ was observed < 1; with lowest flow behavior index (n) of 0.2219, and high coefficient of determination (R^2) valuing 0.99 for 50 to 60 °C DT for 3mm slices. FTIR spectra of LRP showed typical spectral features with common peaks and slight deviations in different drying conditions, and also showed regions of polyphenols with variation in peaks with the change in DT. It was concluded that samples of 3 mm thickness dried at 60 to 80 ºC required lesser time to dry and possessed excellent WAC, OAC, and lightness values that can be further characterized for the formulation of ultimate LRP.

Keywords: Lotus, rhizome, Nelumbo nucifera Gaertn, powder, drying conditions, physicochemical and rheological characteristics.

TS3-2

Microwave Assisted Variable High Power System for Tea Processing

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Microwave drying technology is fast becoming a very popular name and has tremendous potential to revolutionize various industrial processing sectors in India. In tea processing, the conventional surface heating through hot air, the core moisture remains trapped in larger size tea grains in the existing engineering process, which in turn degrades the quality and life of the processed tea. There are occasions of undesired interceptions due to microbial fungal growth in the finished tea or in stored tea before packing. The Microwave technology based drying, being a molecular phenomenon, not only provides solution for even drying for tea, but also eliminates bacterial growth during various stages of processing of tea. Uniform drying of tea grains and maintaining the moisture content of 3% and less in the finished tea product is a major challenge for the tea industry. Using this microwave tea dryer system the moisture contents of 8-10% in tea powder can be reduced to 3% leading faster process and improved quality. The microwave heating system for tea processing application is capable of generating 1kW to 10kW of microwave power. The frequency of operation is 2.45GHz which falls in ISM band. The microwave power is generated using a high power magnetrons having 72% efficiency. The output power of each source can be varied from 0.6 kWatt to 5 kWatt. The 5 kWatt microwave energy from each microwave source can be applied to the applicator cavity used for tea processing. This cavity is a conveyorised applicator having two microwave ports separated at a distance of 2.5 meter apart. The microwave power is fed to these ports using the waveguide structure and horn antennas.

Keywords: microwave, high power, tea processing, moisture, conveyorised applicator

TS3-3

Weathering of natural fibre composites

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Composite materials are made up of two or more constituent materials at a macroscopic level and are not soluble in each other. These materials have many advantages and hence they find their use in the manufacture of a large number of products and this makes them commercially valuable. However, they may come into contact with various conditions that might lead to weathering. Weathering leads to various harmful effects in composites like discoloration, decrease in durability, decline in mechanical properties, decrease in mass, etc. Hence study on the damage caused by weathering on composite material must be studied. For this study, wood polyester composite (WPC), jute polyester composite (JPC) and coir polyester composite (CPC) were fabricated by hand layup method. The samples were subjected to four weathering tests which include water ageing test at room temperature for a period of 336 hours (14 days), immersion in distilled water at 100°C, exposure to QUV spray weathering tester for a period of 500 hours etc. The CPC sample subjected to water ageing at room temperature and boiling water at 100°C showed comparatively higher water absorption rate than the WPC and JPC samples. This is because JPC and CPC are natural fibre composites and fibres being hollow at the centremost region have higher water absorption rate than WPC which is a particulate composite. The CPC samples also turned whitish after 24 hours of performing of water ageing test. Exposing the samples to the environment for a period of 144 hours did not show any significant change in the sample. The samples of CPC, WPC and JPC were subjected to tensile testing before and after being put in the QUV spray weathering tester. It was found that after being exposed to QUV spray weathering tester, there was a decrease in the tensile strength for all of the samples.

Keywords: coir, jute, wood, polyester resin, weathering.

TS3-4

Impact of freeze-drying on physical and chemical characteristics of Palmyra palm Tender Fruit Endosperm

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Palmyra palm Tender Fruit Endosperms (Taal;Nungu) were freeze dried for shelf life extension since it contains more moisture content. Freeze-drying is an expensive method of processing due to its low pressure operations and prolonged processing time. Therefore it is necessary to determine the optimum working pressure, shelf temperature and shape characteristics that can preserve the Palmyra palm Tender Fruit Endosperm (PTFE) quality at reduced cost and at reduced time. Twelve conditions of freeze drying were studied for optimization of best condition based on working pressure (375 mTorr & 750 mTorr), shelf temperatures (35˚C, 45˚C & 55˚C) and shape of PTFE (whole or sliced). Impact of freeze-drying conditions on physicochemical variables such as moisture content, L*value, chroma, coordinate, hardness and fracturability were evaluated. The results depicted that working pressures and shelf temperatures had great impact on chroma, hue angle and final moisture content. Moreover DPPH, FRAP, and total phenolic content results depicted that bio-actives were well preserved in conditions with high shelf temperature and lowest pressure (less time of operation). It was concluded that optimum freeze-drying condition for better colour preservation with good structural integrity in consort of maximum bio-actives preservation are sliced PTFE dried with 375 mTorr pressure condition through highest shelf temperature 55 ˚C for 13 hours.

Keywords: freeze-drying, Borassus flabellifer, bioactives, colour values, texture.

TS3-5

SPRAY – FREEZE – DRYING. An alternative approach for drying of foods and allied products

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Spray-freeze-drying (SFD) is an unconventional freeze drying technique that produces uniquely powdered products whilst still including the benefits of conventionally freeze dried products. SFD has potential applications in high value products due to its edge over other drying techniques in terms of product structure, quality, and the retention of volatiles and bioactive compounds. In cases where other drying techniques cannot provide these product attributes, SFD stands out despite the costs and complexities involved. Spray-freeze-drying (SFD) involves spraying a solution into a cold medium, and freeze-drying the resultant frozen particles, which can be performed by contacting the particles with a cold, dry gas stream in a fluidized bed, typically at atmospheric pressure. This enables much faster drying rates than are usually possible by conventional freeze-drying, due to the small particle sizes involved.Compared to the classical freeze-drying process the various differences can be pointed out *viz-a- viz* improved heat and mass transfer between the circulating drying medium and the frozen sample; high and homogeneous quality properties of the dry product with an increased retention of volatile aromatic compounds in foods; and A fine, free-flowing powder with a large inner surface area and good instant, i.e. Wetting and solubility properties can be obtained.

Keywords: spray drying, spray freezing. Freeze drying.

TS3-6

A study on the functional requirement and nutritional characteristics of OUAT ragi thresher cum pearler

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Millets are renamed as Nutri-cereals, which itself signifies their nutritional characteristics. At the instance of "Odisha Millet Mission", the mega project of the Government of Odisha, OUAT ragi thresher cum pearler has been introduced in 15 districts during the previous years to reduce the cost of threshing, drudgery involvement, labour requirement and yet to increase the output capacity as compared to the conventional threshing method by manual hand beating and winnowing by bamboo made swinging basket. Performance evaluation of the said machine revealed that the average output is 90 kgh-1 with 95.7% threshing efficiency and 94.5% cleaning efficiency while the cost of operation is Rs 0.33kg-1 as compared to Rs5.00kg-1 in the conventional method. In addition, the hygienic quality of finger millet grains is simply ensured in this method, enhancing the marketability and net benefit considerably. Further, to ensure the retention of nutritional characteristics, a study to find the functional active groups and compounds present with their bond characteristics through FT-IR of the grains, threshed, both in the conventional and mechanical methods was conducted which indicated the presence of nine and ten functional groups respectively. The wave numbers 3276.98 cm-1 and 3276.34 cm-1 showed the O-H and N-H stretching strong and broadband with the peaks at 1646.21 cm-1 and 2920.13 cm-1 in case of manual and machine threshing methods respectively due to the presence of CH2 group (Alkanes). The machine threshed sample had an additional presence of the Ester(P-OR) group containing a peak of 999.64 cm-1. Thus, from functional requirements and nutritional characteristics view, the OUAT ragi thresher cum pearler was found superior to the conventional method.

Keywords: Ragi thresher cum pearler, FT-IR study, output, threshing efficiency

TS3-7

Study of extrusion process parameters on the physico-chemical, morphological, rheological and sensory characteristics of a novel cooked extruded lentil : Essential Amino Acid Balanced Nutri Lentil

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To address the problem of poor protein quality in pulses, an essential amino acid (EAA) balanced Nutri Lentil is developed which resembles natural lentil in physical and sensory characteristics; improved nutrient delivery, reduced antinutrients and cooking time. The extruded lentil is a value addition by utilizing broken lentil (by-product of pulse milling industry). The present investigation studies the effect of extrusion process parameters on functional, cooking, morphological rheological properties and sensory profile attributes of nutri lentil. The Nutri lentil are extruded at pilot scale level by varying the feed moisture (26-30%) and die head temperature (85- 105°C). The samples are analyzed for functional properties viz. water absorption index (WAI), water solubility index (WSI), Browning Index (BI) and Bulk density; cooking characteristics viz. cooking time, and hardness; morphology and crystallinity by SEM (scanning electron microscopy) and viscoelastic properties of lentil flour mixture. Quantitative descriptive analysis (QDA) and consumer acceptance test (9-point hedonic scale) was conducted for sensory profile evaluation. Extrusion significantly changed the bulk density, WAI and WSI which varied from 50.9- 75.8, 0.67-1.15g/cc, 2.02 to 3.12 %. and 20.72-50.76 %, respectively. Cooking time and hardness significantly varied ($P < 0.05$) from 6-18 min, 22-40%, and 2.87 to 15.45 N. G′ and G″ of dough increased at different moisture. Formation of air cells and thinner cell walls resulting expansion at elevation of temperature was observed in SEM. Increase in die temperature resulted decrease in crystallinity. Sensory evaluation through QDA showed increased intensity of descriptors like adhesiveness, beanie aroma and after taste. Consumer acceptability testing indicated significant differences in overall acceptability.

Keywords: Extrusion, functional Properties, SEM, Essential Amino acid, lentil

TS3-8

Improving quality of no cooking rice by Instant Controlled Pressure Drop Technology

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Komal Chaul is obtained by parboiling a low amylose rice which can be consumed without cooking, rather, simply by soaking in warm water for some time. Traditionally it is prepared by boiling or steaming of chokuwa paddy followed by drying. Instant Control pressure drop (ICPD) treatment is an innovative technology that involves high-pressure treatment with an instantaneous decompression towards vacuum, resulting in expansion, moisture loss, and rapid cooling of the product. The intensity of treatment condition modifies the product quality. Hence this technology is investigated to produce improved quality komal chaul due to expansion resulting from exposer of high pressure followed by instant decompression.

For this study presoaked chokua paddy was treated at variable Treatment pressure (Tp) for steaming step, at different treatment time (Tt) i.e., steaming time before decompression, in a locally fabricated ICPD treatment chamber. Steaming is followed by tray drying at laboratory conditions and the paddy was milled to obtain ICPD treated rice. Properties of ICPD treated rice, affected by steaming parameters were studied and compared with properties of conventionally parboiled komal chaul and unparboild rice.

Rehydration time and Cooking time were seen to be lowered whereas milling parameters, degree of gelatinization(dg), saturation moisture content were seen to be elevated in ICPD treated rice, as compared to parboiled and raw rice. Changes in color parameters of ICPD treated as compared to parboiled and raw rice were quite visible. Overall, komal chaul produced by ICPD treatment of paddy at higher Tp and lower Tt produced better quality rice over the conventionally parboiled rice and raw rice.

Keywords- ICPD treatment, milling parameters, rehydration time, saturation moisture, cooking time

Technical Session-4
Food Microbiology and Bioprocessing

TS4-1

Fermented rice beverage (*Chubitchi*) in management of Antibiotic Associated Diarrhoea

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Antibiotic-associated diarrhoea (AAD) is most commonly caused by disturbance of the physiological microflora of the gut. This study aimed to evaluate the potentiality of laboratory made functional fermented rice beverage in mitigating AAD on animal models viz. Wistar rats. The animal models were administered with fermented rice beverage (A1), combination of indigenous *Lactobacillus* isolates (A2), a yeast isolate (A3), loperamide (STD), normal control (NC) and disease control (DC). Various diarrhea assessment parameters were checked from each group followed by analysis of fecal microbiome, haematological parameters, histopathology of colon, liver and cecal short chain fatty acids determination. NC and A1 was least affected by AAD induction with a faecal consistency score of 1 on the final day of the study. After day 10 a significant reduction in the faecal water content was observed in A1, A2 and STD till day 15. Compared to the NC, a slight decrease in body weight was found in rest of five test groups at day 5, 10 and 15. Except NC, the remaining five test groups showed a significant decrease of lactobacilli and yeast counts in faecal microbiota at 5th day. An increase in the enterococci and coliform counts indicated the severe diarrheal condition but A1 reported with significant increase in the population of *Lactobacillus* at day 15. An increase in red blood corpuscles, haemoglobin, packed cell volume, mean cell haemoglobin, mean corpuscular volume, mean corpuscular hemoglobin concentration was reported. During the histopathology analysis of colon and liver, normal layers of mucosa, submucosa, muscularis and serous with absence of any abnormal changes or lesions was reported for A1. The cecal concentrations of lactate, acetate and propionate were significantly higher in A1 as compared to rest of the test groups. Therefore, fermented rice beverage possesses the potentiality to be used in inhibition of antibiotic associated diarrhea with further clinical investigations.

Keywords: antibiotics, diarrhea, fermented rice beverage, lactic acid bacteria, yeast, animal model.

TS4-2

Fermentation kinetics, its optimization, kinetics, and Sustainable Compounds in Ethnic Food Beverage *Joubidwi*

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Fermentation is an enzyme induced transformation reaction of carbohydrate-rich food stuffs like rice, cereals, fruits, maize etc. to fructose and glucose, and finally to ethanol and various volatile and non-volatile congeners. Herein, we were reporting the optimization of *Bodos*' traditional fermentation method for the preparation of *Joubidwi* evaluating the physico-chemical indices *viz.* brewing procedure, bitterness, colour, flavour, carbohydrate, protein and ethanol content, anti-oxidant activity and some volatile compounds. Laboratory fermentation kinetics were also observed. The self- life for fermentation were adapted from 12 hours to 144 hours and observed the pH from 3.23 to 3.62 drifted towards less acidic environment. The alcohol concentration was shifted from 13.61 ±1.11 mg/mL to 78.80 ±1.48 mg/mL Variation in carbohydrate, protein contents from 72.88 ±0.03 mg/mL to 14.94 ±0.30 mg/mL and 0.30 ±0.00 mg/mL to 0.41 ±0.01 mg/mL. Herein, we were again reporting some sustainable compounds like BHT, iso-propyle myrisate, 2,6,10-trimethyledodecane etc. by GC-MS method. Again, gallic acid, caffic acid, ferulic acid were also detected by reverse-phase HPLC.

Keywords: Joubidwi, colour, flavor, fermentation.

TS4-3

Effect of storage conditions on viability and physicochemical properties of spray dried probiotic powder

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The global demand and consumer's acceptance for probiotic based functional food is increasing tremendously due to various health benefits associated with it. However, probiotics have to withstand a number of harsh conditions during processing, handling and storage. Encapsulation of probiotic with various encapsulating agents have been utilized to protect them from various hazards. Powdered probiotic is easy to handle and store, and can be easily utilized for development of probiotic functional products. In the present study, *Lactobacillus rhamnosus* GG (LGG) cells were encapsulated by spray drying at an inlet temperature of 170° C. The encapsulating agents used were 20% maltodextrin and 2.5% Fructooligosaccharide. The effect of storage conditions on viability (CFU/gm) and physicochemical properties (moisture content, water activity and colour) were examined. The encapsulated probiotic cells have shown a positive effect and exhibited better viability during storage conditions compared to free cells.

Keywords: Probiotic bacteria; Storage study; *Lactobacillus rhamnosus* GG; Maltodextrin; Fructooligosaccharide

TS4-4

Anti-nutritional factors, molecular interactions and phytochemical composition of proso millet (*Panicum miliaceum* L.) as influenced by biological processing treatments

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Present study was aimed to investigate the influence of biological processing treatments on Anti-nutritional components and bioactive profile of proso millet (*Panicum miliaceum* L.). Soaking (12 hours at 25°C), germination (48 hours at 25°C), fermentation (20 hours at 38°C) and combination of aforesaid treatments were given to proso millet seeds. Significant ($p<0.05$) reduction was noted in tannin content (73.41 to 26.54 mg/100g), phytate content (8.77 to 2.44 mg/g) and saponins (166.76 to 29.13 mg/100g); however, germination elevated the saponin content to 226.61 mg/100g attributing to higher activity of hydrolytic enzymes. Further, total phenolic content and flavonoid content were lowered due to leaching losses during soaking, but other treatments enhanced the bioactive performance of proso millet flour as also confirmed by estimation of antioxidant activity by different principles including DPPH and ABTS radical scavenging activity, metal chelation, reducing power and ferric reduction antioxidant potential. The aforesaid changes could be ascribed to activation of enzymes during germination and production of microbial enzymes during germination which resulted in higher extraction and biosynthesis of phytochemical compounds due to degradation of starch, proteins and other cell wall constituents. Reports after X-ray diffraction (XRD) analysis and Fourier transform infrared (FTIR) spectroscopy further disclosed that extent of given bio-treatments could not severely damage the structural conformation and crystallinity of proteins and starch molecules respectively.

Keywords: Soaking; Germination; Fermentation; Antioxidants; Nutri-cereals

TS4-5

Refused by man, refused by microbes: From waste to single cell protein

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The rapid rise in industrialization results in decrease in agricultural land occupancy while at the same time increases the concern about waste management. Using waste and discarded material as substrate for single cell protein (SCP production) is the only way forward towards sustainability. The role of various microbes in converting refuse to animal and or human feed is wellknown. A survey conducted in Europe amongst elderly population showed that microbial SCP was 20% acceptable only next to plant protein. There is huge interest in algae, fungi, bacteria that can be used as SCP derived from waste. Algal content of protein is especially high. An increased protein content along with highest SCP production was observed with *Saccharomyces cerevisiae* at 9.3 mg per 2g of groundnut shell substrate as compared to sugarcane bagasse. Similarly, *Saccharomyces cerevisiae* and *Candida tropicalis*, strains of the yeast were used for the preparation of fermentation media using pineapple waste as a sole carbon source. Therefore, we propose to utilize daily household agricultural waste such as (fruits, vegetable, groundnut shell, wheat bran, rice husk, corncobs) for production of *Saccharomyces cerevisiae* as SCP. Our work would be in synchrony with university's food division where we will segregate food waste and convert it to SCP to ensure a zero waste lifestyle. Yeast are deficient in Methionine. Therefore methanotrophs, such as *Methylococcus capsulatus* used in urban bio-waste valorization through coupling anaerobic digestion can be added along in product. *Saccharomyces* and *Methylococcus* combination would provide food security.

TS4-6

Indigenous Method for the Preparation of Rice Beer by Tiwa Community of Morigaon District

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To study the preparation of starter culture and Rice beer of Tiwa tribe of Morigaon district of Assam. Starter culture is prepared from rice with mixing of different types of leaves. Leaves were collected from the different villages of Tiwa community. When the culture is ready, it was mixed with rice and initiate fermentation process. As the fermentation process completed, the beer is ready for consumption. It was found that for 1 kg rice, 40-50 gram of culture is required for the preparation of rice beer. The beer can be taken as distilled or non-distilled form. The shelf life of the beer is 3-4 days without adding any kind of preservative. The beer is high in nutritive content and able to cure some of the diseases such as fever and various enteric diseases. In future, the medicinal value, chemical and physical properties of the beer should be studied for its scientific up-gradation and commercialization. The study indicates that the process of making rice beer was totally indigenous and basically does not have any scientific background but the fermented drink has no side effect on health.

Keywords: Rice Beer, Indigenous Method, Tiwa Community

TS4-7

Bacterial proteases from root vegetables: a sustainable way to alleviate wheat disorders

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Wheat proteins, when ingested or inhaled, break down in body resulting in pathogenic peptides culminating into wheat-related disorders. Wheat disorders are of three types:- wheat allergy (WA), coeliac disease (CD), non-coeliac gluten sensitivity (NCGS). A heightened immune response due to wheat peptides is, called as wheat allergy. WA can be IgE mediated or non-IgE mediated. Ingested wheat peptides lead to an autoimmune response causing coeliac disease. Symptoms of CD and NCGS are similar but a diagnostic test can differentiate between them. Gluten (comprises 40% wheat proteins) peptides is mainly responsible for gluten intolerance. Gluten-free diet (GFD), is highly effective in relieving gluten disorders. There are several ways to produce gluten free wheat (GFW). One sustainable way includes using protease producing bacteria that inhabit root vegetables, potato (*Solanum tuberosum*), carrot (*Daucus sativus*), beet (*Beta vulgaris*), and topinambur (Jerusalem artichoke/ (*Helianthus tuberosus*). *Bacillus pumilus*, *Clostridium subterminale*, and *Clostridium sporogenes* isolated from peels of vegetable roots produced proteases. Koiv, V. et. al simulated conditions of human gastrointestinal tract. They found that these bacteria survived harsh conditions and can potentially play role of gluten degraders. We propose that wheat dough treated with preparations of finely ground, dried peels of these vegetables can act as sustainable source of proteases to degrade gluten. Further, Lactic Acid Bacteria (LAB) of genera *Lactobacillus*, *Leuconostoc*, *Pediococcus*, and *Streptococcus* produce exopolysaccharides (EPS) which have antimicrobial activity against food spoilage molds and bacteria. We propose these can act as natural pro-biotics which can also be added to prepare sourdough increasing shelf-life.

Keywords: Gluten allergy, proteases, LAB, pro-biotics, Gluten-free wheat, dried peels.

TS4-8

GLYCEMIC INDEX AND α-GLUCOSIDASE INHIBITION OF CHOCOLATE INCORPORATED WITH SPICES

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The present study was carried out to determine the glycemic index, α-glucosidase, α-amylase and sucrase inhibition of chocolate developed by incorporating selected spices viz., fenugreek, black cumin, coriander and cinnamon in the form of powders at different equal levels of substitution (1%, 1.5% and 2%). The spices incorporated chocolate showed α-glucosidase inhibition in the range of 27.36-34.20%, 33.30-41.94% and 38.36-48.28% at 50µl, 100µl and 150µl respectively. The glycemic index of developed chocolate was found to be lower than the control chocolate. The results of the present study revealed that the developed chocolate is low glycemic in nature, which was attributed to the low glycemic nature of incorporated spices.

Keywords: Chocolate, cinnamon, glycemic index, α-glucosidase

TS4-9

Chemical modification and characterization of jackfruit seed starch using organic and inorganic acid

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Jackfruit (*Artocarpus hetrophyllus*) that belongs to family *Moraceae* is one of the most underutilized tropical fruits grown in Asian countries, Brazil, Indonesia, India, Malaysia, Philippines and Thailand. It is composed of edible bulbs flesh (yellow to golden), rind, and seeds. The main edible part of this fruits is the pulp; while the seeds contain 8 to15% of total fruit weight. Jackfruit seed is a rich source of starch. Starch extracted from jackfruit seed through distilled water method have some restrictions to use in various food preparations. So modification of starch was done to make it more useful and results showed that the modification of starch showed in improvement in functional properties of starches. Modification of starch was done by acid hydrolysis using organic (HCl) and inorganic acid (Malic acid), at different concentrations viz. o.1 M HCl, 0.2 M HCl, 0.3M HCl and 0.5 M Malic acid, 1.0 M Malic acid, 1.5 M Malic acid, respectively. Modification improves the swelling and solubility as compared to native one. The Jackfruit starch had 28.46% amylose content (db), which initially decreased and then increased with the severity of treatment. FTIR spectra revealed slight changes in bond stretching and bending. Modified jackfruit seed starch can have applications in the food industry.

Keywords: Jackfruit, modification, chemical, swelling, amylose, FTIR spectra.

Technical Session-5
Food Microbiology and Bioprocessing

TS5-1

Kinetics of enzymatic hydrolysis of Guar gum

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Enzymatic hydrolysis of guar gum was studied with two enzymes i.e α-galactosidase and β-mannanase. The levels of the significant parameters (pH, time of hydrolysis, and concentration of enzyme) and the interaction between variables which influences the intrinsic viscosity were analyzed and optimized by Central-Composite design of response surface methodology. The chemical composition of the gum was not altered by enzymatic hydrolysis. The M:G ratio of control guar gum was found to be 1.6:1. Flow behavior index of native guar gum, optimized hydrolyzed guar gum, were 0.27, and 1.76. Molecular weight of guar gum and hydrolyzed guar gum were 4.07 x 10^6 and 1.7 x 10^3 daltons determined by gel permeation chromatography. However marked decrease in molecular weight which is also reflected by very low viscosity of hydrolyzed guar gum compared to native guar gum. The hydrolyzed guar gum has immense commercial application as soluble fiber.

Keyword: Guar gum, enzymatic hydrolysis, Kinetics.

TS5-2

Effect of various substrates on production of cellulase by fungal species isolated from rice beer cake

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Cellulose being the most abundant polymer generated on earth, its conversion to value added products is currently a major area of research. Agricultural remnants, peel and seed of fruits and vegetables, fallen leaves and wood from trees, etc. discarded as waste are basically cellulose and fungal hydrolysis of this renewable waste can provide an economical solution for its utilization. Rice beer cake acting as starter culture in traditional rice beer fermentation is prepared using numerous plant parts consisting largely of cellulose, which are hydrolyzed during fermentation by cellulolytic organisms present within the cake, hence selected as a source of cellulose degrading fungi. The present study was undertaken using fungi isolated from traditional rice beer cakes, bought from the weekly market nearby Tezpur, Assam, by culturing on Potato Dextrose Agar media plates. The isolated fungi were screened for cellulolytic activity by various methods including cellulose degradation test, congo-red test, filter paper assay, etc. All the fungi isolated from the sample was found to utilize cellulose (CMC) as substrate and the fungi with the best cellulose utilization was selected for studying its capability to hydrolyze various cellulose substrates. The substrates chosen for experimentation included: orange peel, cauliflower stalk, corn cob, sugarcane bagasse, rice straw and rice husk. Fermentation was carried out by solid state fermentation (SSF) under pre-optimized conditions using the various substrates. The CMCase activity on various substrates ranged from 0.002 U/ml to 0.35 U/ml with the highest activity obtained for orange peel. Simultaneously the filter paper activity ranged between 0.08 FPU and 0.36 FPU with corn cob producing the highest activity. From the study it can be concluded that orange peel can be used to produce cellulase with sufficient activity. Besides, cellulase produced from cauliflower stalk, corn cob and sugarcane bagasse also possessed considerable activity and can be used with improvements.

Keywords: Fungi, Rice beer cake, Cellulose, Cellulase, Enzyme activity, Solid-state fermentation.

TS5-3

Effects of alkaline fermentation time on anti-nutrients, structural interactions and bioactive profile of locust bean (*Parkia biglobosa*)

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Present investigation aimed at evaluating the impact of different fermentation times (0, 24, 48 and 72 h) on compositional parameters, antinutritional factors, structural & molecular attributes and functional properties of locust bean seeds. Fermentation time linearly reduced ($p<0.05$) the antinutritional compounds as phytic acid (12.59 to 5.16 mg/g), saponin content (6.87 to 1.92 mg/g) and tannin content (2.86 to 1.03 mg tannic acid/g) predominantly due to high hydrolytic activity as revealed by scanning electron micrographs. Fourier transform infrared spectroscopy and X-ray diffraction studies further revealed some significant changes in structural and molecular interactions which could be attributed to gelatinization of starch during hydrothermal treatment prior to fermentation in addition to microbial activity during bioprocessing. Amylolytic and proteolytic activity enhanced the *in-vitro* starch (5.29 to 24.82 g/100g) and protein digestibility (66.47 to 74.29 g/100g). Significant changes ($p<0.05$) were also noted in functional components including water and oil absorption capacity, water solubility and emulsification properties. Further, weakening of gels was also observed as a consequence of fermentation ascribing to lower water retention power due to enzymatic breakdown of starch molecules. Data were statistically exposed to Pearson's correlation and principal component analyses which strengthened the outcomes to validate the differences among variables and observations.

Keywords: Fermentation; locust beans; XRD; FTIR; antioxidant activity

TS5-4

Microwave processing technology and stabilization of Dry Army Ration (Bengal gram flour, semolina, and Green gram) commodities

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Defence Forces are among largest institutional consumers of various dry grains and their milled products. As they operate in far flung treacherous terrains and the geo-climatic conditions, face challenge with respect to safe storage of these commodities especially during hot humid conditions favorable to most of the pest insects. These infestations impact the quality and may affect the consumable quantity available in the supply chain of rations. Chemical based disinfestation practices being discouraged globally being hazardous to operator, consumer, and to the ecosystem. Therefore a method for disinfestation and stabilization using microwave treatment was standardized with respect to whole and milled legumes.

The process parameters were standardized with respect to tempering for moisture equilibrium to absorb adequate microwave energy (KW), treatment time (sec), sample size (kg) and quality parameters along with storage stability for microbial and chemical (oxidative and hydrolytic) were studied such as PV, FFA, Carotenoids (%), Browning index, Degree of gelatinization, uric acid etc.

It was observed that the optimum tempering and microwave treatment of Bengal gram flour (BGF), semolina and Green gram grains (GGG) were 15.0%, MW (900w); 150s, 21.0%; 150s and 14%; 50s respectively. These set of treatments were effective in stabilizing the ration items as attained >99.00% pest lethality including dormant stages and has retained the nutritional and functional properties (amylose, % gelatinization, browning etc.) affecting acceptability of the products.

Keywords: Microwave treatment, Stabilization, Browning, Infestation, Gelatinization

TS5-5

Utilization of Corn Silk to inhibit activity of *Aspergillus flavus* in cereals and cereal products.

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Corn silk is considered as waste of corn crop, though it is waste but have several medicinal benefits such as it reduces hyperglycemia, treats urinary diseases. Also corn silk acts as an antioxidant. But main aim behind of this research is to utilize corn silk volatile extract to inhibit the growth of *Aspergillus flavus* which mainly spoils cereals and cereal products.

Volatiles present in corn silk inhibit the growth of *A. flavus* indicating that it has an antifungal activity. Volatile extract from corn silk contained high levels of α- terpineol and citronellol which is a terpenoid class. Corn silk extract may work as a natural preservative and help to resist certain fungal infections such as *Fusarium graminearum* and *Aspergillus flavus.*

Keywords: hyperglycemia, volatiles, antifungal activity, terpenoid class, fungal infections, natural preservative

TS5-6

Rheological study of curd prepared by plant rennet isolates of *Cucurbita* and *Artocarpus* seeds: Initials towards vegetarian cheese

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Proteases (EC.3.4.11-23) are one of the major classes of hydrolases that is majorly present in animals as well as plants. Rennet is the major animal peptide used in the dairy industry and extracted from the fourth stomach of newborn suckling animals. Chymosin (EC.3.4.23.4) and pepsin (EC.3.4.23.1) are primarily used in the dairy industry for milk coagulation as it cleaves the Phe105-Met106 bond of para kappa casein. In the current research, plant rennet was extracted from *Cucurbita moschata* and *Artocarpus heterophyllus* seed at optimized conditions, and milk clotting activity was optimized and reported maximum at 45° and 50° temperature respectively. Rennet clotting time (RCT profile) revealed that *Artocarpus* extract clot initiates curd formation 4 times earlier than the *Cucurbita* extracts. Sweep analysis of vegetable rennet-derived pasteurized cow milk curd was performed on constant amplitude and frequency. Amplitude sweep in strain range 100-0.1% in decreasing order at 10rad/sec frequency was analyzed and *Cucurbita* derived curd shows stability up to 40% while *Artocarpus* extract derived curd was stable only up to 6% strain. Frequency sweep in a frequency range of 0.1-100 at 0.1rad/sec revealed the viscosity decrease from 10^4 to 10. Storage (G`) and loss (G``) modulus profiles along with the RCT and sweep analysis results of both the curd were comparable with the commercially available chymosin and *Cucurbita* extract can be used as a potential chymosin alternate in the dairy industry.

Keywords: Plant rennet, vegetable resources, milk coagulation, rheology, sweep analysis, dairy industry.

TS5-7

Studies on effect of Lactic acid fermentation on quality of rancid ghee

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Ghee is a traditional dairy product exclusively obtained from milk, cream or butter from various animal species. India is the world's largest producer of milk with 22% share of global milk production. Ghee is the most popular milk product widely used in Indian cuisine. India has rank first in ghee production with production of 3.8 million MT.Ghee is mainly used as frying media and as food additive toimpart pleasant taste and smell to the product.Ghee is produced by both organized and unorganized sector in the country. In an unorganised sector, ghee is mainly produced by churning of curd in the rural villages of the country. In the churning process of curd, Indian butter milk is left as a waste material and it possesses around 1% of fat. This Indian butter milk is to be dried and converted into powder form. But due to presence of higher amount of fat in the powder, it adversely affects their utility. So, to make it more useful, the fat is extracted from the powder. But the extracted fat (ghee) quality is very poor as it is highly rancid and not utilized for human consumption. So, the purpose of this study is to improve the quality of rancid ghee by lactic acid fermentation. The results revealed that lactic acid fermentation not only to reduce the level of free fatty acids (FFA) but also drastically improve the flavour and colour quality of ghee. The overall reduction of 52% was observed in the FFA content of ghee fermented for the period of 36 hr. The resulted ghee sample has good organoleptic quality and highly acceptable by the sensory panellists.

Keywords: Ghee, Rancidity, Colour, Free Fatty Acid

Technical Session-6
Food Packaging

TS6-1

Necessity of innovation in sustainable food packaging technology for food security and safety

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Rapid urbanization, climate changes, increasing population and environmental concerns has leaded a great demand for food sustainability, security and safety. Considering pandemic of COVID 19, where people are challenged for good health, food security and safety, having proper diet is one of the important factor to be considered to solve the human health issues. As immune system itself fight against many diseases. Therefore having proper and healthy diet play a vital role to improve immune system and make stronger to combat with the disease. The main reason for food wastage, spoilage and environmental pollution through food is absence of modern food storage and distribution system. Various initiatives have been undertaken to solve these problems. Among these, improvising methods of food packing is one of the best solutions which would reduce food wastage, spoilage, nutrient losses and also environmental pollution. Therefore there is need to develop a innovation practices in food packaging technology which aims to provide sustainable packaging approach in food system to fix food security, safety, nutrition and environmental issues.

Keywords: Food Safety; Food Security; Environment; Sustainable; Food Packaging.

TS6-2

Fabrication of nanodisc shaped silk dispersed chitosan based nanocomposite for targeted edible coating application: Analysis of structure-property-performance relationships

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The work addresses a unique formulation of silk nanodisc (SND) dispersed chitosan (CS) based edible nanocoating with superior thermal, optical, surface hydrophobicity, mechanical, and food properties. The developed SND (~193 °C) offers a significant improvement in thermal stability compared to silk fibroin (~68 °C) for 5 wt% loss under the identical conditions and further delivers improved crystallinity of ~95%. Additionally, SND dispersed CS edible nanocoatings offer a significant improvement in thermal properties by 9 °C. The surface wettability of SND dispersed CS biocomposite offers improved surface hydrophobicity by ~10° to be used as proper edible coatings for fruit products. The improved tensile strength for CS/SND biocomposite is beneficial to protect perishable fruit products against mechanical damages. Additionally, the addition of chitosan and silk nanodisc materials can provide antimicrobial properties which is beneficial for reduced microbial growth on food products during storage life. It is noteworthy to mention that SND dispersed CS edible coatings provide the improved texture of banana fruits compared to uncoated banana fruits at 25 °C. Further, to date, no study has been done utilizing SND obtained from waste muga cocoons *via* degumming and acid hydrolysis process as a component in developing edible nanocoating on food products.

Keywords: Silk nanodisc; chitosan; edible coating; Morphology; banana; shelf life

TS6-3

Preparation and characterization of corn starch-chitosan incorporated with different ratio of grapefruit seed extract bionanocomposite films for food packaging

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This current study deals with the preparation and characterization of corn starch (CS) incorporated with chitosan (CH) – nanoclay and the effect of the different ratio of grapefruit seed extract (GFSE) bionanocomposite films were evaluated. Experimental results exhibited that addition of GFSE was properly dispersed with corn starch incorporated with chitosan (CH) bionanocomposite films. The presence of GFSE from 0 to 1.5% v/v exhibits increases crystallinity and tensile strength while lower in elongation at break, film solubility and water vapor permeability. Furthermore, an addition of 2% v/v GFSE results revealed in decreasing its physical properties of the bionanocomposite film. Synthetic plastic exhibited the proliferation of fungal growth in 6 days whereas CS/CH/1.5% v/v GFSE bionanocomposite film exhibited the same for at least 20 days when bread samples were packed. CS/CH/GFSE nanoclay film could potentially be useful for active food packaging in extend the shelf life maintain its quality and safety of food products.

Keywords: Bionanocomposite films, Grapefruit seed extract, Functional properties, Anti-fungal activity, Active packaging

TS6-4

Cellulose nanocrystal- Sodium Alginate Pickering Emulsion based Edible Coating for Fruits and its Effect on Storability of Guava

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Nanometric biomaterials possess significant potential to impart functional properties and act as active ingredients in edible coating formulations to increase the shelf life of fruits and vegetables, thereby reducing their spoilage and post- harvest losses. In the present study, sodium alginate- oleic acid composite coatings with cellulose nanocrystal as pickering emulsion has been formulated as a novel edible coating. The developed coating was further casted as films and various properties such thickness, opacity, water vapor permeability, creaming index and particle size were evaluated. The particle size and WVP were found to be 418 nm and 1.64×10^{-10} g m/s m^2 Pa, whereas the emulsion remained stable without phase separation for more than 4 months. Further, whole guavas coated with the formulation were stored under ambient condition (25°C) for two weeks and evaluated for weight loss, color, firmness, titrable acidity, and antioxidant activity. The overall color change was significantly lower in coated fruits than the uncoated ones. Further, the fruits coated with CNC were firmer with less ripening as observed from their lower titrable acidity and color as compared to the uncoated fruits by the end of one week storage period. Weight loss and shrinkage were found to be less in nanoemulsion coated fruits indicating good moisture and gas barrier properties of the composite coating. The shelf life of fruits increased from 6 days in uncoated fruits to 13 days in coated ones. Further, being 100% water soluble, the coating can be washed off with water before consumption, thus omitting the fear of causing any health risk upon consumption as the case of wax based coatings. The developed nanoemulsion coating can further be used for enhancing shelf life of other fruits like banana, mango, pears, apples etc.

Keywords: Cellulose nanocrystal, sodium alginate, oleic acid, guava, edible coating

TS6-5

Bionanocomposites for food packaging applications

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Biodegradable polymers have been considered as a potential eco-friendly alternative to non-biodegradable and non-renewable synthetic packaging materials. But in reality, they only replace about 1% of the synthetic polymers. Poor thermo-mechanical performance, limited flexibility, high moisture sensitivity coupled with the poor processability of biopolymers restricts their commercial use as a packaging material. The property-performance gap between emerging biodegradable polymers such as starch, polylactic acid (PLA), polyvinyl alcohol (PVA), polyglycolic acid (PGA), polyhydroxy alkanoates (PHA), etc. and conventional synthetic polymers such as polyethylene, polypropylene, can be bridged by the development of biocomposites using a polymer blending technique. Polymer blending has been proven as a cost-effective technological solution to prepare biocomposites with desirable properties. Although combining biopolymers help to improve their performance, the composite films yield low dimensional stability and high moisture sensitivity on account of abundant hydroxyl groups. The limitations of biocomposites can be overcome by reinforcing them with nano-fillers. Several inorganic nano-fillers such as nano clays, nano silver, nano-silicon dioxide, nano titanium dioxide, nano zinc oxide, nano graphene, nano silica etc. have been attempted as reinforcements to form biocomposite films with new functionalities. However, the growing environmental concern leads to a search for green and sustainable alternatives to inorganic fillers. In this context, the nanomaterials extracted from natural plants are gaining increased recent attention as potential nanofillers for biobased packaging materials. Nanocellulose, a novel nanomaterial extracted from natural cellulosic fibres, is an emerging green nano-reinforcement for biopolymers. Besides reinforcements, another recent application of nanomaterials is active packaging. Nanomaterials are widely being attempted to impart antimicrobial, antioxidants, oxygen and ethylene scavenging and bio-sensing properties to the food packaging. The development of bionanocomposites appeared to be a promising approach for designing packaging materials with a wide array of functionality. These eco-friendly nanocomposites will help to mitigate the biggest challenge of waste-disposal being faced by the packaging industry.

TS6-6

Development of active packaging system and real time IoT based quality monitoring device for tomatoes

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The present study combined effect of ethylene absorbent ($KMnO_4$ + activated charcoal) and modified atmosphere packaging (MAP) as active packaging method on the quality characteristics of tomatoes were evaluated during the storage. Ripen tomatoes (stage 5) were packed in the PS trays and exposed to different treatment conditions (i) control sample (ii) storing with MAP at different gas compositions without ethylene absorbent iii) storing with MAP at different gas compositions with ethylene absorbent such as T_1 (4 % O_2 and 5% CO_2), T_2 (8 % O_2 and 5% CO_2) and T_3 (12% O_2 and 5% CO_2) remaining is N_2%. All the tomato samples were stored at 15℃ and 90% RH and the shelf life of samples were evaluated for 7 days storage period. It is observed that the pH and TSS are important in determining the consumer acceptability, the values increased from 3.6 $\pm$ 0.01 (UR) to 4.2 $\pm$ 0.02 (R) and 3.7$\pm$ 0.02 (UN) to 5.1 $\pm$ 0.03 (R) respectively. Results confirmed that active modified atmosphere packaging have significant effects on weight loss, pH, TSS, water activity, textural property, colour and chemical spoilage of tomatoes. The developed IoT based monitoring device comprising different set of sensors like DHT11, ME3-ETO, MEMS, Buzzer and GPS module, Arduino module and Wi-Fi module. The utilization of these sensors gathers the data such as temperature, humidity, ethylene concentration, location and shocks by vibration during handling, transportation and storage. The stored data support in monitoring the quality of tomatoes in the supply chain market.

Keywords: Active packaging, tomato, quality, IoT monitoring device, supply chain, storage

TS6-7

Plant extract mediated green synthesis of zinc oxide nanoparticles as a food packaging additive

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Inorganic nanoparticles (NPs) such as zinc oxide (ZnO) NPs have several desirable characteristics which make them suitable for different applications in the food industry. In this work, ZnO NPs were synthesized using phenolics – rich leaf extract of *Ficus auriculata*. The successful synthesis was confirmed using X – ray diffraction, UV – Vis Spectroscopy, and Energy – dispersive X – ray spectroscopy. The functional groups present on the synthesized NPs were analyzed using Fourier transform infrared spectroscopy. The size and morphology of the NPs were observed using field emission scanning electron microscopy and field emission transmission electron microscopy. The UV – blocking ability of the ZnO NPs for food packaging application was investigated.

Results of the current study show that ZnO NPs can be successfully synthesized using green synthesis route and applied in food packaging applications. The findings of the present study will be instrumental to the researchers working in the area of green synthesis of nanomaterials and their applications in food and allied industries.

Keywords: Zinc oxide nanoparticles; Ficus auriculata; Green synthesis; Food packaging

TS6-8

Storage study of Vacuum dried onion Powder using Different Packaging Materials

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Onion (*Allium cepa*), the most common bulb of tropical origin is a potential vegetable having numerous health benefits. It is mostly responsible for imparting pungency and delicious taste to most of the Indian culinary preparations. Onion serves several medicinal purposes by preventing cataract, cardiovascular disease and cancer due to its hypercholesterolemia, thrombolytic and antioxidant effects. The objective of this research is to study the changes in the physicochemical characteristics of vacuum dried onion powder and to estimate the shelf life using a mathematical model at 3 different storage temperatures (25°C, 35°C, 45°C), respectively using two packaging films Polypropylene (PP) and Low Density Polyethylene (LDPE for 49 days of storage. The moisture content and water activity shows a linear increase among onion samples. The energy constant and monolayer moisture content of adsorbed water and heat of sorption was computed using BET equation. The energy constant was227.39 Cal/g-mol was highest in onion samples stored in polypropylene at 45°C and the monolayer moisture content of onion sample in polypropylene was 5.1g / 100g sample when stored at 25°C. The heat of sorption of onion samples stored in PP at 25°C was 4911.75 (ΔHs), kJ/mol and is highest among all other samples. Shelf life for both packaging was estimated and was found that at 25 °C the onion powder have shelf life of 234 days in polypropylene packaging as compared to 189 days in LDPE material and thus it is concluded that Polypropylene packaging is better than Low Density Polyethylene packaging for longer shelf life of Onion.

Keywords: Vacuum dried onion powder, Moisture sorption isotherms, BET model, Monolayer moisture content, Shelf life

TS6-9

Effect of Perforations on Quality Characteristics and Shelf Life of Cucumber under Modified Atmosphere Packaging (MAP)

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The purpose of the present study was to prolonging the shelf life of cucumber under modified atmosphere packaging (MAP). Hence, the effects of different perforations on the quality parameter of cucumber at 10±1°C and Ambient temperature (22-26°C) with relative humidity (RH) 85-90% and 62-66.5%. Physiologically loss in weight was approximately 1 % in MAP up to 27 days of storage period while in case of ambient condition the unpacked sample's weight loss was 14.38% after 6 days. Minimum weight loss was found in non-perforated LDPE film sample (0.94%) proceeded by LDPE film with 3 perforation (1.02) and 6 perforation (1.08), respectively. There was no statistically difference in weight loss with different perforations. Colour change was measured by Hunter L, a and b values at three different points on the surface of sample and then the mean value was obtained. The highest colour change was found in sample with 6 perforations followed by 3 perforation and non perforated LDPE film. Firmness and sensory was good at 10±1°C temperature up to 27 days whereas firmness loss was highest at ambient storage up to 6 days. The study revealed that best quality of cucumber could be maintained up to 27 days under MAP condition with non perforated LDPE film at 10±1°C temperature and 85-90 % RH.

Keywords: Cucumber; Modified Atmosphere Packaging; Shelf-Life; Perforations

TS6-10

Significance of polyhydroxybutyrate based biocomposites in food packaging

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Food packaging plays a vital role in the preservation cum logistic of food materials. Suitable packaging material is required for the protection from protein in biological contaminants. Here, it is discussed about the role of polyhydroxybutyrate for stable mechanical properties for its applications in food packaging. Poly (3-hydroxybutyrate) is a biodegradable biopolymer with relatively low oxygen permeability, making it suitable for packaging application. However, inherent disadvantages of naïve polyhydroxybutyrate such as low mechanical and thermal stability, contribute to a shorter lifetime than conventional food packaging and so limit their use for food packaging. The instable thermal and mechanical properties of polyhydroxybutyrate can be improvised with copolymerization with other synthetic and biopolymer materials. The incorporation of various bioactive compounds to the biocomposites for enhanced stability and protection has been discussed further. Hence, considering the potentials of polyhydroxybutyrate, they may be used as better alternative for various non-biodegradable materials for food packaging applications.

Keywords: Food packaging, biopolymer, polyhydroxybutyrate, biocomposites, biodegradable

TS6-11

Achieving Sustainable Solution in Food supply chain via Technological Intervention

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In the food supply chain, food product follows a path, which starts with production and continues through processing, packaging, transportation, and distribution, before reaching to the consumer. To achieve safer product, safety needs to be addressed throughout the supply chain, right from the farmer to the consumer. Ensuring food quality and safety is crucial to provide adequate protection for consumers and to facilitate trade. These goals can be achieved by implementing and monitoring quality and safety assurance measures along the entire food supply chain. Everyone involved in the chain, shares in the responsibilities by taking the necessary precautions to keep food protected from hazards that can increase human health risks. These actions will also prevent or reduce food losses, which is especially important in those situations where food security is threatened. Food safety assurance involves a series of approaches all along the food supply chain which include GMP, GHP, and HACCP. Besides food safety systems food legislations are also there to ensure the food quality and safety at various levels. In addition to these, various technological approaches have been developed in recent years which can be incorporated in order to ensure the food safety in the whole supply chain. This paper gives an idea about the technological interventions which can assure food quality and safety and can be a sustainable solution in the food supply chain.

Key words: Food Supply chain, Food quality, Food Safety, Technological interventions.

Technical Session-7
Food Packaging

TS7-1

Novel Active Antioxidant Films Based on Biopolymer with Coconut Shell Extract and Sepiolite Clay to Control the Oxidative Stability of Lipid-Based Food

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An active antioxidant film was fabricated by using polyvinyl alcohol (PVA) and corn starch (ST) and incorporated with and 3, 5, 10, and 20% (v/v) coconut shell extract (CSE) and sepiolite clay (SP) for the first time. The microstructure and physical properties of prepared films were characterized and examined. The addition of sepiolite clay to PVA improved the elongation break 15.57 to 69.24 %, and water vapor permeability increased with the addition of CSE. In addition to CSE to films, the antioxidant activity properties of the films were enhanced up to 80%. Further, increasing the amount of CSE slightly affected the color of the active films. The thermal properties of films were enhanced with the addition of CSE and SP. The dispersion of SP in the PVA matrix was affected by an increase in CSE concentration in the PVA matrix. Remarkably, PVA-ST film-based sachets successfully improved the oxidative stability of packaged soybean oil. Our results suggest PVA-ST film containing CSE and sepiolite clay can be utilized as a novel antioxidant packaging material in the food processing industry.

Keywords: Coconut shell; PVA; Starch; Antioxidant film; Active packaging; Edible oil Preservation

TS7-2

Polysaccharide based composite film as an alternative of packaging material

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Biopolymers are found in nature and most of the biopolymers are produced during life cycle of plants, animals, bacteria, and fungi. Development of environment-friendly bio-based polymeric material is an area of emerging interest to the replacement of conventional petroleum-based polymeric material. Since petroleum-based polymer materials are non-biodegradable, environmental pollution is the major issue we face in the technological world. Biopolymers have been exploited due to their biodegradability and environment friendly material. However, most of them are moisture sensitive and poor mechanical property [1]. Among the biopolymers, polysaccharide such as guar gum and chitosan are important biopolymer that has a property to the formation of polymer film [2]. The objective of the present work was carried out in the formation of the polysaccharide-based biopolymer composite film by the casting method. We successfully fabricated Guar Gum- Chitosan composite film cross-link with NaOH (GG-CH-C). The film was characterized with the help of UV–visible spectroscopy, Fourier Transformed Infra-Red spectroscopy (FTIR), Mechanical properties, Thermogravimetric Analysis (TGA) and contact angle analysis. Atomic force microscope (AFM), and Scanning Electron Microscope (SEM), were used to investigate the surface morphology of the film. The film was also investigated for their water uptake test, water-solubility properties, and water vapour permeability. The GG-CH-C film shows high mechanical strength (39.5 MPa), stability in water, and the film was thermally stable up to 250 ^{0}C. The contact angle of the GG-CH-C composite film was found 92^{O} i.e., the film was hydrophobic in nature.

Keywords: Biopolymer, biodegradable, composite film, cross-link.

TS7-3

Study the effect of mustard, soybean and flaxseed meal blends on the properties of biopolymers

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Oilseed production is one of the major industrial crops for the production of oil all over the world. After the extraction of oils from oilseed substantial amount of de-oiled meals is produced; it is used as poultry feed and mostly considered as waste. Oilseed meals have found in abundance, biodegradable, inexpensive and have good amount of protein as base for the development of biopolymers. Oilseed meals-based biopolymers can be seen as a good alternative in replacing petroleum-based plastics. Defatted Mustard, soybean and flaxseed meals were utilized for developing biopolymer. These defatted oilseed meals were blended in different ratios (100:0:0, 0:0:100, 0:0:100, 50:25:25, 25:50:25, 25:25:50, 50:50:0, 50:0:50, 0:50:50). Glycerol and soy lecithin were added in oilseed meal based suspension and biopolymers were casted. The developed biopolymers were evaluated for their thickness, color, moisture content, solubility and swelling property, water vapor permeability etc. The effects of meal ratios on properties were studied. Film thickness ranged from 0.09-0.30 mm, moisture content of biopolymers varied between 7.06-11.30 %. The biopolymers were seen highly affected by the percentage of flaxseed meal used in the development of films. The solubility of film as well as swelling property increased in the biopolymer blends with high amount of flaxseed meals and decreased in absence of flaxseed meal. The biopolymer with higher amount of flaxseed meals were darkest in colour in comparison to other blended biopolymers. The biopolymers with high percentage of soybean gave the overall best results.

Keywords: Oilseed meals, biowaste, blended biopolymers, moisture barrier properties, mechanical properties, colour analysis

TS7-4

Antimicrobial activity of cinnamon and ginger extract and Physico-chemical changes in cinnamon dipped fresh-cut pineapple during storage

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As consumers' preferences shifted from chemical preservatives to natural-based products, naturally available spices such as cinnamon and ginger can be a good alternative. In addition, they can improve the quality and enhance the shelf-life of fresh-cut fruits due to their rich antioxidant and antimicrobial activity.

The objective of this study is to evaluate the antimicrobial activity of cinnamon, ginger and combined cinnamon and ginger against *Bacillus cerius*, *Listeria monocytogenes*, *Staphylococcus aureus*, *Escherichia coli*, *Salmonella*, *Pseudomonas aeruginosa*, *Klebsiella pneumonia*, *Yersinia pestis* and *Candida albican*, followed by determination of physicochemical changes in fresh-cut pineapple dipped in the best extract.

Antimicrobial activity of cinnamon, ginger, and combined extract (100mg/mL each), was evaluated for their antimicrobial properties against the selected microorganisms by the agar well diffusion method. It was observed that cinnamon showed higher zone of inhibition against the microorganisms than ginger and combined extract. Therefore, fresh-cut pineapples were dipped in cinnamon extract solution for 2 min and stored for 10 days at 4±1 ˚C. The total phenolic content and antioxidant activity of cinnamon-dipped fresh-cut pineapple increased significantly ($P < 0.05$) by 46.98 and 50.6%, respectively. In comparison, vitamin C was retained by 68.21 % at the end of the storage compared to the untreated sample. Weight loss was observed throughout the storage. Water activity and firmness decreased at the end of the storage while total soluble solid increased. Change in colour was observed only from day 6.

Keywords: Cinnamon, ginger, microorganisms, zone of inhibition, and fresh-cut pineapple

TS7-5

Antiviral food packaging: An emerging and sustainable approach for improving food safety and quality

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In recent years, food packaging has emerged as a promising technology in protection and preservation of the quality of the food product leading to improved sustainable food value chains and limited food waste. Antimicrobial food packaging has been found to be efficient in improving the shelf life, safety and quality of food products due to its ability to inhibit microbial growth and spoilage. Natural bioactive compounds available in plant extracts exhibited a great extent of antimicrobial activities by destruction of microbial cell wall structure and therefore are widely used in the antimicrobial food packaging formulation.

Among various food borne outbreaks, nearly 15% are related with viruses as the causative agents. Although extensive research is on the development of antibacterial and antifungal food packaging, there is still a dearth in antiviral food packaging system. This deficiency may be possibly due to both living and non-living characteristic of viruses; non-compatibility of antiviral compounds with polymeric structure; or the quick release and early degradation of antiviral agents.

One of the promising ways to develop sustainable antiviral packaging is to identify various natural antiviral agents and incorporation of these antiviral compounds into the packaging matrix. The controlled release of these antivirals can be achieved by a combination of emerging techniques like immobilization, by encapsulation and nanotechnology. This research on development of antiviral food packaging can be implemented for the safety and the quality of the food products and provide a better future to deal with the viral pandemic like COVID-19.

Keywords: Antiviral agent, Bioactive compounds, Food packaging, Food processing, Food safety,

TS7-6

Packing Alternatives for a Sustainable Future

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The purpose of this study is to examine the alternatives available to replace the usage of plastic-based packaging materials in food and beverage products. The current market, which is dominated by passive packaging, which is largely plastics that are non-compostable and non-biodegradable, poses the greatest damage to the environment. Plastic is a petroleum-based commodity that poses a concern to the environment because it is non-biodegradable. There is a great need for a novel-green plastic substitute, and the entire scientific community is hunting for an innovation that can replace the passive technique while also replenishing the environment. Some innovative materials are now being researched and are vying for the top spot in the race for green packaging solutions. Various sustainable packaging materials shall be examined utilising specific criteria in this paper. With this analysis, the viability of each of the alternatives presented will be assessed. The factors to be considered in this paper when examining the packaging materials are Raw material Sourcing, Manufacturing method, Physico-chemical qualities, Product economics, Applications, and Similarity index. Based on these variables, it will be clear as to which packaging material is more likely to find its place in a greener future.

Keywords: Green- Novel Alternative, Raw Material Sourcing, Manufacturing method, Physico-chemical properties, Product Economics, and Similarity index

TS7-7

Effect of native and hydrothermally modified potato starches on properties of developed starch films

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Use of biopolymers as a sustainable packaging system reinforced through various techniques forms an eco-friendly alternative to petrochemical-based plastics in extending the shelf-life and quality of food materials. Among the biopolymers, starch has been considered as the most promising candidate for manufacturing biodegradable films mainly due to its abundance and renewability. However, packaging films from native starch lack certain functionalities to withstand the properties to which synthetic polymers are subjected. In this study, hydrothermal modification (annealing and heat-moisture treatment) of potato starch was done to evaluate its effects on properties of the developed films. Potato starch was annealed in excess water at 60°C for 24 h. Starch was also modified under heat–moisture treatment at 110°C after adjusting 20% moisture content for 8 h. Potato starch-based films (native and modified) were prepared by solution casting method (5.0g/100ml) using glycerol (40ml/100g) as a plasticizer and characterized by several physico-chemical techniques evaluating tensile strength, elongation %, color analyses, transparency, opacity, sealing strength, and biodegradation assay. Films prepared from heat-moisture treated starches showed better mechanical properties (7.62 MPa tensile strength, elongation of 11.36%) and highest seal strength 4.06 MPa. The films produced from annealed potato starch showed enhanced elongation (9.36%), lower solubility (17.31%) and WVP (0.65 g mm m^{-2} h^{-1} kPa^{-1}) compared to the native starch films. The potato starch-based films were biodegraded within 15 days. The developed film can be used as a potential packaging material to meet various packaging requirements.

Keywords: potato starch, annealing, heat-moisture treatment, mechanical properties, biodegradable

TS7-8

Performance improvisation of starch based composite film by incorporation of biofillers and antimicrobial agents

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Due to population growth, plastic as well as food wastes are the major environmental issues these days. Bioplastics have been emerged as a solution for reducing the tremendously raising environmental pollution because of its biodegradable and non-toxic nature. The recent innovative methods in bioplastic manufacturing from food waste extracted raw material specifically starch can encourage a sustainable solution to decrease in plastic as well as food waste. But the reason behind the inefficiency of bioplastic in completely replacing the synthetic plastic is its low physicochemical/mechanical properties. It has been reported that incorporation of Eggshell Powder (ESP) as fillers with starch obtained from potato waste has been proven to overcome the sustaining drawbacks in properties of produced bioplastic. The tensile strength (mechanical property), water absorption capacity and biodegradability of potato starch-based bioplastic reinforced with ESP has been reported near to the petroleum based plastics. Also incorporation of essential oil extracted from onion and garlic by distillation as they have significant antimicrobial property. Thus, it is suggested that food waste can be a substrate for the production of bioplastic and ESP can be better biofiller for enhancing the properties of biplastics as well as the addition of essential oils can enhance the antimicrobial property of the film.

Keywords: Biodegradable film, egg shell powder, bioplastic, antimicrobial, fillers

TS7-9

Active & Intelligent Packaging of Cheese: Developments & Future Scope

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Consumer inclination towards safe and healthy food have led to the development of state-of-the-art and unique approaches in food processing and packaging .One such development is the introduction of smart packaging technologies. Food packaging materials have traditionally been chosen to avoid unwanted interactions with the food. Technological advances and changes in consumer preferences for safer food with better shelf life have led to innovations in packaging. Smart packaging systems involves properties of active & intelligent packaging .Cheese is the major dairy product and its market is expanding exponentially .Some of the smart packaging systems pertaining to cheese like antimicrobial packaging, antioxidants releasers and ripening indicator can hasten commercial acceptance and reliability of cheese products .Due to increased consumption of cheese ,these packaging tools have potential marketing growth .The expansion of smart packaging technologies in cheese industry remains at a nascent stage .For research directions, active packaging could also be used for facilitating the reduction of cholesterol and lactose in cheeses using cholesterol reductase and lactase enzymes.

Keywords: Food processing, active packaging, antimicrobial packaging, ripening indicator, antioxidants releasers

TS7-10

Ethylene scavenging active nanocomposite films based on corn starch-gum Arabic with sepiolite clay for fresh produce packaging

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Present study explores the development of ethylene scavenging active food packaging films based on corn starch (CS) gum arabic (GA) nanocomposite incorporated with different sepiolite clay(SP) concentrations (0, 3, 5, 10 and 20% w/w) via the solvent casting method.The effects of sepiolite clay on the prepared films were investigated by the optical, chemical, morphology, mechanical, thermal, crystallinity, barrier properties and ethylene scavenging capacity.The scanning electron microscope photographs showed that SP particles evenly distributed in the CS/GA film matrix.The X–Ray diffraction displayed that crystallinity of in the CS/GA/SP films increased with increasing concentration of SP. The addition of SP improved tensile strength (1.65±0.39 to 3.60±0.27 Mpa) and elongation at break (8.68±1.00 to 11.43±0.33%) and water vapor permeability of the prepared CS/GA/SP films. The thermal stability of the CS/GA/SP films was also improved with the addition of sepiolite clay upto 20%. The films containing SP at the concentration of 20% showed the highest ethylene scavenging activity (13.8 µL/25 cm^2). Results highlight the prospective and capable nature of SP incorporated CS/GA films as possible substitute for active/functional packaging films for ethylene sensitive produce. The active CS/GA/SPfilms showed great potential as environmentally friendly active packaging materials for fresh produce packaging.

Keywords: Ethylene scavenger; sepiolite; Active packaging; Fresh produce; Nanocomposite film

Technical Session-8

Quality, Safety and Hygiene in Food Processing

TS8-1

Protein Isolation from Underutilized Legume *Macrotyloma uniflorum*, and its Fortification

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Macrotyloma uniflorum, commonly referred to as horse gram in India is a highly nutritious but considered as underutilized legume. The legume is rich in protein (21-24%), which finds its application as animal feed due to easy availability and relatively low cost. In this study, freshly harvested, germinated and dried horse gram (var. PHG9) floor was used to extract protein and study the properties of the proteins. Proteins were obtained using alkali extraction and acid precipitation method, under the best extraction conditions. After extraction, protein rich extract was dried in hot air oven at 50 °C. Dried extract was found to contain more than 70% protein with an extraction yield about 15%. In the extract after protein, carbohydrate was found to be the major constituent. XRD and FTIR studies of the horse gram protein extract revealed a similar pattern as that of market available soy protein isolate. Beside this, the protein extract showed increased antioxidant activity, but reduction in total phenolic content, than horse gram before extraction. For application purposes of the horse gram protein extract, it was fortified in cookie dough for the preparation of protein rich cookies. Fortification of the horse gram protein extract resulted increase in cookie protein content, which was obtained by 25% replacement of all purpose floor with horse gram protein extract. Horse gram proteins may find its various other food and non-food applications.

Keywords: Horse gram, legume, protein extraction, characterization, plant protein

TS8-2

Influence of combination treatments (hydrocolloids, freezing and centrifugation) on quality attributes of vacuum fried papaya chips (*Carica papaya* L)

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The objective of present study was to analyze the influence of hydrocolloids and freezing pre-treatments with and without post frying centrifugation on oil uptake and other physico-chemical attributes of vacuum fried papaya chips. Papaya slices (3 mm) were pre-treated with previously optimized concentration of carboxy methyl cellulose, guar gum and gum Arabic i.e., 1.0, 0.5 and 1.5%, respectively and kept for subsequent freezing at -18°C for 24h. A pre-optimized vacuum frying conditions i.e., temperature (100ºC), time (20 min) and pressure (13.33kPa) was used for frying of pre-treated and untreated papaya chips followed by centrifugation at 750 RPM for 2 min before packing and storage. Hydrocolloids pre-treatment with subsequent freezing significantly ($p<0.05$) increased the oil content and reduced lightness as compared to samples pre-treated with hydrocolloids and freezing separately. However, post-frying centrifugation was found highly effective in reducing the final oil content in papaya chips. Among hydrocolloids pre-treatments, 1% CMC in combination with post-frying centrifugation resulted in samples with low oil content (21.81%) and with improved instrumental color and texture characteristics. However, textural properties as well as sensory attributes of samples pre-treated with freezing in combination with post-frying centrifugation were highly accepted by the sensory panelist. Untreated control (CON) samples showed highest retention of ascorbic acid content. However, total phenolics, total flavonoids, total carotenoids and antioxidant activity were found highest in CMC pre-treated samples.

TS8-3

Characterization and Comparison of Lipid Profile in Ghee (heat clarified milk fat) Using NIR Spectroscopy

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Ghee is a dairy product obtained exclusively from milk, cream or butter through processes that almost completely remove water and non-fat solids with a distinct flavour and physical structure. Consumption of Ghee as a food item in Indian peninsular region is enormous. The common adulterant used in this product are vegetable fat (Vanaspati), hydrogenated fats, inter-esterified fats, mineral oils etc. Apart from mixing different fats sometime chemicals are also used for enhancing its flavour and colour. To detect such adulterants various chemical methods exists but such methods are not only time consuming but it also requires various other chemical and special glass wares. The present study proposed NIR spectroscopy to detect such adulterant present in ghee made from cow and buffalo milk collected from different zone of NCR Delhi and Haryana region. NIR spectroscopy is quick, non-destructive and does not require any special chemicals or glassware to detect.

Spectra of cow and buffalo ghee were acquired in the NIR region (10 000 cm^{-}–4000 cm^{-1}), for the purpose of allocating absorption bands to an IR spectrum. In the NIR spectrum, peaks were obtained for both cow and buffalo ghee, with almost equal intensity of absorption. The intensity of absorbance was higher for cow ghee compared to buffalo ghee.

Keywords: ghee, Near Infra-Red Spectroscopy (NIR), adulteration, lipid, milk fat, vegetable fat.

TS8-4

Effect of storage conditions on viability and physicochemical properties of spray dried probiotic powder

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The global demand and consumer's acceptance for probiotic based functional food is increasing tremendously due to various health benefits associated with it. However, probiotics have to withstand a number of harsh conditions during processing, handling and storage. Encapsulation of probiotic with various encapsulating agents have been utilized to protect them from various hazards. Powdered probiotic is easy to handle and store, and can be easily utilized for development of probiotic functional products. In the present study, *Lactobacillus rhamnosus* GG (LGG) cells were encapsulated by spray drying at an inlet temperature of 170° C. The encapsulating agents used were 20% maltodextrin and 2.5% Fructooligosaccharide. The effect of storage conditions on viability (CFU/gm) and physicochemical properties (moisture content, water activity and colour) were examined. The encapsulated probiotic cells have shown a positive effect and exhibited better viability during storage conditions compared to free cells.

Keywords: Probiotic bacteria; Storage study; *Lactobacillus rhamnosus* GG; Maltodextrin; Fructooligosaccharide

TS8-5

Potential use of seaweed to improve quality and safety of poultry meat

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In the global scenario where epidemics occur regularly in livestock and poultry, farmers depend on antibiotics for growth promoting action and to treat various pathogenic diseases in livestock, thus the risk of abuse, even illegal use of antibiotics in livestock is very high which is hindering the quality and safety of poultry products. Use of Seaweed has a tradition of being part of the animal feed in the coastal areas from ancient times, and is considered as a natural source of additives that can substitute the antibiotic usage in various animals. This study highlights the research on seaweed as a valuable and sustainable feed additive for poultry farming system in comparison to melatonin, which is a synthetic antibiotic responsible for metabolism and growth in chicken.

In this research work brown marine algae (Sargassum species) was collected from the south Andaman coast and was processed under two condition viz., shadow and autoclave dried. The samples were then extracted using aqueous and methanolic solvent. Aqueous extract showed antibacterial properties against bacterial isolates (E. coli). It also revealed that the seaweed supplementation enhanced the immune response and the antioxidant content in the chicken. In terms of immunity the aqueous autoclave extract has showed increased antibody titer against GRBC antigens. The yolk from shadow-dried group has colour similar to melatonin but was darker than the autoclaved-dried and the control supplemented group. In conclusion dietary supplement using brown seaweed inclusion can improve the poultry product quality and security and could fulfil the requirement of meeting the essential adequate nutrients for the human health and well-being.

Keyword: Seaweed extract, Poultry quality, Antioxidant, Feed Utilization, Andaman and Nicobar Island, Meat Quality and Safety.

TS8-6

Quality investigation of rice kernels using image processing

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Rice is one of the essential cereal grains consumed by almost half of the world's population. Maintaining the quality of rice seeds is important as it directly impacts human health. India is the second leading country in the production of rice in the world. It is indispensable to secure the property of rice for exportation. This paper presents the non-destructive approach for examining rice grains using image processing. The novel experimental setup made for investigating rice seed is capable of capturing images of sample from different angles. The unique experimental setup is governed by a system on chip device. The algorithm for measuring the length, width, aspect ratio, colour and the presence of foreign seeds in a given rice sample is discussed in this paper. The experimental setup is capable of generating a 3D view of kernel samples under investigation. The rice sample is graded as per DMI, ARSO, Cambodia and Codex standards from the various structural measurement parameters mentioned. The database of result is maintained in the server. The procedure of 3D reconstruction from 2D images and the performance of various open-source 3D generation platforms are also discussed in this paper.

Keywords: rice quality, image processing, standards, grade, structure analysis.

TS8-7

Food quality analysis using photoacoustic spectroscopy

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Quality and hygiene of food items is mainly deteriorated by pathogenic microorganisms like bacteria and fungi, occurrence of human hair strands and mycotoxins. It is possible to keep such causes of food contamination in check using the technique of Photoacoustic Spectroscopy (PAS), in which when the sample is irradiated with non-ionizing laser pulses, there is a rise in the local temperature leading to thermoelastic expansion which further to periodic pressure waves known as photoacoustic waves. This pressure is sensed by photoacoustic signal acquired by detector. The rotational and vibrational motions of organic functional groups such as C - H, O - H, N - H and C – O, when exposed to their exact absorption wavelength forms the basis of this method of detection.

Photoacoustic is a target specific and a zero-background signal technique with high sensitivity and responsivity. Thus, using PAS to eliminate either the deteriorated food items or those with contaminants in industries will prove to be an effective and compact contact-less method in food quality analysis and adulteration check.

We propose the development a sensor system, which can be attached to conveyer belt of food processing units or at quality check points of mega kitchens. Microbial volatile organic compounds (mVOCs) such as alkenes, alcohols, ketones, benzenoids, sulphides, and terpenes, if detected at ppm level with PAS can easily quantify the level of contamination in the foods. Higher concentrations of VOCs may cause irritation of the lungs, as well as damage to the liver, kidney, or nervous system.

Keywords: food mycotoxins, human hair, Microbial volatile organic compounds, laser absorption, photoacoustic spectroscopy

Technical Session-9

Quality, Safety and Hygiene in Food Processing

TS9-1

Comparative studies of microbial and heavy metal safety assessment of the herbs cultivated in hydroponically and regular soil system

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Hydroponics was considered as an effective method to practice sustainable agriculture. However, very few studies were carried out related to the microbial and heavy metal safety assessment of hydroponically grown produce. So the microbial and heavy metal quality of hydroponically grown produce needs to pay attention. The present study's objective was to address microbial and heavy metal safety assessment of basil and coriander grown hydroponically was compared with soil-grown. Such data could be useful while proposing a scientifically validated report for consumers and farmers to reduce foodborne illness and food poisoning risk. The microbial study was carried out in three steps, i.e., primary screening, secondary screening, and MALDI-TOF biotyper based confirmation. Whereas heavy metals were analyzed using ICP-OES. Results from a study of the comparative analysis showed that basil and coriander collected from the hydroponic farm as well as soil farms had no pathogenic bacteria such as *Salmonella* spp. *Escherichia coli*, *Staphylococcus aureus*, *Listeria monocytogenes*, *Shigella* spp., and *Campylobacter*. The basil was not found to contain pathogens, yeasts, and molds. However, the coriander sample collected from soil-grown contained *Enterobacter cloacae*, *Klebsiella pneumoniae*, and *Pseudomonas aeruginosa*. In the case of heavy metal assessment, the hydroponically grown contain no heavy metal content except copper, which is present within the permissible limit. However, soil grown basil and coriander had heavy metal content more than the permissible level. This study can infer that hydroponically grown herbs microbial and heavy metal safety was better than soil grown from the study.

Keywords: Enterobacter cloacae, Klebsiella pneumoniae, Pseudomonas aeruginosa, basil, coriander.

TS9-2

Characterization of Cinnamon Quality Attributes from Different Locations

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Cinnamon is one of the most important spices used in food and pharmaceuticals in all over the world. It is commonly used as an antioxidant, anti-inflammatory, antidiabetic, antimicrobial, anticancer, lipid-lowering, and cardiovascular-disease-lowering compound. In this study the proximate composition and essential oil yield of two varieties of cinnamon procured from two different countries i.e. Vietnam and Srilanka were evaluated. The results revealed that Shrilankan variety cinnamon contained higher amount of ash (4.84%), crude protein (4.72%) and crude fiber (24.96%) as comparison to Vietnamese variety. However, the crude fat content was significantly higher in the Vietnamese cinnamon variety. The yield of essential oil was 1.42 and 1.87% in the Srilankan and Vietnamese cinnamon variety respectively. The total phenolic content (TPC) of the extracts was determined spectrometrically and reported as gallic acid equivalents (GAE). The Vietnamese cinnamon showed significantly higher amount of TPC with respect to Srilankan variety.

Keywords –Cinnamon, proximate composition, essential oil, TPC, Essential oil.

TS8-3

Culinary impact assessment on Millets

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Millets are Nutri-cereals rich in fibre, protein, antioxidants, minerals, vitamins, and gluten-free. Millets and their products are very useful in obesity, diabetes, cardiovascular disease, celiac disease, gluten intolerance, malnutrition etc. Raw, nutritious food helps us get proper nutrition, but the utensils used during cooking and cooking methods also play a significant role. Modern cooking methods like aluminium pressure cooking helps to conserve fuel and energy, but somehow we lack proper nutrition; also, Aluminum is heavy, toxic metal and has leaching properties that depends on various factors like pH, temperature, surface of utensils etc. Aluminium leaching in food can cause Aluminum accumulation in the body (tissues, bone, organs). It may lead to dyfunctioning and cause many diseases like renal failure, Alzheimer's disease, osteomalacia, etc. In current research; Millets were cooked in two different cookwares. More cooking loss was seen in Aluminium pressure cooked millet; 50-97% loss was seen. In Aluminium pressure cooked millet, 60% loss in carbohydrates and, in Handi 55% loss in carbohydrates was seen. Protein loss was more in Aluminum cooked Millets than Handi cooked Millets, i.e. 44.74% loss in Aluminum pressure cooker whereas 29.64% loss of protein Handi cooked millet. Overall, nutrients loss were more in Aluminum pressure cooked millet than Handi cooked Millets. More loss in Aluminum pressure cooked millet may be due to high temperature, High pressure and uneven heating. Less loss was seen in Handi cooked Millets this might be due to porous nature or Handi and even heating.

Keywords: Millets, Cookwares, Aluminium, Handi, Cooking loss

TS8-4

Composition and functional properties of protein isolates obtained from Manila tamarind seed flour

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Manila tamarind (*Pithecellobium dulce*) commonly known as jangle jalebi or Madras thorn, is one of the important legume trees of tropical America and cultivated throughout the plains of India. The seeds are rich in protein, which have potential to combat protein malnutrition. They also possess good medicinal values. The seeds are consumed in raw/roasted/cooked form. Manila tamarind seeds could be a valuable protein source for human food and animal feed which otherwise get wasted as by-product. Present investigation was taken up to evaluate the physico-chemical and functional properties of the Manila tamarind seed flour. *Pithecellobium dulce* pods yielded 8%, dry seed, in which 20% was hull and remaining 80% were cotyledons. Manila tamarind seed flour was prepared by dehulling, drying and powdering. Fat in the seed flour was removed by using petroleum ether (bp 40-60°C). The defatted seed flour was used for the preparation of protein isolate by using alkali method. Protein content in the seed flour was 37.50% whereas protein isolate showed protein content higher than 80%. Bulk density of the seed flour came out to be 0.56g/cc. Total ash content of the seed flour was 2.98% indicating abundance of minerals and its moisture content was 10.62% wet basis. Protein isolate from Manila tamarind seed flour showed high water and oil absorption capacities in comparison with soy protein isolate. Emulsifying activity and emulsion stability of the Manila tamarind seed flour isolate was also high.

Keywords: functional properties, protein isolate, alkali method, emulsifying activity

TS8-5

Influence of black cumin incorporation on the physicochemical characteristics of sesame oil

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Black cumin seeds are known to possess health promoting components and its oil has many medicinal uses. However, this oil has not been exploited at its full potential for food purposes. Taking this into consideration, the present study investigated the influence of premixing black cumin seeds (at 5 to 50 g/100 g incorporation levels) in sesame seeds and their subsequent mechanical co-pressing (without using any heat or chemicals) to obtain different oil blends. The pure oils and their blends at different incorporation levels were examined for the oil yield, colour, peroxide value (PV), acid value (AV), total phenolic content (TPC), antioxidant activity, oxidative stability index (OSI), chlorophyll, and carotenoid content. The results revealed that pure sesame oil had the highest oil yield (40.05%), while pure black cumin oil had the lowest (18.58%). Increasing levels of black cumin incorporation increased the redness (a^*) and blueness (b^*) values, TPC, antioxidant activity, OSI, chlorophyll as well as carotenoid content but decreased the lightness (L^*) values. Moreover, it was noticed that primary oxidation products of black cumin seed incorporated oils initially increased (as reflected by high PV and AV) due to the high amount of polyunsaturated fatty acids that easily get oxidized and lead to the production of these oxidation products. However, OSI of these oils also enhanced with increasing black seed incorporation, owing to the presence of inherent antioxidant components (such as phenolic compounds and carotenoids) which limit their oxidative degradation.

Keywords: Black cumin oil, Sesame oil, Oil yield, Oxidative Stability Index, Antioxidant Activity

TS8-6

Quality evaluation of natural protein enriched value added jaggery

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Jaggery is a traditional sweetener made by concentrating sugarcane juice and palm sap. As it contains all the minerals and vitamins present in sugarcane juice, it is known as the healthiest sugar in the world. Jaggery is a rich source of important minerals, 2.8g/100 grams, whereas only 300mg/kg is obtained from refined sugar.The majority of Indian population, being rural, suffers due to malnutrition. Protein enriched, value addedJaggery can be made available to the masses to mollify the problem of malnutrition.The average person needs about 7 grams of protein daily. Though jaggery is abundant with health benefits but its protein content is very less (0.4/100 g). This study was made with the purpose of value addition of Jaggerywith soybean. The protein content drastically increased in value-added jaggery on incorporation of soybean. Results also showed that an increase in pH took place with the addition of soybean. Reducing sugars in value-added jaggery increased as compared to plain jaggery. After one month of study, bacterial growth was observed in jaggery samples. However, no fungal growth was observed in control and value added jaggery. It was concluded that there was no negative effect of soybean on quality parameters of Jaggery, except an increase in the moisture content.

Keywords: Jaggery, protein, soybean, value addition.

TS8-7

Nanocellulose as unique immobilization matrix for the development of biosensor for fish spoilage monitoring

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Fresh fish consumption is a prime requirement for human health. Fish freshness is indispensable for manufacturing high-grade products by the food industries. During nucleotide decomposition in fish, ATP degradation leads to xanthine formation. Xanthine concentration increases after the death of fish because of bacterial metabolism and is a sign of spoilage. Thus, xanthine level is an indication of fish freshness. Development of a secure, sensitive and reliable detection protocol for xanthine detection is essential in food research. Biosensors show greater sensitivities than laboratory-based tests since they are portable, selective, specific, cost effective and responsive. The choice of a suitable matrix is crucial for the sensitivity of electrochemical biosensors. Xanthine can be oxidized by xanthine oxidase and forms hydrogen peroxide (H_2O_2) which can be monitored electrochemically onto the biosensor electrode surface. Recently nanocellulose hydrogel has received immense attention in bio-applications due to its highly hydrated porous nature with good mechanical properties, high surface area, easy surface fictionalization and biocompatibility. The present study provides the preparation of nanocellulose membrane which can be used as suitable matrix for xanthine biosensor development. Nanocellulose membrane has been prepared using acid-alkali hydrolysis method from raw cotton. The morphology of the prepared membrane has been characterized using scanning electron microscopy (SEM) and FESEM. SEM and FESEM experiments confirm the prepared cellulose fibres are of nanometer range, which will again provide high surface area for xanthine oxidase immobilization and thereby will facilitate high sensitivity of the developed biosensor.

Keywords: Fish Spoilage, Biosensor, Xanthine, Nanocellulose, Scanning electron microscopy.

TS8-8

Development of smartphone-based sensor for monitoring fish spoilage during storage at room temperature

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Fresh fish fillets are one of the most perishable food products which when deteriorated attributes to undesirable chemical reaction resulting to increase the pH value of the fish flesh. The present work introduced a potable, cost effective smartphone-based sensor for monitoring the spoilage of fish fillets during storage at room temperature. An external 3-D printed cradle was constructed that holds the optical components and integrated to the rear camera of the smartphone. To indicate the spoilage of fish fillet, polyaniline label was used that response to basic volatile amines produces during fish spoilage through change in color of the label. The sensing performance of the sensor has been evaluated and the results were used to correlate with the increased in pH value of the fish during storage at room temperature. The polyaniline label showed significant change in color from translucent green to blue within 12 h. The initial pH value of the fresh fish was found to be 6.06 which then increases to 6.84 in 12 h. The built-in CMOS sensor of smartphone camera was used for optical imaging and the spectral were analysed using a free downloadable software. It was then converted into a standard spectrometer reading (0.1987 nm per pixel). The developed smartphone sensing device showed good response and it can be an alternative platform for monitoring volatile gases releases from the samples which can be detected through a sensing probe.

Keywords: Smartphone, CMOS sensor, Polyaniline label, Spoilage, Fish fillet

Technical Session-10

Quality, Safety and Hygiene in Food Processing

TS10-1

Development of spinach based value added jaggery by raising iron content

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Development of Spinach based Value Added Jaggery is being developed with a view to improve nutritional and medicinal quality of jaggery and its palatability. Spinach-based value added Jaggery is expected to have all the nutrients of added spinach besides natural nutrients of jaggery. Jaggery samples were made using sugarcane as a base material and spinach. Different amount of spinach was considered for the study. These amounts were formulated based on taste, flavour, palatability and their suitability with Jaggery. Addition of spinach made Jaggery even more nutritious and gave it a distinct taste, flavor and aroma. In this study, three different spinach Jaggery were made and analyzed (250gm, 500gm, and 1000gm in 5 litre of sugarcane juice respectively). Spinach was added in concentrated sugarcane juice. These Jaggery samples were subjected to physical, chemical, microbial and organoleptic analyses. Addition of spinach showed drastic increase in iron content in spinach based value added jaggery. Results showed that mineral contents substantially increased with addition of spinach as compared to plain jaggery. Results also showed reduction in bacterial count due to anti-bacterial action of spinach. No fungal count was observed in the spinach based value added jaggery. It was concluded that there was no negative impact of spinach on quality parameters, except darker colour of jaggery because of incorporation of spinach in Jaggery.

Keywords: *Jaggery, Spinach, Iron, Value addition, Nutrients*

TS10-2

Effect of Date Sugar and Jaggery on Fat, Protein and SNF of Ice-cream

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Ice-cream is a frozen dairy product prepared by proper blending and aeration of cream with various milk products and also contains sugar, flavor, emulsifier, stabilizers, etc. Generally ice-cream has definite proportion of milk fat (8-10%), protein (3.5%), total solids (35-36%). The development of any products involves interaction of ingredients and many operations are involved in obtaining the final product. In this study the effect of sugar, date sugar and Jaggery on various properties of the ice-cream are evaluated. The sugar is for sweetness but also plays a vital role in melting point and viscous nature of ice-cream. The addition of date sugar in ice-cream showed varied effects as it melted slowly compared to sucrose and a minute variation was found in the sample added with Jaggery. The fat, present in the date sugar, lead to the change in flavor, melting point and palatability. Results also showed a change in the chemical composition and freezing point while the solid content also increased by addition of date sugar and jaggery. The color was darker when jaggery percentage increased. As the fat percentage was increased the taste sensation changed, more creamy and graininess was observed. As date sugar contains vitamins, minerals, antioxidants so the nutritive value also increased. Date sugar sample possess less calories due to the low glycemic index in comparison to sucrose. The shortcoming was that the color of ice-cream was not that good and the date cannot be added with many recipes.

Keywords*: Ice-cream, date sugar, melting point, sucrose, glycemic index.*

TS10-3

Acrylamide quantification in potato-based Indian traditional snack

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Acrylamide in food products, especially in potato-based snacks, is a thermally induced process contaminant which has become a worldwide food safety concern due to its neurotoxicity and potent carcinogenic properties. Processed food products derived from potatoes, cereals, coffee and chocolates are the major sources of acrylamide, wherein fried potato products top the list. Several studies have been conducted on potato-based products such as French fries and potato chips but so far, a very popular Indian traditional product i.e., *aloo tikkis* (similar to that of potato cutlet) has not been explored. The present study was carried out to quantify the acrylamide content in *aloo tikkis* collected from various local vendors in National Capital Region (NCR), by using liquid chromatography coupled with triple quadrupole mass spectrometry (LC-MS/MS) in positive ion multiple monitoring mode (MRM). A total of 30 samples were analyzed. Acrylamide content in *aloo tikkis* ranged from 196 to 763 ppb and 3.33% of samples were higher than the benchmark level (500-750 ppb) set for potato-based products by the European Union Regulation Commission. This thereby indicates the need to reduce the level of acrylamide in *aloo tikkis* as a step to ensure food safety and to reduce the health risk to the public.

Keywords**:** *Acrylamide, Aloo tikkis, Carcinogen, Food safety, Health risk, LC-MS/MS*

TS10-4

Development and quality evaluation of papad prepared from cereals and under-utilized crops

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Papad is savoury, wafer-like flat bread that is roasted or fried until crisp and is commonly prepared with black-gram flour. The impact of buckwheat, foxtail and proso millet flours incorporation (10%, 30% and 50%) on the nutritional, sensory, shelf-life, rheological and textural attributes of papad were studied. Further, papads cooked using tawa, dry-air and infrared roasting were also compared and analysed. The papad prepared with addition of buckwheat and millet flours had higher total dietary fibre, phenolics and antioxidant activity than the control (100% blackgram papad). The highest total phenolics and flavonoids and antioxidant activity was observed for buckwheat papad variants. Addition of foxtail and proso millet flour caused a decrease in storage (G') and loss moduli (G''), however addition of more than 30% buckwheat increased G' and G'' and increased Tan δ. Break strength of roasted papad increased with buckwheat incorporation (30 and 50%) but reduced drastically upon 50% millet flour incorporation. Sensory analysis also revealed that buckwheat papad variants had the highest fracturability and crispiness score. Further, Overall acceptability were highest for 10% Buckwheat and 10% foxtail millet roasted papads. IR roasting showed better sensorial attributes followed by dry air roasting and tawa roasting.

Keywords**:** *Papad, Buckwheat, Millets, Rheology, Roasting*

TS10-5

Evaluation of yield, protein recovery, protein purity and physicochemical properties of pulse protein concentrates produced by wet processing methods

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The wet processing methods, namely alkaline extraction (AE), acid extraction precipitation (AEP), water extraction precipitation (WEP) and micellization precipitation (MIP) were used for purification of proteins from horse gram (HG) (*Macrotyloma uniflorum*), green gram (GG) *(Vigna radiata)* and cowpea (CP) *(Vigna unguiculata*). The yield of protein, protein recovery and protein purity were calculated and also determined the physicochemical properties. The protein contents of green gram, cowpea and horse gram were found to be 23.34%, 26.26% and 23.45%, respectively. Protein concentrates obtained by AE had slightly higher protein content (GG-87.54%, CP-79.52%, HG-78.93%) and the lower in other methods. Highest yield of protein (GG-AE 14.44%, CP-AE 18.09%, HG –AE 13.81%), protein recovery (GG-AE 60.03%, CP-AE 68.89%, HG–AE 58.90%), and protein purity (GG-AE 87.54%, CP-AE 79.52%, HG–AE 78.93%) were obtained for AE, and the lower in other wet processing methods (GG-AEP 09.71%, CP-MIP 11.67%, HG-MIP 13%; GG-AEP 40.36%, CP-MIP 44.45%, HG-MIP 55.44%; GG-MIP 70.76%, CP-AEP 70.76%, HG-AEP 70.61%). The mean values of protein yield and protein recovery were significantly different at ($P < 0.05$), where as purity of protein values did not vary significantly. These results indicated that alkaline extraction was more effective for the purification of proteins from pulses.

Keywords: *Horse gram, Green gram, Cowpea, Protein Concentrate, Wet Processi*ng

TS10-6

An ultrafast study on flash gas chromatography based electronic nose for the detection of adulteration in ghee

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Ghee is one of the expensive edible fats and because of its huge market demand ghee is prone to adulteration with less expensive edible plant oils such as soybean oil. The existing adulteration detection methods are time consuming, requires sample preparation, and expertise in these field.Therefore, a flash gas chromatography electronic nose (FGCEN) was used in this study to detect the adulteration in ghee with rapid results. The adulterant used was soybean oil with various levels of adulteration concentration of 10, 20, 30, 40, 50, 60, 70, 80, 90, and 100%. The odor fingerprint of volatile compounds of all the pure and adulterated ghee samples were selected based on the higher characteristic compound peak areas from FGCEN instrumental analysis. The classification and pattern recognition of the results were analyzed using multivariate chemometric analysis such as principal component analysis (PCA), discriminant function analysis (DFA), and soft independent modeling of class analogy (SIMCA).

A clear differentiation among the ghee samples were achieved through the use of PCA and DFA method with classification accuracy of 99.77 % and 99.75 %, respectively. The SIMCA was unable to detect the low concentration levels of ghee adulteration that showed a low accuracy (73 %) compared to PCA and DFA method. The average time for FGCEN instrumental analysis was about 100 s. The developed methodology for adulteration detection in ghee using FGCEN combined with chemometric methods have shown to be an efficient and convenient technique.

Keywords: *Ghee, Adulteration, Flash gas chromatography electronic nose, Chemometric analysis, Pattern recognition.*

TS10-7

Effect of spices (ginger and garlic) and Indian gooseberry extract addition on the physicochemical characteristics and oxidative stability of different edible oils

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The study examined the Impact of spices (garlic and ginger) and Indian gooseberry extract addition on the physicochemical characteristics (specific gravity, refractive index, peroxide value, free fatty acid and acid value, total phenolic content and radical scavenging activity) and oxidative stability using rancimat of different edible oils (sunflower, groundnut, soybean, mustard and rice bran). These edible oils initially showed different and low oxidative stability. However, their oxidative stability enhanced during storage with spices and gooseberry extract addition. A decrease in the trend of oxidation was observed in some oils, while an increase in antioxidants level was observed after incubation. Interestingly, a single spice addition did not cause an increase in the antioxidant activity but a synergistic effect of both the spices did. Apart from this, the Indian gooseberry extract exhibited good antioxidant activity leading to the lowering of peroxide value (PV) for soybean, rice bran and groundnut oil, while a similar effect was observed for mustard and sunflower oil with ginger addition. The PV was found to be positively correlated with the acid value (AV) and negatively correlated with the total phenolic content (TPC). Gooseberry extract addition also increased the TPC of groundnut and rice bran oil, while a similar effect was observed for rest of the oils with ginger addition. Rice bran oil having gooseberry extract addition showed the maximum free radical inhibition and caused an increase in the induction period. Overall, this study can provide better alternatives to the conventional artificial antioxidants which have many harmful side effects.

Keywords: *Vegetable oil, Ginger, Garlic, Indian gooseberry, Oxidative Stability*

TS10-8

Natural plant extracts as preservative for shelf-life enhancement of fresh-cut pineapple and its quality evaluation

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Fresh-cut pineapples (*Ananas comosus*) may gain attention among consumers due to their convenience in consumption, flavour and high nutritional values. Conventionally used chlorine for disinfecting fresh produce has a negative impact on human and environment raising too many safety concerns. Moreover, damages during processing operation also led to microbial spoilage.
Natural extract derived from herbs and spices having antimicrobial properties can be an alternative as they play an important role in preservation of fresh produce and are also safe for human consumption. The study was planned to enhance the shelf-life of fresh-cut pineapple using natural plant mixture extracts (green tea, basil, cinnamon). In the present study, antimicrobial activity was evaluated against *Bacillus cereus* and *Salmonella typhii* by agar well diffusion method. Respiration rate (mg CO2/ kg-1 h-1), respiration quotient (RQ), color, firmness, were monitored during storage study of fresh-cut pineapple. Plant mixture extract showed the significant effect on *Bacillus cereus* with low minimum inhibitory concentration (12.5 mg/mL) and minimum bactericidal concentration (25 mg/mL). The highest respiration rates were observed for fresh (26.55±1.7 mg CO2/ kg-1 h-1) and lowest in the sample treated with 25 mg/mL plant mixture extract (23.43±0.9 mg CO2/ kg-1 h-1). The storage time has a significant effect on the respiration rate of pineapple slices. From these findings, it reveals that the combined plant extract of green tea, basil leaf and cinnamon exhibit good antimicrobial properties and could be used as preservatives for shelf-life enhancement of fresh-cut pineapple.

Keywords: Fresh-cut pineapple, antimicrobial activity, ethanolic extracts, pathogenic bacteria, respiration rate, agar well diffusion method.

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Technical Session-11
Waste utilization and management in food processing

TS11-1

Physiochemical characterization of extracted almond shell cellulose and its nano-sized physical derivative for multifaceted use in the food industry

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The woody shell is the major waste of the almond industry requiring suitable valorization approaches. Cellulose, the major component of the biomass was extracted using a previously developed met+hod comprising steps of dewaxing, alkaline delignification and bleaching to obtain material purity higher than 90%. Interesting, unconventional micro-porous monolithic structures of the cellulose were observed indicating probable interwoven characteristics of cellulose filaments in the shell. This holocellulosic material was further acid hydrolyzed and whisker-shape nano-derivatives sizing 130-470 nm in length and 10-30 nm in diameter were obtained. Purity of the nanocrystalline structures was indicated by gradual enhancement in crystallinity and change in infrared absorption spectra. The cellulose structures showing good affinity towards Cu^{2+} and Pb^{2+} ion adsorption suggested tremendous scope for chemical derivatization of the material to produce adsorption or filtration matrices for heavy metal cleaning from effluent industrial streams. The high surface area of the material can be used for making chemically derived cellulosic ingredients for use in food as thickener and emulsifier. Nano-scale derivatization resulted in development of strong thermostability in the crystalline domains. Colloidal suspension of the nanomaterial in aqueous phase with zeta potential of -32.4 mV was indicative of its possible use in beverage systems. No hemolytic toxicity of the material to goat blood erythrocyte further supported its potential use in food systems creating scope for further research on physiological feasibility.

Keywords: Nanocrystalline, Cellulose, Adsorption, Toxicity, Food

TS11-2

Valorization of horticultural waste to legnocellulosic nanofibrils: a sustainable approach towards waste management

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In India, approximately 35-40% of total agro-industrial or horticultural wastes are produced in large quantity due to inadequate storage infrastructure and transportation facilities. These horticultural biomass residues cause various environmental pollution as well as hazardous to the health of living beings. Therefore, today need is to valorize these solid wastes (that are rich in lignocellulosic components such as cellulose, hemicellulose, lignin, pectin, soluble sugars and essential oils) to produce eco- friendly biomaterials to protect the green environment. The natural biopolymer obtained from these wastes has shown a lot of potential as food packaging materials due to its versatile properties. These biopolymers can also be engineered or surface modified to obtained several biopolymer composites with improved physical and mechanical properties that can be utilized to catalyze specific process or reaction on laboratory as well as commercial scale *by* immobilizing enzyme of interest on it. Thus, surface modified biopolymer derivatives that have enhanced thermal, mechanical stability may compete with the other conventional ones for various industrial applications. Therefore, horticultural waste valorization concept is a sustainable approach for waste management that may go for cyclic economy by producing natural biopolymer-based products and will also contribute to pollution free environment.

Keywords: Horticultural wastes, Valorization, Cyclic Economy, Surface Modification, Natural biopolymer, Composite.

TS11-3

Extraction of Cellulose nanocrystals from Indian Gooseberry (Amla) Pomace: Food processing waste to value added product

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The present study proposes valorization of *Indian gooseberry* pomace for the extraction of cellulose nanocrystals (CNC) to provide a sustainable and low-cost precursor material for the production of nano-based biomaterials. The raw fibers were subjected to bleaching and alkali treatments to obtain cellulose; followed by acid hydrolysis for the isolation of CNC. The resultant nanocrystals were characterized for structural changes using Fourier transform infrared spectroscopy (FT-IR), X-ray diffraction (XRD), field emission scanning electron microscope (FESEM), atomic force microscopy (AFM), transmission electron microscope (TEM). FT-IR results showed progressive removal of non-cellulosic components. This rendered CNCs with a 45% yield, negative zeta potential value of -32.33mV, and a higher crystallinity index of 45% as determined by XRD. TEM clearly shows that the CNCs exhibit rod-like structures in nano-dimensions. This study will not only aid in the sustainable conversion of food industry waste into a value-added product but also promote the circular economy.

Keywords: Cellulose nanocrystals; Indian Gooseberry; Agri-food industrial waste; Pomace; Waste valorization; Amla.

TS11-4

Recovery of Gelatin from Poultry Waste: Characteristics of the Gelatin and Lotus Starch-based Coating Material and Its Application in Shelf-Life Enhancement of Fresh Cherry Tomato

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The present study was aimed to obtain gelatin and starch from poultry waste lotus stem respectively, and their application in preparation of edible coating material for shelf life extension of food material. Recovery of 14.5 % and 9.20 % was attained for gelatin and starch from chicken legs and lotus stem respectively. The flow behaviour of coating material was pseudoplastic as the flow index (*n*) ranged from 0.332-0.428. The consistency coefficient (*k*) ranged from 1.62-4.92 $Pa.s^n$, and it increased with the starch concentration. Storage modulus decreased with changing temperature from 10-25°C and 10-35°C in starch free and starch-containing solutions respectively. FTIR transmission band shifted from 3313 to 3343 cm^{-1} while changing the starch concentration form 0 to 10 %, indicating the strong interactions of OH groups of the starch with gelatin amino groups. The transmission of UV light was low and remained unaffected by the starch concentration, however the transmittance showed decrease with the starch concentration in entire visible light range. The coating material was used for shelf life extension of cherry tomatoes. The firmness and pH was retained to greater extent while increasing the starch concentration in the coating material. The weight loss in tomatoes minimized with increasing the starch concentration during the 15 days storage. The study revealed the starch content plays important role in transparency and thermal stability of the coating solutions and the coating material prepared by starch and poultry waste gelatin may have a great potential in shelf life extension of fresh fruits and vegetables.

Key words: *Gelatin; Waste; Edible Coatings; Rheology; Color; Shelf-life*

TS11-5

Valorisation of food processing wastes; Okara and Lima bean peels

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The use of edible films and coatings has shown to be effective to a certain degree in prolonging the shelf-life of some otherwise easily perishable fruits and vegetables. The mechanism behind this being regulated internal atmosphere with controlled respiration aided by the restricted permeability of gases, moisture and aroma compounds from the food to the surrounding environment and vice-a-versa. The inedible petroleum-based packaging are not just unsuitable for consumption but also contribute to waste accumulation. The additional downside is their non-renewability and unsustainability along with their inedible and non-biodegradable nature. There is a switch in researches on the feasibility on their substitution with edible and biodegradable packaging. This approach is on both safer side for the consumers and the environment as well. The perks of biopolymers as edible packaging have gained a considerable attention owing to their natural decomposition unlike the petroleum-based packaging materials. This has opened up new ideas and innovations on utilization of underutilized food resources and huge fraction of waste from agricultural sector. This has opened up new ideas and innovations on utilization of underutilized food resources. Okara is a huge waste fraction accounting from soymilk production and has a good potential to be utilized as a source of polysaccharide which can be implemented on development of edible films and coatings. The peels of lima beans that generally goes as waste can be utilized as a potential material for formation of edible films and coatings. However, the compatibility of the coat or film is to be checked with the food product to be coated or wrapped.

Keywords: *Edible films, Prolonging, Shelf-life, Coatings, Edible, Biodegradable Packaging, Okara, Lima beans*

TS11-6

Waste utilization of sorghum bran for futuristic food safety applications

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Sorghum bran is considered as an agricultural waste in India and worldwide. This under-utilized by-product is a rich source of bioactive compounds with known antioxidant property. Several extraction solvents have been explored to extract the bioactive compounds from this polyphenol-rich agro-waste. Recently, ionic liquids (a new class of solvents) have been in the focus as a green extraction solvent due to non-flammability and low vapor pressure serving as an alternative to conventional solvents.

Therefore, this current work was undertaken to understand the extraction solvent dependency of the sorghum bran extracts (SBE) through investigation of their spectral properties. The SBEs were extracted via anhydrous methanol, acidified methanol and imidazolium based ionic liquid (1-butyl-methylimidazolium chloride (bmim[Cl])). The SBEs were found to be quite stable towards light and temperature while methanolic SBE was found to be slightly pH sensitive. FTIR analysis revealed characteristic peaks suggestive of O-H, C-H and C-N stretching in all the extracts, however spectral similarity was found to be more between ionic liquid (IL) and anhydrous methanol (AM) extracts. LC/MS/MS spectra of IL and AM extracts were quite similar when compared to methanolic extract, as the latter have numerous peaks suggesting greater number of phenolic compounds. Furthermore, the extracts exhibited absorption maxima at 410 and 485 nm. On excitation at 410 nm the SBEs showed emission at 660-670 nm while on excitation at 485 nm, emission at 530 nm was observed This dual emission suggests more than one fluorescent species in these extracts.

Keywords: Agro-waste; sorghum bran; bmim[Cl]; spectral property, absorbance, fluorescence

TS11-7

Value Addition and Waste Utilization of Dragon Fruit

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Dragon fruit, known as pitaya or pitahaya belongs to the *Cactaceae* family and also known as strawberry pear. Due to more consumption purposes, the fruit has great potential in national as well as international markets. Dragon fruit is rich in nutrients, vitamins, minerals and dietary fibres. low in calories. Dragon fruit consists of three principal components, pulp (47–73 %), peel (36–37 %), and seed (3–15 %). Dragon fruit is highly perishable product which requires more attentiveness from unit operations, till reaches to market. Since the major quantity of fruit undergoes for fresh consumption, establishing a good marketing channel for transportation to distant places presents a big task. In this purpose, postharvest research and development efforts must be strengthen to boost the industry. From the perspective of processing, dragon fruit pulp has been utilized for the preparation of valorised products like juice, jam, jelly, powder, wine, etc. Also, the seeds have application as an ingredient in many food products such as syrup, ice cream, sherbet and candy. The fruit peel has potential as an antibacterial agent and antioxidant. Apart from the nutritional benefits of mature fruit, the young stem, and fresh flower buds are also edible and can be used as a vegetable. The dehydrated dragon fruit flowers were used for making antioxidant-rich tea. Summarized, both industrial and developing countries will be extensively benefitted by effective pitaya processing.

Keywords : Dragon fruit, Pulp, Seed, Peel, Value addition, Waste utilization.

TS11-8

Pineapple Peel as a Potential Resource for the Extraction of Antioxidants

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Generation of free radicals from various sources are considered to be the main cause of oxidative stress and the result will be the development of many degenerative diseases e.g. cardiovascular, nervous system disorders, cataract, arthritis and immune system related diseases etc. Antioxidant is established as a potential candidate to prevent or reduce the risk of such kind of diseases. Occurrence of polyphenolic compounds and their antioxidative potentials as free radical scavenger in various fruits and their waste fractions gained significant importance in recent time Now, pineapple is a very famous tropical fruit cultivated worldwide and generate approx. 50% of waste as such or from pineapple processing industries. Each portions of pineapple waste (Crown, Peel and Core) have immense potential in term of occurrence of natural polyphenolic compounds. Major fraction of pineapple waste is pineapple peel and considered to be the good natural source of polyphenolics which is ranging from 7.97 ± 0.63 to 10.62 ± 0.37 mgGAE/g dw. Conventional or non-conventional techniques are used for effective extraction of polyphenolics found in pineapple peel. Microwave assisted extraction (MAE) and Ultrasonic assisted extraction (UAE) as non-conventional technologies establishes the occurrence of polyphenolics in pineapple peel. Extracted polyphenols can not only solve the waste management issue but also has immense potential in different industries like food industries, pharmaceutical industries, therapeutic industries etc. to develop new emerging product like energy drinks, functional food and nutraceutical product.

Keywords: *Pineapple Peel, Polyphenolics, Free Radical, Oxidative stress, Microwave assisted extraction (MAE), Ultrasonic assisted extraction (UAE).*

TS11-9

By-product utilization of dried mango pulp fibre in the ready to eat extruded products

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Objective: Development of ready-to-eat extruded snacks using Twin-screw extrusion technology.

Methodology: Maize grits have been with dried mango pulp fiber, obtained from a pulp processing industry in Krishnagiri, India. Response surface methodology (RSM) investigates the effects of independent parameters such as temperature, dried mango pulp fiber, and moisture content on the extrudates' physic-chemical, functional and textural attributes.

Result and discussion: The optimized condition obtained through Box Behnken Design. The incorporation of dried mango pulp fibre in the corn grits increased the hardness and fracturability of the product. There was an increase in water holding capacity and reduction in water solubility index with the increase in fibre content. The expansion ratio reduced and increased bulk density was observed with an increase in dried mango pulp fibre. The optimized parameters obtained were barrel temperature 160°C, 14% moisture content and 7.5% dried mango pulp fibre. The current study successfully establishes the application of dried mango pulp fibre in ready to eat snack products. The growing health consciousness among consumers, change in lifestyle, and increased inconvenience are driving the development of nutritious snack products. This shall be attained while securing environmental sustainability. Thus, extrusion technology is a very flexible process under appropriate processing conditions that can help in developing nutritionally enhanced products with significant diversification

Keywords**:** *dried mango pulp fibre, extrusion, corn, optimized, nutritious.*

TS11-10

A Study into Effective Supply Chain Management Aiming at Zero Food Wastage for a Sustainable Dairy Industry

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The United Nations Sustainable Development Goals of ending poverty and zero hunger can only be achieved by ensuring food and nutritional security through reduction of food wastage to minimum levels through effective management of food supply chains. The inefficiencies in Agri.-food supply chain management results in food wastage which may have tremendous environmental, social and economic consequences. Effective management of milk and other dairy products is even more important due to the perishable nature of milk. Dairy food wastage in the supply chain directly impacts the profit margins of the stakeholders in a negative way leading to increase in operational costs and ultimately consumers have to pay higher prices. The aim of this study is to identify the challenges in effective supply chain management of milk and other value added dairy products and suggest effective food waste minimization practices through adoption of technology for a sustainable dairy industry.

Keywords: *Food Security, Supply Chain Management, Dairy waste, Sustainable Development, Entrepreneurship, Rural Development, Value Chain*

TS11-11

Effects of microwave and enzymatic pretreatments on ultrasonic extraction of polyphenols from papaya peels

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Papaya peels (*Carica papaya L.*) are usually discarded as waste even although a significant amount of polyphenols are often present in the outer parts of fruits. These polyphenols can be utilized in different industries including the food industry, for the development of functional or enriched foods, the health industry for medicines and pharmaceuticals, and the textile industry, among others. The objective of this study was to establish an extraction procedure for polyphenols and antioxidants from papaya peels (PP), and to assess their potential radical scavenging activity. The present work investigated the influences of microwave (M), enzyme (E) and their combination (ME and EM) as pretreatments followed by ultrasound on extraction of polyphenol compounds using water (W) as a solvent. Ultrasonication was done for 90 min at interval of 15 min. Microwave-enzyme treatment (MEW) gave the highest extraction yield of polyphenols (i.e. 93.98 mg GAE/100g), followed by enzyme-microwave treatment (EMW) (i.e. 86.49 mg GAE/100g) while enzyme treatment (EW) gave the lowest extraction yield (80.58 mg GAE/100g) respectively. The DPPH (2,2-Diphenyl-1-picrylhydrazyl) radical scavenging activity of extracts had a linear relationship with the polyphenol's yield in the extracts. This study revealed that combined pretreatment for extraction has many advantages as following: improving extraction yield and quality, direct extraction capability, low energy consumption, fast processing time and reduced solvent levels and can be used as an environment friendly method for producing polyphenols and antioxidants from the PP.

Keywords: papaya peel, polyphenols, pretreatments, ultrasound, microwave, enzyme

Technical Session-12
Modeling and simulation approaches in food processing

TS12-1

Identification and Optimization of Process Conditions for Ozone treatment of Ultrafiltered Sugarcane Juice using Multi-objective Genetic Algorithm

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Sugarcane juice (SJ) is susceptible to rapid spoilage and quality deterioration owing to incidence of browning and fermentation phenomena leading to short shelf life which discourages its storability and marketing aspects. This spoilage issue necessitates the need for a reliable preservation technique that, in addition to stability, can guarantee preservation of nutrients. In the current study, ultrafiltration followed by ozonation were adopted as non-thermal hurdles for SJ treatment. The applicability of multi-objective genetic algorithm (MOGA) as an optimization tool for ozone treatment of ultrafiltered SJ has been explored. Regression models for various response parameters were developed to construct the objective functions for optimization. The goal was to maximize the polyphenol content while simultaneously minimizing the browning index (BI) and polyphenoloxidase (PPO) activity. The minimum BI and PPO activity of 66.17 and 6.24 U/ml, respectively were predicted by MOGA. Confirmatory experiment performed with optimal process variables of gas flow rate (4.58 l/min), ozone concentration (3.12 ppm) and exposure time (8.2 min) verified the accuracy of GA-based multi-criteria algorithm. The combined non-thermal technology adopted in this work was efficient in minimizing the spoilage rate of SJ to a greater extent as proven by post-treatment comparison study of control and treated samples. The identification of operating parameters is expected to aid process control, food safety and industrial process design.

Keywords: Sugarcane juice; Spoilage; Non-thermal technology; Optimization; Genetic algorithm; Post-treatment study

TS12-2

Computational fluid dynamic simulation of the twin screw extruder for fortified rice dough

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The extrusion of starch-rich food products has been widely researched, especially for pasta and noodle production. In recent years, co-rotating twin-screw extruder (TSE) is more studied in structural and fluid dynamics viewpoints. The present study deals with the rheological characterization of food to food fortified (FtFF) rice dough with marjoram powder and skim milk powder to improve its iron, folate, and vitamin B_{12} content. The FtFF rice dough was subjected to a rheometer to obtain viscosity values at different temperatures fitted to different rheological models. These models were used for 3D CFD simulation of feeding, transition, and metering zones of the TSE.

The results showed that the power-law index, $n < 1$ indicating the non-Newtonian shear thinning behaviour of FtFF rice dough. Among all, the Carreau model was fitted best to the experimental data with $R^2 > 0.97$ and percentage error < 10% at the selected temperature conditions. This model was further modified by taking temperature parameter into account and used to describe the flow behaviour of FtFF dough inside the twin-screw extruder. In CFD simulation, velocity and dynamic viscosity contour plots were obtained for the TSE's feeding, transition, and metering zones. The velocity vector clearly described product direction due to screw rotation which was in agreement with real case and boundary conditions. The dynamic viscosity contour plots were further validated with the viscosity of samples at ten sections of the extruder. This study will help in choosing the specific design parameter for TSE.

Keywords: Food to Food Fortification; Twin-screw extruder; Rheological model; Computational Fluid Dynamics; Viscosity; Rice dough

TS12-3

Docking simulation of chitosan-alginate complex in encapsulation of quercetin rich fraction and its optimization using RSM-BBD and ANN

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Quercetin is secondary metabolites in bhimkol (*Musa balbisiana*) blossom (BB) known to exhibit health beneficial activities. Quercetin rich fraction purified by RP-HPLC followed by column chromatography was encapsulated with chitosan-alginate nanoparticle complex by ion-gelation method. Response surface methodology- Box-Behnken design (RSM-BBD) and artificial neural network (ANN) were used to develop predictive models for simulation and optimization of encapsulation of quercetin rich fraction from BB extract. The influence of input variables such as concentrations of quercetin (0.1 to 0.3 %), sodium alginate (2 to 4 %) and chitosan (0.5 to 1.5 %) at 1:3:3 ratios on the encapsulation efficiency (EE %) were investigated through a two level three factor (2^3) full factorial design. Experimental design (17) obtained by RSM was used for obtaining a training set for ANN. Microbeads obtained at optimum condition (0.1 % quercetin, 4 % sodium alginate and 1 % chitosan) with 84 % EE was selected for the comparison of prediction performance with coefficient of regression (R^2), root mean square error (RSME), and absolute average deviation (AAD). ANN was found to be superior over RSM in for predicting and optimization of encapsulation. Microbeads were studied for its physicochemical, morphological properties. Molecular docking was performed to simulate the positions of interaction between chitosan-alginate complex (target receptor) and quercetin rich fraction (ligand). The optimized quercetin rich fraction encapsulated microbeads will be beneficial for its potential applications in food industry and pharmaceutical sector as controlled release of biological activity.

Keywords: Quercetin, encapsulation, simulation, ANN, RSM, docking.

TS12-4

Molecular Dynamics Study of the Phase Behaviour in Lipid Bilayer Mixture

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The flexibility of lipid bilayer governs transport of nutrients across the membrane. The knowledge of bilayer phase transition aids in efficient designing of multivitamin delivery vehicle for functional foods. Computational simulations offer great advantages of eliminating the lengthy experimental runs by providing the optimal processing conditions. Molecular dynamics (MD) simulations are used in this study to demonstrate the effect of temperature (40, 50, 60°C) over several bilayer combinations (DPPC/DPPE/DPPI/PCA) containing different number of lipid molecules in the leaflets. It is observed that at 50°C the lipid molecules exist in both gel/fluid state resembling a ripple phase. The area per lipid for gel phase increased its mobility with temperature and changed its state to liquid-crystalline. Similar trend was observed in diffusivity coefficient. Van der Waals attraction showed stronger influence over the molecules than electrostatic force. Additionally, the negative potential energies denoted attractive forces or the self-assembly behaviour of the phospholipids. Overall, 60°C provided most mobility through overlapping adjacent lipid tails, thereby this fluid crystalline temperature can be considered for structuring of lipid bilayers. The successful application of MD in interpreting the phase changes can be also used for evaluating and screening the interaction of lipid head-tail groups.

Keywords: phase transition; bilayer; simulations; molecular dynamics; delivery vehicle

TS12-5

Mathematical modelling on Microwave and Conventional drying and rehydration kinetics of Ridge Gourd and Snake Gourd slices

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The conventional and microwave treatment under different time from 60-120 min and at temperature range 50-90°C has been studied on the snake gourd and ridge gourd. The microwave drying kinetics model of snake gourd and ridge gourd showed that moisture ratio decreased from ≈2.5% to 0.5% and ≈2.1% to 0.8% with microwave power from (P-10, P-20, P-40, P-60 and P-80). In addition to this, the increase in temperature (50°C-90°C) may decrease the moisture ratio from ≈1.53 to 0.75% and ≈0.64% to 0.34%, respectively in conventional drying. Shrinkage ratio 0.32% and 0.43% of ridge gourd and snake gourd during microwave drying was greater than conventional drying. The data obtained from drying experiment for moisture ratio vs. drying time were fitted to the 5 drying models i.e. Newton [MR = exp (-kt)], Page [MR = exp ($-kt^n$)], Wang and Singh [$MR=1+at+bt^2$], Logarithmic [MR= a exp (-kt)+c], and Henderson and Paleg [MR = a exp (-kt)]. The experimental data of ridge gourd showed that the Newton model and Wang & Singh Models were found suitable to fit (Ridge gourd R^2 0.77- 0.99 and Snake gourd R^2 0.91-0.99) for to describe the drying characteristic both in conventional and microwave drying. The nonlinearity measurement for discrimination, the most appropriate Peleg equation [MR = a exp (-kt)] in terms of R^2 (≈0.93) and RMSE (≈0.0003) used to represent the rehydration kinetics.

Keywords: *Drying kinetics model, Rehydration ratio, Ridge gourd, Snake gourd, Moisture Ratio.*

TS12-6

Implementation of Machine Learning tool for Near Infrared based rapid identification of low amylose rice variety

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Rice samples having almost similar chemical composition in terms of starch were differentiated using NIR spectral data of a portable sensor. A non-destructive and real time way of analysis. Random forest (RF) classifier was used for calibrating the NIR spectra obtained from four rice samples viz. *Aghunibora*, *Bhogalibora*, *Chokuwa* and *Disang* that have a considerably low amount of amylose i.e. 3.2, 1.6, 9.2 and 10.3 %, respectively. The computationally efficient RF model proved to be a reliable classification tool with F value of 0.899 for validated data and classification accuracy of 0.923 based on test data. Instrumentally measured rheological property values of peak and breakdown viscosity reveals similarities between *Aghunibora* and *Bhogalibora*; and between *Chokuwa* and *Disang* varieties. Also, slurries from these rice varieties, exhibited shear thickening behavior. These varieties, which are indistinguishable from each other, based on a single measurement of rheological properties, could be distinguished from each other when ML based classifier complemented single measurements of NIR spectrum. Besides when a portable NIR sensor is used, this would facilitate on-site identification of low amylose rice varieties with available library of spectral data.

Keywords: Rice, low amylose, spectroscopy, machine learning, random forest classifier

TS12-7

Neuro-fuzzy interface system and biot number based unsteady state approach for the simulation of instant decompression assisted paddy steaming process

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Instant decompression assisted steaming (IDAS) process is a novel approach for the quality improvement of milled rice. In this study, gelatinization kinetics of paddy grains for the bulk level IDAS treatment and its effect on the broken rice percentage (BRP) and micro-structural characteristics (MSC) of milled rice were investigated. An integrated approach of neuro-fuzzy interface system (NFIS) and biot number based unsteady state heat transfer approaches were applied for simulation of the steaming process. Unsteady state heat transfer kinetics was formulated by implementing computational fluid dynamics (CFD) approach. Initially, neuro-fuzzy interface system (NFIS) was applied for the mapping of single layer gelatinization kinetics of the grains. This relationship was integrated along with CFD for determination of temperature profiling during bulk level IDAS treatment of the grains. Hence, CFD based unsteady state heat transfer features were utilized for the ultimate mapping of degree of gelatinization (DG) at various nodes of the sample box. Parboiled rice treated for 40s TT showed best quality in comparison of BRP for the paddy samples obtained from all the nodes. The reason for the minimum BRP in case of IDAS treated parboiled rice was also revealed from the results of MSC in terms of higher gelatinized and expanded structure along with homogeneous filling of fissures.

Keywords: NFIS, CFD, IDAS, gelatinization, MSC, BRP

Technical Session-13
Functional, Nutraceutical and Health Foods

TS13-1

Evaluation of polyphenols enriched bread developed by incorporating black carrot (Daucus carota L.) powder

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Black carrot bread was prepared by incorporating black carrot powder (BCP) at 2.5, 5.0, 7.5 and 10% level. Proximate composition, physical and textural quality, bioactive compounds, antioxidant properties, sensory analysis, mineral content and storage study of black carrot breads were analyzed and compared with those of control. Moisture content, Loaf volume and specific volume decreased with the incorporation of BCP. Textural analysis showed that hardness increased whereas resilence, cohesion and springiness decreased significantly with addition of BCP. Bioactive compounds content viz; Anthocyanins, total phenols and flavonoids were exceptionally in BCP incorporated bread and showed high antioxidant activity as tested by the DPPH, ABTS and FRAP assay. An incorporation of 7.5% BCP into bread showed most acceptable sensory scores. Significant improvement in mineral content (Ca, Na, K, Mg, Fe and Zn were reported in 7.5% BCP added bread. Results: Sensory analysis revealed that black carrot concentrate could be used up to 7.5% as an ingredient into dairy product with high acceptability. Significant improvement in mineral content (Mg and Fe), polyphenols and antioxidant activity were reported in black carrot concentrate added dairy products. Storage study revealed that bread developed with 7.5% BCP stored at ambient temperature can be consumed up to 3 days without affecting its sensory quality. We may infer that incorporation of black carrot powder into bread would enhance its bioactive compounds and mineral content, which could be highly significant in preventing hidden hunger and oxidative stress-induced disorders in developing countries.

Keywords: Functional Foods, Polyphenols, Black carrot, Bread, Anthocyanins

TS13-2

PREPARATION OF DIFFERENT TYPES OF WEANING FOODS AND THEIR PHYSICO-CHEMICAL PROPERTIES

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Weaning foods were prepared from finger millet, foxtail millet and brown rice as cereals and green gram as a legume. Composites were prepared by soaking, germinating, malting, grinding and mixing malted cereals at 70% and malted legume at 30% level. The raw materials had a moisture content, contents of carbohydrate, protein, ash, acid insoluble ash as 7 to 12%; 54 to 75%, ~ 7 to 23%, 1 to 3.5% , 0.02 to 0.23%. After germination these parameters increased to different extents; about 3% in moisture content, 2-4% protein content , however the ash content decreased from 1 to ~ 12% in native. EMC and total amylose content in raw samples were 28-58% and 13-18%; after germination there was increase in these parameters. Phytate varied from 310-350 mg%, after germination it reduced to 240-333 mg%. Tannin varied from 0.8-0.53 % in raw materials and after germination it reduced tremendously. Amylase activity increased from 0.2 to 1.7 U/g/min. The weaning foods showed a moisture content of ~ 3%, 2-3.5% ash content, 57-61% carbohydrate content, protein content from 10-11%, total amylose content from ~ 17%-22%, phytate content from 0.028-0.03%. Viscography showed that ragi had highest PV and lowest by foxtail millet. Weaning foods showed less PV and BD. Germination increased EMCs, contents of amylose, protein, amylase activity; decreased contents of phytate, ash, tannin; sensory wise weaning foods were good in all respects.

Keywords: Weaning foods, amylase activity, viscography, brown rice, foxtail millet, finger millet

TS13-3

Antioxidant Activity and Phenolic Content of some Non-conventional Vegetables of Assam

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Antioxidant can protect the human body from free radicals and reactive oxygen species (ROS). Reactive oxygen species (ROS), such as superoxide ($O2^{\bullet -}$), hydroxyl radical ($OH^{\bullet}$), peroxyl radical ($ROO^{\bullet}$), and singlet oxygen ($^1O_2$) are generated in the body as by-products of normal cellular aerobic respiration [1]. Exposure to environmental factors such as pollution, radiation, cigarette smoke and herbicides also sometimes accelerates the generation of ROS in human body. Oxidative damage and lipid peroxidation caused by the action of ROS may initiate and promote the progression of many diseases including cancer, liver disease, Alzheimer's diseases, ageing, inflammation, rheumatic disorder, diabetes, Parkinson's disease etc. Methanolic extracts of non-conventional green leafy vegetables were examined for *in vitro* antioxidant activity using DPPH assay, ABTS assay and FRAP assay. Total phenolic content (7.6 to 17.7 mg GAE/g dry dw), flavonoid content (1.8 to 12.2 mg QE/g of dw) and Vitamin C contents (31.9 to 121.6 mg/100 g dw) were evaluated by colorimetric methods. There was a positive linear correlation between the total phenolic content and antioxidant activities measured by three different methods.

Key words: Non-conventional vegetables; Antioxidant activity; Phenolic content

TS13-4

Nanoemulsion-based encapsulation: An emerging natural antioxidant delivering approach to replace synthetic antioxidant in edible oil

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Antioxidants are components that are used to prevent the oxidation of edible oil. Synthetic antioxidants are mostly used by the edible oil industry, due to their low cost and high antioxidativity. However, safety concerns regarding the use of synthetic antioxidants have increased globally due to their detrimental health effects such as impairment of blood clotting, mutation, tumors, liver damage, cytotoxicity, and carcinogenesis. In recent years, there is a growing interest in the usage of plant-based natural antioxidants in edible oils, to avoid the use of synthetic antioxidants and effectively utilize agricultural waste. The safety, high antioxidativity, and potential health benefits of natural antioxidants make them a suitable alternative to synthetic antioxidants. The natural antioxidants extracted from the plant have antioxidant activity due to the presence of bioactive polyphenolic compounds. However, the hydrophilic nature of many polyphenol-based natural antioxidants hinders their direct addition to edible oil. Furthermore, their low physical and chemical stability, loss of antioxidativity at high temperature, and impartment of taste, odor, and color, limit their usage in the edible oil industry. One promising technology for overcoming the aforementioned limitations of natural antioxidants can be nanoemulsion-based encapsulation. In recent studies, nanoemulsion-based encapsulation of natural antioxidants has been found to be effective in (i) improving the stability, bioavailability, solubility, and antioxidativity of the natural antioxidants; (ii) controlling their release rate; (iii) masking their unpleasant taste, odor, and color so that they do not affect the organoleptic property of edible oil; and (iv) extending the oxidative stability of edible oil.

Keywords: Nanoemulsion-based encapsulation; Natural antioxidants; Edible oil; Oxidative stability

TS13-5

Study on the suitability of sorghum (*Sorghum bicolor (L.)* grain variety for the development of gluten-free cracker

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The study aimed to identify the suitable variety for developing gluten-free crackers based on their nutrient, antioxidant and mineral profiles. Among the five varieties, the highest protein and fat content observed in ICSV1502 (7.34 ± 0.03 g/100g) and PS (10.06 ± 0.08 g/100g) varieties. The total dietary fibre content of crackers ranged between 2.86 ± 0.06 to 4.62 ± 0.02 g/100g with the highest reported in PM variety. The highest total phenolic (5.28 ± 0.05 mg GAE/g) and flavonoid content (80.70 ± 0.05 mg CE/g) observed in CO-30 variety whereases highest DPPH radical scavenging activity (10.06 ± 0.08%), reducing power (13.24 ± 0.11mg AAE/g), $ABTS^{+}$ scavenging activity (52.95 ± 0.01%) of the cracker obtained in K-12 variety. FT-IR spectra showed changes in band intensities. The total color difference ranged between 36.43 ± 0.00 to 42.78 ± 0.00 with the highest in ICSV15021. Texture profile analysis showed the highest hardness and Fracturability value in PS (3.28 ± 0.01N) and PM (22.48 ± 0.01N) varieties. Particle size distribution of PM variety changed from unimodal to a bimodal distribution. Crackers were also investigated and compared for mineral and sensory properties. Based on the results, sorghum crackers can provide health-promoting benefits, especially for people with celiac conditions.

Keywords: Antioxidant characteristics; Crackers; Dietary fibre; Mineral composition; Sensory evaluation; *Sorghum bicolor*.

TS13-6

Comparative analysis of phytochemical extraction potential of three different solvents from *Chenopodium album* leaves.

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Food from plants have been chosen for eating purposes because of their medicinal and health promoting benefits. Components like antioxidants, phenols, alkaloids and flavonoids present in them exhibit functions as anthelmintic, antiviral, antifungal, anti-inflammatory, anti-allergic, anti-septic, anti-pruritic etc. Presence of various minerals, vitamins and high quality proteins, carbohydrates and lipids helps in performing various functions in human body. Exploring the nutritional profile of weedy plant is of great advantage that will change the perspective of people towards weeds, *Chenopodium album* a commonly known weed have purpose full perspective apart from crucial nutritional benefits, it possess nutraceutical and functional properties. The bio active components were extracted from bathua leaves (fresh, dried and blanched+ dried) with three solvents like distilled water, ethanol, acetone. Phytochemical estimations, total phenol concentration, flavonoid concentration and antioxidant activity have been evaluated to compare the efficiency of different extraction solvents. The results shows that using ethanol as an extraction solvent works best with flavonoid concentration of 336.35±0.25 mg/100 g of extract, phenol concentration of 301.41±0.30 mg GAE equivalent/100 g of extract and 91.14±0.14% of DPPH. As shown in the results, ethanol was found the best solvent for the extraction of bio active components. Fresh bathua leaves was found to be having more bio active components as compare to dried and blanched leaves which might be due to the leaching and destruction of components during processing.

TS13-7

Wheat bran: A valuable byproduct of processing

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Wheat (*triticum aestivum*) belongs to family *Poaceae*. Wheat bran is a byproduct obtained after milling process of wheat. Wheat bran is considered as low-cost byproduct produced in abundant amount from the whole flour industry. Wheat bran is a good source of insoluble dietary fiber and protein. Wheat bran comprises major amount of dietary fiber i.e. 46% of non-starch polysaccharides, including arabinoxylan (70%), cellulose (24%) and beta-glucan (6%), and it also contains minor amounts of glucomannan and arabinogalactan. It also contains minerals, vitamins and several bioactive compounds such as phenolic acids, arabinoxylans, alkylresorcinol and phytosterols. These compounds have been recommended for the prevention of especially non-communicable/degenerative diseases such as colon and breast cancers, cardiovascular disease, obesity and gastrointestinal diseases.

Keywords: Dietary fiber, wheat bran, degenerative diseases, bioactive compounds

TS13-8

Pigmented Wheat: A Nutritional Security

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Wheat grain (*Triticum aestivum*), is a cereal crop, belong to Poaceae (Gramineae) family, and possesses a significant place among all food things. It is the most significant staple food crop for more than 33% of the total populace and contributes more calories and proteins to the world eating regimen than some other cereal crops. Normally developed wheat varieties are golden in color, recently, much consideration has been focused on colored wheat varieties. Whereas pigmented wheat, rich in anthocyanin and different phytochemicals are getting popular around the world over attributable to the related medical advantages. The color in the wheat grain is essential because of natural pigments, for example, carotenoids and anthocyanins. Purple color is restricted to the pericarp of grain whereas blue color to the aleurone .In recent years, bioactive compounds in wheat have attracted more interest from both researchers and food manufacturers because of their benefits in promoting health and preventing diseases. Some bioactive mixes can be explicit to specific cereals, for instance, γ-oryzanol in rice, avenanthramides, and saponins in oat, β-glucans in oat and grain, alkylresorcinols in the rye, and anthocyanins and carotenoids in pigmented cereal grains. Compared to normal wheat, roughly 11.74%–18.17% higher protein content, 7.31%–18.13% higher essential amino acids, and 8.88%–18.91% higher total amino acids were recorded in colored wheat. Pigmented wheat is a rich source of vitamins-B (B1, B2, B3, B6, B9, and vitamin E. Apart from these, it also contains a small amount of provitamin A, vitamin D, and vitamin K. Zn, Fe, and magnesium content in pigmented wheat is about 108.54%–142.68%, 8.57%–42.86%, and 5.31%–40.63% higher than normal wheat, separately.

Keywords: Pigmented wheat, Staple food, Bioactive compounds,

TS13-9

Effect of germination process on germination efficacy of black soybean (*Glycine max* L. Merr.) grains and physicochemical characteristics of flour

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Black soybean (*Glycine max* L. Merr.) is a variety of soybean which is characterized by black seed coat and is commonly consumed in countries like Japan, Korea, China. However, in India its cultivation it limited to some parts of Himalayan and North-eastern region. Germination is an inexpensive bioprocessing technique which can be used to improve the nutritional quality of grains. In the present study, the effect of short-term germination period (24 and 48 h) on the germination efficacy (weight loss, radical length, and germination efficiency), physiochemical characteristics was examined. Germination efficiency increased significantly ($p \leq 0.05$) from 43.00 ± 0.20% for 24 h germinated beans to 82.57 ± 0.50 for 48 h germinated samples. Similar trend was also observed for radical length and weight loss of grains germinated for different time period (24 to 48 h). Significant ($p \leq 0.05$) increase in protein and crude fiber content was observed with the increase in germination time with the highest value obtained for 48 h germinated beans. Further, germination significantly ($p \leq 0.05$) improved the water holding capacity (WHC) and oil holding capacity (OHC) of black soybean flour. The color attributes varied significantly ($p \leq 0.05$) among the studied sample and the flour color became darker with the increase in germination time. In conclusion, germination can be utilized as a potential strategy to obtain flour with enhanced nutritional and functional attributes which can be used to develop functional food products.

Keywords: Black soybean; Germination; Functional properties; Nutritional quality; Germination efficiency.

TS13-10

Fabrication of hydrophobic starch nanoparticles for the enhancement of tocotrienol stability and permeability: Focusing on dyslipidemia

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Tocotrienol (T3) is helpful in mitigation of cardiovascular diseases. However, various studies have demonstrated minimum stability and low permeability of T3 inside the gut system. To overcome this challenge, we have developed starch nanoparticle (StNP) as a carrier material that have been hydrophobically modified using incorporation of linoleic acid (LA) via ultrasonication. The average particle size of StNP was below 100 nm with negative zeta potential value of -10 mV. AFM study confirmed the formation of StNP having particle size <25 nm. Proton NMR spectra of StNP confirmed the presence of acetyl methyl protons of LA. *In vitro* characterizations have proved that the developed StNP possessed excellent stability at low pH including gastro-intestinal stability and protein resistance property. The findings were further supported by *in silico* molecular dynamics study where LA have interacted with the active site amino acids of α-amylase. On the basis of these results, a bioconjugate (BioC) of T3 with StNP was formulated with size <60 nm and tested in HepG2 cell line and on animal model. The prepared BioC was observed to be non-toxic to cells in comparison to the free T3 and with enhanced permeability. Hyperlipidemic animal model was developed in SD male rats after feeding high fat diet for four weeks and a streptozotocin injection (35mg/kg i.p single dose) after completion of two weeks. *In-vivo* study showed that the T3 (free and conjugate form) interventions have effectively reduced serum triglyceride and ALT levels. Further, histopathological study indicated that BioC forms were more efficient in penetrating the liver tissues and were thus able to reduce fat accumulation and fibrosis in liver.

Keywords: Starch nanoparticle, linoleic acid, tocotrienols, dyslipidemia, ultrasonication and gastro-intestinal stability

Technical Session-14
Innovative approaches in food processing

TS14-1

Ohmic Heating of Different Fruit Materials: Study of Heating Behavior and Energy Performance

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Novel-thermal processing methods of food are being developed to counter the limitations of conventional thermal processing. The present study was aimed to evaluate the ohmic heating (OH) behavior and energy performance of different fruit products. Juices of litchi, tomato, pineapple, watermelon, and puree of mango were studied for OH at 10, 20, 30 and 40V/cm. Watermelon juice had maximum (0.974 S/m) electrical conductivity (EC), followed by pineapple, tomato, mango puree and litchi juice. The EC increased linearly with temperature (R^2 0.95-098), whereas the heating rate increased exponentially with EFS (R^2 0.92-0.97). At EFS >30V/cm heating rate in mango puree was less than litchi juice, although the EC of mango puree was higher. At 10V/cm, the energy efficiency was inferior as nearly 32 to 47% energy waste. The efficiency increased from 73.32 to 86.94%, 82.06 to 86.37%, 75.27 to 81.02%, 76.45 to 82.93% and 88.67 to 90.11% in litchi, tomato, pineapple, and mango puree and watermelon juice, respectively, as the EFS increased from 20 to 30V/cm. However, the efficiency remained stagnant in tomato juice and mango puree on a further increase of EFS up to 40V/cm and decreased slightly in watermelon juice. However, the efficiency increased further with the EFS in litchi and pineapple juice. The OH process achieved energy efficiency up to 90 %; however, the OH behavior and energy efficiency depend on food material type. Therefore, for process optimization and OH equipment development, the critical point of a product's heating behavior and energy efficiency must be studied in detail.

Keywords: Electric field strength; Energy; Electrical conductivity; Heating behavior; Thermal processing

TS14-2

Pasteurization of progressive freeze concentrated coconut water using ultraviolet-C radiation, ultra sonication and thermal pasteurization method

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Emerging non-thermal pasteurization techniques are applied as substitutions to thermal processes to maintain the microbial safety and quality of the liquids. Coconut water is a nutritious and naturally flavored refreshing beverage. Preserving the original quality of coconut water during concentration and preservation is a crucial factor. Mature coconut water (MCW) was concentrated by progressive freeze concentration (PFC) up to 8.5^0 ± 0.53 Brix from the initial concentration of 3.5^0 ± 0.08 Brix with 73.56% ± 0.10 of average yield. To find the best preservation method, the properties of the treated products by ultraviolet-C radiation (UV-C) (UV dose; 33 kJ L^{-1}, 253.7 nm) and ultra-sonication (US) (20kHz, 30 min) were compared with thermal preservation (TP) (85 °C for 10 min, sterilized at 121 ^{0}C, 30min). Vitamin-C loss percentage was 58.01%, 65.13 %, and 72.05% for UV-C, US, and TP respectively. Total plate count 1.47, 1.92, and 0 $\log_{10}$ CFU/mL and fungi count (FC) 0, 1.47,0 $\log_{10}$ CFU/mL were detected after 14 days of refrigerated storage (4 ± 1 °C) for UV-C, US, and TP respectively. UV-C and TP achieved the standard microbial safety level within 14 days of refrigerated storage condition. Analyzing the physio-chemical and microbial properties UV-C light was selected as the best pasteurization method for PFC coconut water compared with US and TP methods.

Keywords: Progressive freeze concentration, Coconut water, Ultraviolet-C radiation, Ultra-sonication, Thermal preservation

TS14-3

Effect of Irradiation on Aflatoxins and Bio active Compounds of Deoiled Peanut Cake

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Peanut meal (cake) is the high-protein solid residue obtained during extraction of oil from whole or broken peanuts. After peanut oil extracted, the protein content in the cake reaches 35-40 %. It also contains other functional components, such as peanut lectin, resveratrol and other functional ingredients. Peanut meal is generally used as feed for animals in spite of its high protein and nutrient content. The present investigation was conducted with a broad aim of developing the technology for production of high protein meal form commercial deoiled peanut cake. The commercial deoiled peanut cake was given treatments like microwave treatment (1 kW) at different microwave exposure time (2, 4, 6 and 8 min) using commercial domestic microwave oven. The effect of microwave treatment was analyzed in terms of its proximate compositions, reduction in aflatoxin content like AFB1, AFB2, AFG1, AFG2 and total aflatoxin content, retention of resveratrol and phytosterol content deoiled in peanut cake after microwave treatment. Among the different microwave time the maximum reduction in aflatoxin content and maximum retention of resveratrol and phytosterol content in deoiled peanut cake was found at 8 min microwave exposure time. At 8 min of microwave exposure time the total aflatoxin content (AF total) was found 74.91 (ppb). While in terms of percent reduction in aflatoxin content was 20.34 %. The percent retention in resveratrol content, β-Sitosterol, campesterol and stigmasterol content at 8 min microwave exposure time were found to be 67.14 %, 68.73 %, 67.81 %, 67.70 % respectively.

Keywords: Peanut meal, microwave, aflatoxins, resveratrol, stigmasterol

TS14-4

Effect of Microwave on Aflatoxins and Bio active Compounds of Deoiled Peanut Cake

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Peanut meal (cake) is the high-protein solid residue obtained during extraction of oil from whole or broken peanuts. After peanut oil extracted, the protein content in the cake reaches 35-40 %. It also contains other functional components, such as peanut lectin, resveratrol and other functional ingredients. Peanut meal is generally used as feed for animals in spite of its high protein and nutrient content. The present investigation was conducted with a broad aim of developing the technology for production of high protein meal form commercial deoiled peanut cake. The commercial deoiled peanut cake was given treatments like microwave treatment (1 kW) at different microwave exposure time (2, 4, 6 and 8 min) using commercial domestic microwave oven. The effect of microwave treatment was analyzed in terms of its proximate compositions, reduction in aflatoxin content like AFB1, AFB2, AFG1, AFG2 and total aflatoxin content, retention of resveratrol and phytosterol content deoiled in peanut cake after microwave treatment. Among the different microwave time the maximum reduction in aflatoxin content and maximum retention of resveratrol and phytosterol content in deoiled peanut cake was found at 8 min microwave exposure time. At 8 min of microwave exposure time the total aflatoxin content (AF total) was found 74.91 (ppb). While in terms of percent reduction in aflatoxin content was 20.34 %. The percent retention in resveratrol content, β-Sitosterol, campesterol and stigmasterol content at 8 min microwave exposure time were found to be 67.14 %, 68.73 %, 67.81 %, 67.70 % respectively.

Keywords: Peanut meal, microwave, aflatoxins, resveratrol, stigmasterol

TS14-5

Farm SunFridge – an off-grid, battery less, solar refrigerated-evaporatively cooled structure for storage of perishables

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India is the second largest producer of fruits and vegetables in the world. Postharvest losses of vegetables and fruits are estimated to be about 30% (Chadha, 2001) and when coupled with poor or variable prices, can spell major economic disaster for farmers. The stand-alone off-grid, batteryless solar refrigerated evaporatively cooled (SREC) structure/ also called Pusa-Farm SunFridge (FSF) with a capacity of 2-tonne of fruits and vegetables can be the first link in the cold chain of foods from farm to fork. The Pusa Farm SunFridge could achieve daytime temperatures as low as ~3-4 °C and nighttime temperatures below 10 °C, when the daily ambient maximum temperature reached approximately 35 °C; without use of electricity/grid and/or batteries It has mesh and wetted fabric walls (for evaporative cooling), low cost styrofoam insulation and a refrigeration system operating during the day from solar panels. The innovations are a split evaporator coil for cooling air and water; "*water battery*" for nighttime cooling; intelligent sunlight sensing and IoT control system. Sun adaptive controller (IoT based with sunlight intensity sensor, amplifier, microcontroller and modem) was developed and connected with refrigeration system to match demand of refrigeration system with varying solar insolation levels. The sunlight intensity was sensed periodically and compared with preset thresholds for sunlight intensity. The refrigeration system demand was reduced when the sunlight intensity declined and/or when there was a cloud cover and reverted to increased demand conditions when the sunlight insolation was high. This system starts every morning and shuts down every evening automatically. The IoT (Internet of Things) enabled programming the system remotely to monitor and change the refrigeration system demand with different sunlight intensity threshold levels.

Keywords: fruits, vegetables, post-harvest loss, ambient temperature, IoT, Solar insolation, cold chain

TS14-6

Overview on super critical CO_2 extraction of functional bioactive from Flaxseeds and its in-vitro antioxidant, antimicrobial and therapeutic efficacy

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Plant bioactive have been increasingly viewed and emerged as most abundant source of phytochemical for treating numerous illnesses, including neurological disorders, due to their strong anti-inflammatory, antioxidant, chemo-preventive, anti-microbial, and anti-tumor activities. Green extraction technologies like Supercritical Fluid Extraction (SCFE) can certainly conform to all the recent as well as likely future regulations pertaining to safety, health, and environment. Supercritical fluid extraction (SCFE) has gained increasing interest in a variety of industries over other extraction technologies because it can provide high solubility, improved mass transfer rates, and improved selectivity with small changes in process temperature and pressure.

Flaxseed (*Linum usitatissimum* L.) is the mostly studied oilseed to date as a functional food and it has a great economic importance. Flaxseed contains almost 40% oil content. The oil has approximately 45-55% α-linolenic acid (ALA) of its total fatty acid content, hence regarded as a rich natural source of ALA which is a ω-3 fatty acid and also rich in phytosterols, for example, b-sitosterol, campesterol and stigmasterol tocopherols. In addition, flaxseed mucilage has a high water-binding capacity which can enhance the consistency, stability and viscosity of beverages. This mucilage has prebiotic potential (i.e., ability to modulate gut bacteria), and also provide bulking effect to stools thereby controlling constipation and irritable bowel syndrome, and body weight. These bioactive components seem to act on many cellular functions in body immunity, preventing inflammation, reducing the absorption of low-density lipoprotein (LDL), decreasing cardiovascular diseases, inhibiting the oxidation of cholesterol, decreasing the risk of other chronic diseases such as type 2 diabetes and cancer, and protecting against neurogenerative disease like Alzheimer's. In order to get the complete benefits of the oil and other bioactive components, the optimization of method of extraction is of prime importance. Literature reveals that supercritical extraction of flaxseed provides better yield of oil as well as bioactive components. As a part of experimental design, a central composite design (CCD) combined with response surface methodology (RSM), has been reported by researchers, for optimizing supercritical CO_2 extraction conditions including pressure, temperature, and extraction time being the independent variable for the extraction of essential oils from Flaxseed.

Keywords: Flaxseed, Supercritical Fluid Extraction, Plant bioactive, response surface methodology, α-linolenic acid, Alzheimer's disease

Technical Session-15
Innovative approaches in food processing

TS15-1

Electrohydrodynamic Drying: An Innovative Approach for Sustainable Food Processing

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Drying is an important processing technique which aids in food preservation by lowering the water activity. With rising consumer awareness about health, there arises a need to develop a drying technique which simultaneously fulfills the criteria of causing minimum damage to food and being less energy intensive, enhancing the drying rates and being economically feasible and environment friendly. This is the point where electrohydrodynamic (EHD) drying of food comes into light. Electrohydrodynamic drying is a non-thermal drying technology which uses the electric wind, generated in the air by application of non-uniform and high voltage electric field, for drying. Its use was reported for the first time for drying of potato slab and since then several other researchers have successfully reported it for dehydration of rice, shrimp, banana slices, to name a few. The EHD drying technique increases the drying rates of food, preserves the quality characteristics of food, and requires lesser energy and thereby lesser costs than its conventional counterparts. The specific energy consumption (SEC) in EHD drying is lesser than its conventional counterparts, for e.g., spouted bed drying (one of the most energy-intensive conventional drying technique) has average SEC several times higher than EHD drying using needle electrodes. This makes EHD drying a cost effective alternative drying technology. EHD-dried foods are free of atomic or molecular species from the electric wind, thereby making them safe for human consumption. Overall, EHD drying can serve as a novel and sustainable food processing technology.

Keywords: Electrohydrodynamic; Drying; Food Processing; Electric Wind; Non-Thermal; Sustainable.

TS15-2

Microwave Treatment of Bael Juice in comparison with pulsed light and thermal processing

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Microwave heating (2,450 MHz frequency) is an advanced thermal processing technology and have great potential in achieving microbiological safety and good nutrient retention. The search for better processing alternatives for safe and high quality products attracts researchers towards advanced thermal or non-thermal processing techniques. Pulsed light technology (200-1100 nm wavelength) is also gaining attention because of its non-thermal and environment-friendly characteristics to provide and safe and quality products. Among many tropical fruit juices, bael is very nutritious and have great aroma, its juice is not available as commercial product and thus prone to wastage. The study aims to explore the effect of microwave processing on quality (microbes, spoilage enzyme, colour change, and bioactives) of bael juice in comparison with pulsed light and thermal treatment. Batch and continuous microwave (powered with 1800-2000 W magnetron) of bael juice at "10-100% power for 10-150 s" and "flow-rate of 0.62 mL/min at 100% power", respectively. Batch thermal treatment at 70-95 °C for 2.5-7.5 min and pulsed light treatment at 10 J/cm^2/pulse for 3 and 4 min was performed for comparison. Significant effect of all the three techniques was visible. Thermal treatment showed maximum loss of ascorbic acid, total phenol, antioxidant capacity and colour. 5D reduction in E.coli (ATCC 43888) was reached in all technologies, but it was reached faster in case of batch microwave. 90% inactivation in PPO and POD, and 5D reduction in aerobic and yeast-mold count was only achieved by thermal treatment at 80 °C, 7.5 min and 90 °C, 2.5 min.

Keywords: Microwave processing, pulsed light treatment, thermal treatment, microbial safety, general bioactive compounds

TS15-3

Non-Thermal Cold Plasma treatment for shelf-life enhancement of Fresh Strawberries (Sweet Charlie) for Improving Commerciality

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Non-thermal cold plasma is a novel technology that uses reactive species of air for surface disinfection of fresh/processed produce, packaging material, and any other contaminated surfaces at low temperatures. It is an innovative approach for the safety and quality retention of food products with potential commercial prospects. The study was aimed to reduce the microbial load and enhance the shelf-life of strawberries by applying nonthermal cold plasma.

Dielectric barrier discharge (DBD) cold plasma treatment was applied on freshly harvested and fully matured strawberries. The treatment was carried out in an acrylic container. A treatment voltage of 40 kV was given for 2 min and held for 1h in the treatment chamber. Storage studies were done for 5-days keeping both the treated and untreated sample in clamshell at 20^{o}C. The average moisture content of the strawberry was 93.011 % (wb). The untreated sample deteriorates on the 2nd day of storage, while the cold plasma-treated sample remains good for 5-days. Treatment with cold plasma on strawberries reduces the microbial count from7.93 log CFU/g to 5.60 log CFU/g. Weight loss during the storage was observed to be 10.88%. Analysis showed that the pH level of the treated sample was reduced by 6.097%. The TSS of the treated sample was increased by 30.16% during storage. The vitamin C content of the treated sample decreases from 55.22 to 39.32 mg/100g. The contents of total phenolic were reduced by 30.20 % during the storage period. Thus, the cold plasma treatment may be easily applied to improve the commerciality of fresh strawberries.

Keywords: Cold plasma, storage, microbial, vitamin C

TS15-4

Radio Frequency based disinfestation System

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Considering the rise in pests & insects during storage of food products, the aim is to design a RF based disinfecting system. The exchange of electromagnetic energy in the process of RF heating is mainly used to generate heat within the product acting as a dielectric between the electrodes, initiating volumetric heating due to frictional interaction between molecules. The continuous change in polarity of electrodes causes, the molecules try to realign themselves with the electric field by flip-flop motion. The resulting kinetic energy and friction caused by colliding neighbouring molecules generate heat within the product. The main challenging part is to have diffential heating between pathogens and grains to achieve objective of disinfection of grain without damaging it as well as provide sufficient isolation RF radiation produced from outside environment. This thermal energy utilization for disinfestation operates in 27-12 MHz frequency of ISM band and maximum power achieved in case of solid state approach is 2.5kW. The generated power monitoring is done through electronics, sent to an independent control panel for displaying data from different sensors such as grain temperature, power levels, and other sensors, operating of the system features and interlocking purpose.

The main advantages of the above system includes reduction in overall drying and disintestation operating costs, suitable for all types of embroyic stages of insects and effective in removing low moisture levels. Seed treatments, pasteurization, food preservation and food quality control are some of its major field related applications.

TS15-5

Rapid determination of fish freshness (Tenualosa Ilisha) using Ag doped SnO_2 patch electrode low cost sensor

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Tenualosa Ilisha fish is one of most popular and sought-after food fish due to its excellent taste. Its trade is affected due to supply of inferior quality which can lead to serious health issues. Fish freshness is essential for preservation of its nutritional value. The conventional methods for the determination of fish freshness are tedious and time-consuming making it inappropriate for on-site and real-time use in different stages of fish supply chain and trading. Here, we report an onsite rapid determination of fish freshness using metal oxide nanostructure based patch electrode capacitive sensor. The capacitive sensor using Ag-doped SnO_2 as sensing material on SiO_2/Si substrate and Al as patch metal electrode was calibrated with known composition of target volatile amine gases Ammonia (NH_3), Trimethyle amine (TMA) and Dimethyle amine (DMA) (biomarkers for fish freshness) under dry air with 20% relative humidity at 30 ^{O}C. The sensing results of these volatile gases mainly emitted from its spoilage is almost close to that obtained from total volatile basic nitrogen (TVB-N) test. The accepted storage time of fish freshness for healthy consumption of Illisa at temperature 30 ^{O}C is found to be 11.5 hours by using our method. The sensor response time and recovery time are obtained as 60s and 175s respectively.

TS15-6

Influence of γ-irradiation on antioxidant, thermal and rheological properties of native and irradiated whole grain millet flours

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Millets of different types like Barnyard (*Echinochloa utilis*), Finger (*Eleusine coracana*), Foxtail (*Setaria italic*), Kodo (*Paspalum setaceum*) Little (*Panicum sumatrense*), Pearl (*Pennisetum glaucum*) and Proso millets (*Penicum miliaceum*) are staple foods for Indian and African diets. The germination, fungal and microbial contamination leads to postharvest losses mainly due to poor warehouse storage in Asia and Africa. Six millet varieties conditioned at 12% and 14% moisture content and irradiated at a dosage of 2.5 and 5 kGy and then milled into flours. The flour was analysed for composition, antioxidant and the rheological and thermal properties. Pearl, Proso, Finger Kodo at 12% moisture contents showed significant ($P \leq 0.05$) increase in Phenolic contents at 2.5 kGy level of irradiation treatments compared with native and 5% irradiation treatment level. The DPPH activity showed an interesting results (42.77– 72.65%) with wide variation and a mixed trend of high and low results with irradiation. Thermal transition temperatures showed that the irradiation decreased the transition temperatures primarily due to loss of the crystalline and amorphous starch structure due to radiation that lead to rapid water uptake and shorter time to reach peak viscosity. We are further studying the application of the irradiated flours in different food products to understand the influence of irradiation on nutritional, sensory and functional properties in cereal-based products.

Keywords: Antioxidants, irradiation, millets, pasting properties, thermal properties.

TS15-7

Synthesis of kaempferol nanoparticles by using *Moringa oliefera leaf* extract, extracted with CO_2 supercritical fluid extractor: a green technology

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Moringa has been used for centuries due to its medicinal properties and health benefits. Kaempferol is a non-polar dietary flavonoid found in Moringa oliefera leaf. Due to its thermolabile nature people are facing challenges to extract it from natural sources at high temperature. Nonpolar nature of kaempferol is one of the challenges to extract it with hot water. As per available literatures a selective extraction for Kaempferol from Moringa oliefera based on CO_2 supercritical fluid extraction may formulate by selecting Temperature (40 °C to 80 °C), Pressure (10 MPa to 30 MPa), Extraction time (60 min to 150 min). The kaempferol yield increased with the decreasing temperature and pressure and increasing the time of supercritical CO_2 extraction process. It turned out that extraction of Kaemferol was strongly affected by Pressure (bar) and the extraction time (minute). 11 g/kg Kaemferol yield was extracted from tea seed cake. 52.92 mg/kg kaemferol was extracted from Cuscuta reflexa.1700 mg/kg of kaempferol was extracted from Moringa oliefera with conventional method (hot water extraction) which may be increased with CO_2 supercritical extraction process. Kaemferol have wide range of pharmacological activities like antioxidant, anti-inflammatory, antimicrobial, anticancer, cardioprotective, neuroprotective, antidiabetic, anti-osteoporotic, estrogenic/antiestrogenic, anxiolytic, analgesic and antiallergic activities. To maintain its activity for long time it can be ecapsulated with certain polymers. Supercritical extracted kaempferol extract can form concentrated kaempferol nanopartciles (K-nPcl) due to its high purity extraction compared to other extraction methods. As kaempferol have high value in pharmacological and food applications it has high demand in market. The method of extraction of kaempferol from Moringa oliefera using CO_2 supercritical process is novel and may be the cost effective.

Keywords: Optimization; *Moringa oliefera* ; Kaempferol; CO2 supercritical fluid extraction; Nanoprticles

TS15-8

3D printing as novel production tool for development of heat desiccated dairy based functional products

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The demand for foods with specific functionality and nutrition is increasing. The technology of 3D printing aims at elevating the product profile with customized structure, texture, nutrition, and functionality. The present study investigated the feasibility of inulin as a promising functional ingredient in the development of functional heat desiccated dairy systems. The effect of incorporation of inulin (0,2,4%) on the rheological, color and sensorial attributes along with 3D printability of heat desiccated milk semi solids was explored. Results concluded that increased level of incorporation enhanced the printability of heat desiccated dairy systems for extrusion-based 3D printing, which could be observed from the dimensional stability of the 3D printed structures. Moreover, incorporation of 4% inulin provided printed structure closest to the target geometry. Addition of inulin had a significant effect on the mechanical and viscoelastic attributes as displayed by the increased viscosity, storage moduli and gel strength. Post-printing acceptability of the 3D-printed functional dairy systems was evaluated in terms of color and sensorial attributes. Incorporation of inulin had a significant effect on color as compared to control. Also, the 3D printed products exhibited acceptable scores for attributes such as appearance, stability, flavor, and texture. The present work could help to formulate designer foods with enhanced functionality to combat shortfalls in health in present lifestyle.

Keywords: 3D Printing; Functional foods; Heat Desiccated Milk Semi solids; Sustainable

Technical Session-16

Functional, Nutraceutical and Health Foods

TS16-1

Utilization of neem products and its bioactive compounds in Pharmaceutical and Food Industry

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Neem (*Azadirachta indica)*, a commonly produced plant source in India and nearby countries, has always been appreciated and used for its medicinal value since ancient times. The different parts of Neem have shown good antifungal, antibacterial and pesticidal effects, and thus are being used for protecting the crops and trees. Neem oil, neem leaf extract, neem juice etc., are some of the neem- products that are commonly available in the market. Neem-products are usually not consumed directly; but are mostly used for external usage like treating dental, skin, fungal problems, etc. Neem extract enhances the immunity of body and is consumed in diluted form. Neem products also have wide application in cosmetics and pharma industries and are used in creams, soaps, solutions for bath, tooth paste etc. Neem is also a prominent source of many bioactive compounds. These bioactive compounds along with neem products have high pharmaceutical and nutraceutical potential. Few of these bioactive components like azadirachtin and nimbolide, have been studied extensively for their use in pharmaceutical and food industry. Recent advancements have helped in extension of use of neem extract and neem bioactive compounds in food packaging systems; as antimicrobial/preservative agent in food systems; for cure of chronic as well as mild illnesses; in cosmetic industry, etc. This review throws light upon the utilization of neem tree, its parts, products and bioactive compounds in agriculture, pharma, food and other fields.

Keywords: Neem, bioactive compounds, application of neem, medicinal value.

TS16-2

Dragon Fruit: Nutritional, antioxidative health benefits

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Dragon fruit, known as *pitaya* or *pitahaya* belongs to the *Cactaceae* family. Due to its nutritional and functional potentials as well as its appearance, there is an interest in dragon fruit among consumers on the world market. Besides being consumed fresh, dragon fruit can also be processed into, for example, juice and puree. Dragon fruit and its products may be used as ingredients for innovative food products that respond to consumers' interest. Dragon fruit is healthy and nutritious for human health due to its essential nutrients such as vitamins, minerals, complex carbohydrates, dietary fibers and antioxidants. It exhibits anti-inflammatory and antidiabetic properties with a suppression effect on cardiovascular disease including cancer prevention potential. Dragon fruit promotes the healing of wounds and cuts. Moreover, this fruit improves appetite, eyesight and memory of human being. It has old-age retarding properties, cancer-preventing effects, and positive effects on metabolism, digestion, immune system, reinforcement of bones, clear vision, oxidative stress, prevent colon cancer, diabetes, fighting against cough and asthma, increase the wound healing properties and cardiovascular diseases. It strengthens the immune system, increase haemoglobin and erythrocyte levels, limit cholesterol level, and are used in the treatment of diabetes. Medicine made from its flower and stem improves blood circulation. These effects draw the attention of food and pharmaceutical industries towards using this fruit in controlling various diseases and vital health-promoting factors.

Keywords: Dragon, Cactaceae, Anti-inflammatory, Immunity, Antioxidants.

TS16-3

Development of Nutraceutically Improved Indian Savory Snacks using Okara

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Introduction: Study was carried to determine the effect of partial replacement of bengal gram flour with soy-okara powder in traditional Indian snacks and to identify the retention of isoflavones in developed snacks. The study has been conducted with the following objectives:

a) To develop savory snacks by replacing Bengal gram flour with okara in different proportions.
b) Comparing nutrition through physico-chemical analysis.
c) Determination of textural and antioxidant properties of snacks prepared from blend of okara powder and bengal gram flour.
d) Studies on retention of isoflavones in prepared snacks were conducted using HPLC.

Methodology: Different samples were prepared by replacing bengal gram flour with okra powder at three different levels to prepare different compositions. A control sample was also made using bengal gram flour. Auto hydro dryer machine was used to remove excess oil. All the samples were analyzed based on above objectives.

Salient Findings and Conclusion: Significant effect was observed on different parameters on partial replacement of bengal gram flour with soy-okara. Protein and hardness value increased with increase in amount of soy-okara. Appearance, colour, texture, flavor and overall acceptability of the prepared samples increased up to certain level but beyond that reverse trend were observed. The shelf life was found at par with the control sample along with goodness of soybean.

Keywords: Soy-okara, Snacks, Savory item, Isoflavones.

TS16-4

Nutraceutical functions of *Lagerstroemia speciosa* derived bioactive material Corosolic acid

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Corosolic acid is a biologically active compound isolated from many plants including *Lagerstroemia speciosa.* This bioactive compound has different functional properties. Here it has been discussed the structure and different sources of corosolic acid. Furthermore, corosolic acid shows various pharmaceutical properties such as antidiabetic, anti-carcinogenic, anti-inflammatory properties which have been elaborated hereby. It is considered a natural compound for anti-diabetic therapeutic application. Corosolic acid is a major compound of glucosol and glucofit having commercial value. Around 0.89% of corosolic acid content is found in *Lagerstroemia speciosa* leaf. It occurs with its structural isomer masilic acid. Two extraction methodologies have been discussed. Furthermore, due to its hydrophobic and lipophilic nature, the development of nanostructured lipid carriers loaded with corosolic acid has also been discussed.

Keywords: Lagerstroemia speciosa, corosolic acid, anti-diabetic property, anti-cancerous property.

TS16-5

Effect of Processing on the Physico-chemical & Functional Properties of Muskmelon *(Cucumis melo.)*

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Cucumis melo L. is underdeveloped fruit of the Reticulatus type, usually called muskmelon belongs to the family Cucurbitaceae. In this study two selected varieties of Muskmelon i.e. Sarda and Bobby Muskmelons were taken as sample. Consumer awareness and acceptance of Sarda and Bobby Muskmelons was studied. Data was collected from 200 panellists by generating google form showing people have knowledge of both the varieties and this does not depend on socioeconomic factors. To analyse the results descriptive and inferential statistics were used. Various food properties were determined such as Engineering, Organoleptic, Physico-chemical, Nutritional, and Functional Properties. Engineering properties such as Physical (geometric and gravimetric), Frictional, Optical, Textural properties were evaluated of whole fruit and seed. Sarda has shown higher results than Bobby. In case of Organoleptic properties overall rating was 7 for Bobby and 2 for Sarda was given on the basis of appearance, shape, colour, aroma, taste, texture and juiciness. Physico-chemical properties of Muskmelon juice of both varieties such were also analysed. Both the varieties. have shown almost similar results. Further effect of processing on Nutritional and Functional properties was studied which includes pigments, proximate composition, Total phenolic content, Total Flavonoid content, Total Antioxidant capacity, Ferric Reducing Power, Tannin content which shows that lyophilisation preserve more nutritional and bioactive components than oven dried. Both the varieties have shown significant results. Lastly, wine is developed from muskmelon and Physico-chemical and Functional properties of wine was determined.

TS16-6

Ice cream remade: a sustainable, cruelty free approach

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Ice-cream production, involves the usage of animal-based gelatin and fat. Countering the problems faced by factory farms, we propose the usage of microbial based gelatin and transglutaminase for the production of 'a sustainable ice cream.' Microbial transglutaminase (MTGase) is gaining interest of food industry with its usage leading to food products with high physicochemical stability due to the formation of cohesive protein structure. Application of MTGase to a dairy product is known to improve their nutritional as well as technological aspects through intramolecular cross linking. The networked dairy proteins improve consistency, give greater overrun, melting resistance, fat destabilization, increased flow behaviour index and pseudoplastic properties to ice cream. Additionally, MTGase led to a reduction in the firmness of the ice cream showing an inverse relationship with fat content. Hence, making it cost effective by decreasing the fat and stabilizing content. Multi-functional enzyme (MTGase) added into ice cream gave a more sustainable product by modifying functional properties incorporating amine, cross-linking deamidation.

Gelatin has been a crucial component of ice cream. Using animal-based gelatin problems including animal cruelty. Vegan alternatives exist but they hamper quality of the product. rGelatin from Pichia pastoris GS115 strain has a similar structure to that of natural gelatin. Using synthetic gelatin in ice cream would allow precise control of chemical composition, molecular weight and its production. Furthermore, it will also help prevent diseases such as Bovine spongiform Encephalopathy (BSE). We, therefore propose to make a very sustainable, cruelty free ice cream using microbial MTGase and Gelatin.

TS16-7

Nutritional and Antioxidant Composition of Hemp Seed Extracts

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Hemp (*Cannabis sativa L.*) is an herbaceous plant and is primarily grown because of its industrial use for fiber and medicine. Its cultivation is regulated by the governments because of the availability of psychoactive components, especially tetrahydrocannabinol (THC). However, its seed is generally free or has a negligible amount of those components and is therefore extensively used as valuable edible food. It has undeniably high protein and oil content ranging from 25 to 30% each and a good proportion of unsaturated fatty acids. The antioxidant and polyphenolic properties of hempseed have long been over-shadowed. The purpose of this study was to investigate the nutritional and antioxidant content of hempseed fractions produced by a multistage crushing, sieving and aspiration unit. Whole hempseed, hull and seed heart were the three fractions tested. The average protein content recorded for each of the three fractions was 23.6%, 10% and 35% for whole seed, hull and heart respectively. Total polyphenol content in whole hempseed was found 1.52 mgGAE/g, whereas, hull and heart had 2.48 mgGAE/g and 0.71 mgGAE/g, respectively. A positive relation between TPC and antioxidant activity was detected. Trolox equivalent antioxidant activity for DPPH radical for whole seeds, hull and heart, extracted using 80% ethanol was 5.31 µmol, 11.77 µmol and 2.28 µmol respectively. The study suggests the potential of hempseed hull as a good source of natural antioxidants. Considering the bioactive properties of different hempseed fractions, it could potentially be used as a functional food ingredient or as a dietary supplement.

Keywords: Hempseed fractions; Hempseed protein; Polyphenol; Phytochemicals and antioxidant activity; DPPH.

Technical Session-17
Functional, Nutraceutical and Health Foods

TS17-1

Development and Evaluation of Functional Milk Fortified with Omega-3 Fatty Acids, Phytosterols and Soluble Dietary Fibre

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Milk, considered as near complete food, has very low levels of omega-3-fatty acids and phytosterols and lacks fibre. It, however, fulfils the requirements of an ideal vehicle for fortification with these substances. In this study, attempts were made to develop and evaluate the milk fortified with omega-3 fatty acids (flaxseed oil as source of α-linolenic acid), phytosterols (commercially available source) and soluble dietary fibre (polydextrose as source) through an oil-in-water emulsion. The preparation of the emulsion involved the usage of flaxseed oil and milk fat as source of oil, polydextrose solution as an aqueous medium and Diacetyl tartaric esters of mono-diglyceride (DATEM) as an emulsifier. Based on the different combinations of the fortificants in emulsion tried, it was observed that flaxseed oil, phytosterols and polydextrose can be incorporated at 0.5, 0.5 and 1% levels, respectively without adversely affecting the inherent sensory and physico-chemical properties of milk. Upon storage of one week did not significantly influence physico-chemical properties of fortified milk and also the sensory attributes except flavor. Moreover, no loss in initial content of α-linolenic acid, phytosterols and polydextrose had occurred after one week of storage. Two servings of the fortified milk per day would provide almost the entire recommended requirement of α-linolenic acid, phytosterols and soluble fibre and thereby enhance its nutritive and therapeutic values.

Keywords: Milk, Flaxseed oil, Phytosterols, Polydextrose

TS17-2

Jack Fruit Functional Candy-lollypops

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The jack fruit (*Artocarpus heterophyllus Lam*) is a multi-purpose tree that provides food, fodder, timber, fuel. Both immature and mature fruits consumed in different local dishes; soft-type ripe fruits remain underutilised due to poor shelf life despite their immense potential. The present investigation developed fruit-based hard candy and lollypops that showed better acceptability, storage stability for more than 10months, rich mineral composition, and consumer safety. The study proved that it is possible to convert soft-jackfruit pulp into functional candies instead of wastage. The water activity(a_w) ranged from 0.46 to 0.58 during 14 months of ambient storage and found acceptable by all age groups.

The nutritional composition were moisture (2.45g/100g), protein (1.30g/100g), total ash (0.59g/100g), carbohydrates (94.57g/100g) and energy (393.30 KCal/100g). Calcium (42.38mg/kg), Potassium (3309.42mg/kg), Magnesium (263.75mg/kg), and Sodium (239.08mg/kg). Among the trace minerals, Chromium(2.04mg/kg), Copper (3.00mg/kg), Iron(40.19mg/kg), Gallium (0.155mg/kg), Manganese (2.47mg/kg) and Zink (3.64mg/kg). Others elements like Lithium(0.04mg/kg), Gallium (0.15mg/kg), cobalt (0.05mg/kg), Cadmium (0.007mg/kg), Barium (1.02mg/kg), Silver(0.02mg/kg), Nickel(0.31mg/kg) and Strontium 0.59 mg/kg) found in traces and Bismuth, Indium and Thallium was found below the detection limits. The process is cost-effective to convert waste into a new value-added product, besides additional income for the producers and self-help groups.

Keywords: Hard-boiled candy, Functional fruit candy, Jack fruit candy.

TS17-3

Development of herbal tea using bael leaves and determining the nutritional and organoleptic properties of developed product

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The study's purpose was to create a nutrient-dense herbal tea with therapeutic benefits prepared from bael leaves. The purpose of this study was to determine the nutritional properties in herbal tea, and their organoleptic properties. There were two trials of bael leaf herbal tea: one with powdered bael leaves and one with dried bael leaves. Tulsi, ginger, and cardamom were among the other herbs used in the herbal tea, resulting in a wide range of flavours. The organoleptic acceptability of this tea was graded on a nine-point hedonic scale, and the production methods was standardised. Protein, energy, zinc, and iron are all present in moderate amounts in the samples. In a lab, the iron, saponin, and iron content of samples A3 and B3 were determined.

The iron and saponin concentrations in the control were 3.90 and 12.39 mg per 100 gm, respectively, but they were 21.30 mg and 148 mg per 100 gm in sample A3. Sample B3 contained 19.25 mg of iron and 142 mg of saponin. There were no tannins in any of the samples. The most acceptable samples, according to the sensory evaluation, are sample A1 from trial 1 and sample B2 from trial 2. Because all of the samples are acceptable, the herbal tea can be easily made with the components added based on the availability of bael leaves or bael leaves powder. It is safe to drink the herbal tea 3-5 times a day.

***Keywords*:** Bael leaves, Aegle Marmelos, antioxidants, herbal tea, Saponins, tannins

TS17-4

Extraction of bioactive compounds from *Terminalia chebula* (Haritaki) using Novel technologies and Development of functional food (yoghurt) using encapsulated powder

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Nowadays, medicinal plants are a thrust area for research due to their special attributes as a large source of bioactive compounds that may lead to the development of novel drugs or functional food. *Terminalia chebula* (Haritaki) fruit is an important constituent of the many medicinal preparations in the Ayurveda system of medicine. Thus, to utilize the bioactive compounds in the formulation of functional food, the present investigation has been focused on the extraction of bioactive components from dried fruit using green technologies (supercritical fluid extraction (SCFE), microwave-assisted extraction (MWE), ultrasound-assisted extraction (UAE) and enzymatic method). The use of novel and combined technologies enhanced the mass transfer rates, increases cell permeability as well as increasing secondary metabolite diffusion, leading to higher extraction yields. In comparison to all extraction process, Ultrasound-Microwave-Supercritical fluid extraction (UMS) yield higher extraction of bioactive compounds. The extracted bioactive compounds were encapsulated via freeze-drying using potato starch and zein as a carrier at a different ratio. The encapsulated powder produced from pure starch, results in appreciable properties like the highest encapsulation efficiency, physical properties, flow behaviour and functional attributes. Based on these, outcome, starch encapsulate was further incorporated in yoghurt to observe the stability and interaction with active constituents. The yoghurt was prepared from pasteurized milk at 43 ℃ and studied for physicochemical properties (acidity, TSS, pH, color, syneresis) and bioactive properties (phenol content and antioxidant properties).

Keywords: *Terminalia chebula*, Extraction, Functional Food, Phytochemicals, Zein, Microencapsulation

TS17-5

Effect of Processing on the Physicochemical & Functional Properties of Watermelon

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Watermelon **(*Citrullus lantanas*)** is a nourishing and popular fruit in the world. Watermelon is grown in favourable climates from tropical to temperate regions worldwide belong to the family Cucurbitaceae. In this study two selected varieties of watermelon such as Sugar Baby and Century Watermelons were taken. This study was done to know about consumer awareness and acceptance of Sugar Baby and Century Watermelons. Data was collected from 200 panellists by generating google form. To analyse the results descriptive and inferential statistics were used. Various properties such as Organoleptic, Engineering properties, Physicochemical properties were estimated. In case of Organoleptic properties overall rating was given according to the Appearance, Shape, Colour, Aroma, Taste, Texture and Juiciness. Engineering properties such as Physical (geometric and gravimetric), Frictional, Optical, Textural properties were evaluated of whole fruit and seed. Geometric properties such as length, shape, diameter, fruit weight, seeds/fruit, rind thickness pulp thickness, juice volume, weight (rind, seeds, pulp, pomace), sphericity, one seed mass, ten seed mass, 100 seed mass, 1000 seed mass, Arithmetic mean diameter, geometric mean diameter, moisture content were evaluated. Gravimetric properties such as Mass, Volume, Projected area, L-D Ratio, L-Mass Ratio, Fruit mass ratio, Bulk density, True density and Porosity was evaluated. Frictional properties such as Angle of repose and Static coefficient of friction were determined. Optical properties such as L, a, b, Chroma and hue° were determined. Mechanical properties such as Rupture force, Toughness, cutting force, Maximum Shearing Force, Shear Strength was determined. Physicochemical properties of watermelon juice of both varieties such as Reducing Sugar, Non- Reducing Sugars, Ascorbic acid, Refractive Index, Concentration, Density, Specific gravity, Shelf life, pH, TSS, Titratable acidity and moisture content was estimated. Further effect of processing on Nutritional and Functional properties was studied which includes pigments, proximate composition, Total phenolic content, Total Flavonoid content, Total Antioxidant capacity, Ferric Reducing Power, Tannin content. In the end wine is developed from watermelon and Physicochemical properties of wine was determined.

TS17-6

Development of Sweet Curd (Dahi) incorporated with Beet Root Juice

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The main aim of this study was the development of sweet curd incorporated with beetroot juice and to measure the feasibility and other properties of beetroot juice in the manufacturing process of Curd (Dahi). Five samples of curd were developed with added sugar (12%) along with a control sample (Normal curd). Four curd samples were incorporated with 0.5ml, 1ml, 1.5ml, and 2ml of beetroot juice in pasteurized full cream milk (Fat-6% and SNF-9.0%). Samples were tested for various physico-chemical, microbiological, sensory evaluation, and shelf life. Data analysis of different parameters of color, pH, TSS, acidity, sensory, TPC, water holding capacity, and moisture content were self-recorded and analyzed. As per results, the physical qualities of sweetened curd were improved with the addition of beetroot juice to cultured milk before fermentation at 40˚C. Sugar increased the flavor and sensory parameters of curd and decreased the fermentation time of curd in controlled incubation. The sample with 0.5ml beetroot juice possessed better smell and taste while the sample with 2ml beetroot juice showed superior results for consistency as well as color and taste. Addition of beetroot juice decreased the PH value but increased the total solids content, moisture content, acidity and the bacterial count in the curd. Study suggested that curd could be successfully produced by incorporating 2% beetroot juice. Production of sweet curd from pasteurized milk which is easily available in local market, by incorporating a cheap additive (beetroot juice) will make curd processing popular and profitable.

Keywords: Sweet curd. Beet root juice and Dahi.

TS17-7

Comparative study of Functional Properties of different flour samples prepared using bracts of Banana Inflorescence of *Musa accuminata* Colla. dried under different conditions

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The bracts are the outer reddish, maroon-colored leaves like structure of banana inflorescence which is an agricultural waste and produced in abundance. The bracts are protecting naturally the underlined florets which are arranged in rows along the floral stack. A very few literature available that indicates the presence of abundant antioxidants that made it a source of good nutritional food. The active ingredients of bracts made it a popular among the researchers working on the development of a functional food and nutraceutical. Functional properties describe nature of food ingredients during the preparation and cooking and their impact on finished food products in terms of appearance, texture, structure, and tastes. The functional properties of foods and flours are influenced by the components. Food contains ingredients which have a specific function often influence the functional properties of food. Most of the procedure food undergo commence the onset of some functional properties. In this research functional properties of dried bracts (Bulk density, True density, Porosity, Angle of repose, Syneresis, Emulsion activity, Emulsion stability, Paste Clarity, Foaming, Swelling Power, Gel Consistency, Oil absorption, Water absorption) were studied. The collected samples were cleaned and dried using freeze-drying and at different heating temperatures (40°C, 70°C and 105°C) to make it a fine flour. The results of the study indicated that the flour samples are suitable for making different food products. This research added value to an important but underutilized by-product.

TS17-8

Processing for the improvement in functionality of peanut protein – An important plant-based protein: A Review

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Groundnut ranks the sixth most important oilseed crop in the world where India ranks second. It plays an important role both as oil and food crop. Groundnut contains 48-50 % oil, 26-28 % protein and is a rich source of dietary fiber, minerals and vitamins. Food and beverages processing industries are keen to include plant-based protein part for innovative products development especially sports drinks, meat analogues, and dairy alternatives. Thus, the industrial demands should be justified with the properties and functionality of the plant-based protein sources as raw ingredients. Peanut protein concentrates and isolates are comparatively cheaper and rich sources of plant-based protein, if the functionality and quality are improved. Enhancement of functional and structural properties of peanut protein can be done by physical, chemical or enzymatic modification. Depending on the level of modifications and final properties, the method is being chosen. The properties can be emulsibility, water binding capacity, gelling capacity, solubility, foamability, film-forming property, texturability or any other. This article includes all possible practices, scope and challenges for enhancing functional properties and producing improved peanut protein concentrates and isolates suitable for various food industries utilizing plant-based protein.

Keywords: Peanut protein, Plant-based protein, Protein concentrate, Protein isolate, Functional properties, Modified peanut protein

Technical Session-18
Functional, Nutraceutical and Health Foods

TS18-1

Dietary approach for management of over nutrition among obese women

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Ready to use rich in dietary fibre multigrain mix was developed for management of over nutrition. The ingredients Italian millet, Bengal gram whole, Horse gram and Semolina etc, were used for the development of RTU multigrain mix. Nutrient content and microbial count of RTU multigrain mix was determined. The different products were prepared utilizing RTU multigrain mix were Upma, Roti and Dhirde. These developed products were evaluated for acceptability. Awareness on over nutrition and health related complications was created through talk/ lectures, demonstrations and exhibitions. A total number of 60 obese women having BMI more than 25 were selected. They were divided into two groups experimental and control (30 each). Pre and post assessment of nutritional status, anthropometric measurements, biochemical parameters and nutrient intake of 30 control and 30 experimental obese subjects was carried out. Results of the study showed that the developed mix was rich in total dietary fibre (28.74 g/100g) and was safe for three months period of storage and products prepared from developed mix were within acceptable range. The mean values of weight, waist and hip circumference of experimental subject were decreased after supplementation. The mean values of per cent adequacy of post intake of fat and energy s were decreased than the pre values in experimental group. Haemoglobin content and HDL levels in experimental subjects were increased significantly. Hence it can be concluded that, 120 days feeding RTU dietary fibre multigrain mix exerted positive effect on obese subjects for losing weight.

TS18-2

Physical, textural and thermal properties of bor-thekera (*Garcinia pendunculata*) fruit

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Bor-thekra fruit (*Garcinia pedunculata R.*) is an underutilized fruit that grows abundantly in the Northeastern region of India, with Assam being a good supply among the northeastern states. Despite its large production and nutritional potential, this fruit's utilization is fairly limited due to issues such as a lack of information about its nutritional usefulness, astringency, perishability, and inadequate processing technologies. In this paper, various physical, chemical, textural and thermal properties of *Garcinia pendunculata* were discussed and different parameters associated with these properties were determined by applying various procedures. The result revealed that this fruit has a high moisture content of 75±2 percent (w.b.), which is the primary cause of its softness and perishability. The sphericity of the GP fruit were found to be 89.91%, hence, it is almost a spherical fruit. Average mass of the fruit was 290.3 gm with length 7.34 cm, width 6.33 cm and thickness 6.21 cm. Bulk density and true density were found to be 0.403 and 0.706 g/c.m3 and porosity of the fruit was 53.89%. Color values of pulp and peel were calculated separately using Hunter lab colorimeter. Properties like hardness, adhesiveness, gumminess, resilience, and cohesiveness has been investigated using texture analyzer. Under thermal properties determination, values of specific heat capacity, thermal conductivity and thermal diffusivity were found to be 3.446, 0.568 and 0.179 respectively. The findings of this study will aid researchers, machine designers, food scientists, and technicians in their planning for the development of processing machines.

Keywords: *Garcinia pendunculata*, Underutilized, Physical properties, Machine design

TS18-3

Effect of chemical modifications on morphological, pasting and crystalline properties of Talipot palm (*Corypha umbraculifera*) starch, a nonconventional source of starch

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Talipot palm is an underutilized nonconventional starch source with a higher yield (76%), which can be used as an alternative to commercially available starch. This study focuses on the effect of chemical modification by acid thinning, acetylation, and oxidation on the physicochemical, morphological, functional, crystalline, and pasting properties.

The FTIR spectra of native and modified starches showed strong peaks at 3420 cm^{-1} and 2940 cm^{-1} are indicating characteristics of O-H stretching vibration and C-H stretching, respectively. In addition, a characteristic peak was observed at 1730 cm^{-1} and 1240 cm^{-1} for acetylated starches, which confirms the esterification reaction. The morphological examination is noticed that the remarkable effect of the chemical treatment on the granules. The swelling power of talipot palm was decreased after the treatment, and acid thinning caused a greater reduction in swelling power, whereas the solubility was escalated after treatment. Acid treated starch did not show any characteristic peak in the viscosity profile. Acetylatilated and oxidized starches exhibited similar pasting profiles to the native counterpart with decreased pasting temperature, peak viscosity, hold viscosity, and final viscosity. All the starches showed A-type crystalline pattern and the relative crystallinity was decreased after modification.

Keywords: Acid thinning, Oxidation, Acetylation, Swelling power, Pasting temperature, Peak viscosity

TS18-4

Exploring Polyphenols and bioactive compounds identified by HPLC from methanol extract of leafy edible plant *Antidesma acidum*, Kokrajhar, Assam, India

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Antidesma acidum is a widely distributed plant in Kokrajhar district of Assam, India. The plant is used as vegetables and known for some ethno-pharmacological effects. The study estimated the bio-active compounds of *Antidesma acidum* leave in methanol extract. 7 polyphenols with prominent biological activity; identified in phyto-chemical investigation with HPLC technique were viz. Protocatechuic acid (0.385±0.01mg/mL), vanillic acid (1.909±0.01mg/mL), Syringic acid (0.0049±0.11 mg/mL), ρ-Caumaric acid (1.971±0.23 mg/mL), Ferulic acid (0.658±0.34 mg/mL) and Quarcetin (1.079±0.12 mg/mL).

Keywords: Phyto-components, HPLC analysis.

TS18-5

Nutraceuticals and dietary supplements: A possible preventive measure to improve efficacy against covid-19.

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Currently Covid-19 pandemic is a leading challenge across the globe. A compromised immune system is a known risk factor for all viral influenza infections. Functional foods optimize the immune system capacity to prevent and control pathogenic viral infections, while physical activity augments such protective benefits. Foods with antiviral properties include fruits, vegetables, fermented foods and probiotics, olive oil, fish, nuts and herbs.

It is mandatory to attain and maintain good nutritional status to fight against virus. Optimal nutrition and dietary nutrient intake impact the immune system, therefore the only sustainable way to survive in current context is to strengthen the immune system. Functional foods and nutraceuticals can be used to modulate and stimulate the immune system for reducing the severity of covid-19 symptoms with immune boosting ingredients like polyphenols, antioxidants, pigments, vitamins and minerals. The nutraceuticals are safe and can be administered to all ages. In addition, combination of natural anti-viral elements and immune-stimulating molecules could be sufficient against others upper-respiratory tract infections as well. However along with the dietary management guidelines the food safety management and good food practices is compulsory. Thus the immune stimulant therapy may support the immune system in the case of covid-19 due to its ability to stimulate the local and systemic immune system, There is no specific model to follow to enhance the immune system against covid-19. However, the more varied the dietary sources, the better the protection is against all viral infections.

Keywords: Functional foods, nutraceuticals, viral infection, dietary sources, immune modulation, covid-19.

TS18-6

Health Benefit Potential of Major Indian Food Ingredients

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Functional foods, Nutraceuticals, Health foods represent one of the most intensively investigated and widely promoted areas in the food and nutrition sciences today. Food providing therapeutic benefits is obviously not a new concept. The tenet, “Let food be thy medicine and medicine be thy food” was embraced 2500 years ago by Hippocrates, the father of medicine. However, this “food as medicine” philosophy fell into relative obscurity in the 19th century with the advent of modern drug therapy. In the 1900s, once again the important role of diet in disease prevention and health promotion came to the forefront. Moreover, in the past one and half years with the emergence of COVID-19 Pandemic, humans have realized the value of ethnic food in balancing their health. India, a country with diverse climatic regions has variety of traditional food preparations with a broad spectrum of ingredients. From aegis, it is known fact that most of the ingredients used in Indian Cuisine are having health benefits. Though, there is an evidence that certain food ingredients play a role in disease prevention and health promotion, safety considerations should also be given paramount importance. Nevertheless, one should also keep in mind that diet is only one aspect of a comprehensive approach to good health. With this purview, an emphasis to understand health benefits and functionality of a few important Indian traditional food ingredients used in Indian Cuisine is made through an integrative scientific network approach. This helps to strengthen the health benefits of the Indian traditional food.

Keywords: Traditional Food, Functional Food, Nutraceuticals, Antioxidants, Food ingredients, Health Benefits.

Poster Sessions

Poster Session-1: Innovative approaches in food processing

PS1-1

Studies on the Processing and Preservation of Dragon Fruit by Formulating Low Calorie, Jam/Jelly

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In India the indigenous fruits are processed into a number of value added products like, jam, juice, jelly, cheese, preserves etc. But the exotic fruits like dragon fruit, kiwi, avocado and their processed fruit products are rarely available in our markets. Dragon fruit is rich in nutritive value. From the literature we can able to find, the dragon fruit pulp contains 82.5-83% moisture, 0.16-0.23% protein, 0.21- 0.61% fat, 0.7-0.9% fiber, 6.3-8.8 mg calcium, 30.2-36.1 mg phosphorous, 0.5-061 mg iron, 8-9 mg vitamin C& 0.20-1.04% pectin. It also contains nutrients, such as carbohydrate, flavonoid, thiamine, niacin, pyridoxine, glucose, and polyphenol. The dragon fruit contains beta-carotene, lycopene and vitamin E, with average concentrations of 1.4 mg/100 g, 3.4 mg/100 g and 0.26 mg/100 g of edible portion, respectively. The seed of dragon fruit contains 50 % essential fatty acids, i.e. 48 % linoleic acid and 1.5 % linolenic acid. The mildly sweet taste and low in calorie of the fruit actually fitted best as a diet for the people suffering in chronic diseases like diabetes, obesity etc.

Therefore, this study is planned to overcome the technological challenges for making proper gel network at best possible low sugar content keeping in view on medicinal and nutritional importance of dragon fruit which would provide opportunity for commercial exploitation of this fruits.

Keywords: Dragon fruit, Gel network, Low calorie, Consumer, Evaluation

PS1-2

Is Cultured Meat –A solution to Covid 19 calls for alternative protein source?

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The origins of SARS-CoV-2, the causative factor of COVID-19, have been linked to wild animals. COVID-19 pandemic is a lesson on a scale of global disturbances that can be induced by zoonoses—the risk of which also exists in relation to livestock farming. While the long-term approach could focus on expanding the production of safe and controlled meat products, it would not eliminate the threats associated with livestock farming. Given the observable and forecasted global trends in meat consumption, realistic alternatives are urgently needed. The highest hopes are likely to be realized with the introduction of cultured meat products. Cultivated (cultured) meat is one of the terms (the others include, e.g., clean, slaughter free meat, in vitro, lab-grown and synthetic meat, or cellular agriculture) coined to characterize the emerging technology which applies the laboratory methods of in vitro cell culture and tissue engineering to produce animal muscle under a controlled environment However, their success requires overcoming specific technological obstacles and social and political issues related to product acceptance. Furthermore, the underlying technology still needs to be investigated and supported economically to ensure that its potential introduction will result in lowering the environmental impact of industrial farming, especially when it comes to energy consumption. Despite that, there is no better moment than COVID-19, which is a reminder about the threats of zoonotic diseases, to mobilize resources to pursue research and development in cultured meat, gain public awareness for these products, and initiate panels on regulatory aspects of their introduction to the market.

Keywords: Cultured meat, zoonoses, environmental impact, food safety, in vitro

PS1-3

Effect of high pressure homogenization on particle size, bioactive compounds and oxidative stability of nanoemulsion of passion fruit peel extract

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Nanoemulsion has become an option for the encapsulation of bioactive compounds, especially the lipophilic one. However, for their incorporation into food systems, it is important to develop nanometric size that is stable under different conditions of its production, transport, and storage. The peel of passion fruit, which comprises more than 50% of the fruit and generally discarded as waste in juice industries, is rich in bioactive compounds like carotenoids, polyphenol, anthocyanins, etc. In this study, bioactive compounds from the passion fruit peel were extracted using ultrasonication assisted extraction method with olive oil as solvent and Tween 80 as surfactant. Nanoemulsions using olive oil enriched with bioactives extracted from peel were formulated by applying highpressure from 100 bar to 500 bar. Nanoemulsions with an average size of 340 nm were produced, which is within the appropriate size for food industrial preparations. The size of naoemulsions decreased with increase in homogenizing pressure up to a critical pressure, and thereafter an increase was observed. However, antioxidant activity and bioactive compounds especially carotenoids and total polyphenol content were significantly higher in the largersized emulsions. The induction time and oxidative stability index of the emulsion was 6.49 h and 12.38, respectively for normal olive oil emulsion, whereas carotenoids-enriched nanoemulsion recorded 12.68 h and 22.18, respectively. Results showed that pressure had significant effect on size as well as antioxidant activity, which will help in designing nanoemulsions enriched with bioactives extracted from fruit peels.

Keywords: Nanoemulsion, high pressure homogenization, passion fruit peel, bioactive compounds, Antioxidant activity, stability.

PS1-4

Effect of ultrasound-assisted extraction on phytochemicals and antioxidant activity ofpigmented rice branextract

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The pigmented rice bran is an underrated by-product from the milling process and currently faces limited use.Despite limitations in productivity, the full potential of pigmented rice remains to be explored in terms of its applications functional foods and nutraceuticals by direct use of its bioactive compounds.An extract from pigmented rice (black rice) bran was extracted using ultrasound-assisted extraction with acidified ethanol (0.1 N HCl). Effect of ultrasound power (100, 200 and 300 W) and extraction time (20, 40 and 60 min) on total phenolics (TPC), total flavonoids (TFC), antioxidants and anthocyanin content of extract were investigated. TPC and TFC for black ricebran varied from27.15-32.10 mg gallic acid equivalent/g and14.74-21.22mg quercetin equivalent/grespectively. Antioxidant activity of the black rice bran extracts was determined by DPPH radical, varied from 62.00 % to 82.21 % inhibition and for red and purple rice bran were 90.93 and 81.42 % respectively. The monomeric anthocyanin content for black rice bran ranged from 11.86-17.54 mg/g and the highest anthocyanin content was found at the combination 60 min and 200 W.

Keywords: Phytochemicals, pigmented rice, ethanol, ultrasound-assisted extraction.

PS1-5

Development of Wine and Grape Juice Powder Using Ultrasonication and Analysis of Wine Powder Via Market Survey: A Review

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As the consumers demand and tightening of food and environmental regulations are increasing, new and powerful technologies have come up as traditional food-processing techniques have lost their optimum performance.From the last few years ultrasonic is one of the fast, versatile, emerging, and promising non-destructive green technology used in the food industry. Several areas of food technology useultrasound to improve the quality of developed product.Ultrasonication is done for extracting multiple compounds from grape juice by applying sound energy to agitate the particles in the sample. Grape juice powder and wine powder are also developed by using ultrasonication method. This review summarizes the effect ofultrasonication on grape juice and it'seffects on physio-chemical properties ongrape juice and wine powder.In this study, a market survey is also analyzed to investigate the consumer view of wine powder and the responses are concluded in the form of pie-chart.

Keywords: Grape juice and wine powder, Ultrasonication,Physio-chemical properties, Survey report and Consumer view.

PS1-6

Ozone Processing: An innovative non- thermal techniques in food processing

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Ozone processing is an innovative techniques in food processing industries. The main purpose of innovative technologies are to upgrade microbial safety and nutritional quality, to improvises the physicochemical properties of food, to take the edge off operating cost requirements, waste management, to escalate the production efficiency etc. Recently, the use of ozone is gradually replacing conventional sanitation techniques such as chlorine, steam or hot water. Its popularity gaining momentum in the food processing industry as one of the safest, most cost-effective and chemical-free way of dealing with food safety management. Various studies have successfully reported about the effect ozone on the biochemistry, of fruits and vegetables, storage of fruits and vegetables like strawberries, kiwifruit, mulberry, citrus, tomato etc. Usage of it also decrease postharvest disease in different fruits. This review can be informative and illuminating for fruits and vegetable industry in term of shelf life aspect.

Keywords: Ozone processing, innovative technology, fruits and vegetables, shelf life

PS1-7

Advanced Microwave Assisted Pasteurization System for Efficient Food Processing

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Microwaves are electromagnetic radio waves that can be used for dielectric heating to extend the shelf life of food products without compromising food safety. Pasteurization is the process that uses relatively mild heat treatment on foods to kill key pathogens, and inactivate vegetative bacteria and enzymes to make food safe for consumption. Pasteurization of milk is achieved by 30 min heating at 63°C or 15 s at 72°C. Food pasteurization by microwave is one kind of green food processing technique, which it does not need chemical preservatives, less energy consumption, and significantly improve food quality. Now a days microwave heating become popular over conventional heating treatment because of fast process, minimum reverse recovery time of temperature. Conventional heating process suffers majorly from non-uniform heat distribution which results in heating spots and overheating which lower the quality and nutritional values. The proposed system is novel in it and assisted with microwave technology which provide uniform and controlled heat distribution, it's also equipped with multiple sensors for controlling the operation and measurement at various places using MIMO system which makes system more accurate and reliable.

Keywords: Microwave, Pasteurization, Sensors, MIMO etc.

PS1-8

Ultrasound-assisted extraction of dietary fiber from pineapple waste and its physical properties

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Pineapple food waste which otherwise contribute heavily to greenhouse gases contains various substances that are valuable for the development of nutraceuticalsand functional foods. The former is very rich in dietary fiber (DF) and can be a cheap substrate, which could be converted intoa high value-added product. Hence with sustainable utilization of pineapple waste and with application of novel technological methods, valuable products from pineapple wastes could be obtained and can be a money spinner.Ultrasound-assisted extraction (UAE)process one of the novel technologiescan be used for the extraction of dietary fiberfrom pineapple waste of Northeast India. The effects of ultrasound-assisted extraction on yield and physical characteristics ofDF were studied. A central composite design was carried out based on solid-liquid ratio, amplitude, and reaction time. Based on the preliminary experiments different solid-liquid ratio (1:40–1:10 w/v), amplitude(20-50 %), and reaction time (10–30 min) were taken to optimize the yield of DF. The best condition to produce DF (87.18 %) was 1:22 w/v, 48% and 26 min for solid-liquid ratio, amplitude, and reaction time, respectively. The physical characteristics of the DF obtained byUAE were examined by water-holding,oil-binding, water-solubility capacitiesand compared with conventional acid-alkali extraction (AAE). The DF obtained by UAE had higher water-holding, oil-binding and water-solubility capacities as compared to AAE. These results evinced that UAE not only increased the yield of DF, but also improved the physical characteristics. Further,UAEcould also be used as a valuable alternative for the sustainable extraction of high value-added molecules forindustrial, food, cosmetic and health applications.

*Keywords:*pineapple waste, dietary fiber, ultrasonic extraction, physical properties.

PS1-9

Microwave freeze drying system for fruits & vegetables

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Microwave frequency spectrum in the frequency band of 300MHz to 300GHz has found vast agricultural applications. Microwave heating is one the unique technology used extensively in drying of crop and high value solids as it has number f advantages like shorter drying time and enhanced food qualities. Freeze drying of vegetables and fruits at very low temperature and extremely low pressure has several advantages but with very high capital requirements and operating cost. Efficient incorporation of microwave heating system along with freeze drying system can speed up the drying rate and increased vegetable and fruit quality.

In the frozen condition of temperature below -10 degree Celsius, power losses in the water content of fruits and vegetable is very less. Microwave energy at frozen level is mainly absorbed by the fruits and vegetable molecules results in direct apply of energy. Thus phenomena causes microwave freeze drying system for fruits and vegetables are more efficient and faster.

Heating pattern of conventional freeze drying is from surface to the core which causes loss of energy and time consuming in materials like vegetables and fruits. In Microwave assisted drying system, greatest advantages are due to the volumetric heating in the penetrated depth which drastically reduces the time required for the drying. When the water in the vegetables and fruits frozen temperature less than -5 degree Celsius, depth of penetration of Microwaves will increases enormously and they can penetrate deep in to the bulk of fruits or vegetables.

Keywords: Microwave heating, Agriculture, microwave-assisted freeze drying.

PS1-10

"Sweet Spoon"-the Sustainable Vegan Yoghurt

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The most significant Challenges faced by the World today is to ensure that the growing population has access to adequate sustainable and nutritious food. Humanity now poses a threat to the stability of the planet-this requires nothing less than a new global agricultural revolution. Replacement of Animal Based Protein is envisaged by combining plant ingredients in a Novel way for giving an experience of Animal Based protein. In the present investigation which is an initiative for the development of Plant based Yoghurt -made solely from plant ingredients intended to replicate dairy based Yoghurt in terms of actual texture, taste and flavour.'Sustainable Spoon 'is a plant-based analogue of dairy based Yoghurt in terms of its unique texture and flavours.Plant ingredients like Peanuts,Almond,Palm Jaggery Syrup and Novel technologies like Roasting, Soaking ,Blanching ,Microwave Heating ,Grinding ,Mixing ,Centrifugation ,Thermal Processing ,Low Temperature Storage ,Inoculation of Microbial Culture ,Incubation of Microbial Culture ,Fermentation have successfully yielded Biomimic Yoghurt. Development ofVegan Yoghurt by effectively combining peanuts and almonds is an alternative way of producing an acceptable nutritious yoghurt based on plant sources thereby reducing global malnutrition and global protein demand.

PS1-11

Detection of Limonin for the measurement of delayed bitterness of citrus fruit juice using Magnesium silicate based capcitive sensor

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Limonin, a highly oxygenated triterpene biomolecule of citrus fruits is responsible for delayed bitterness of citrus juice lowering the consumer's acceptability. The detection of limonin at different stages of processing is essential for suitable debittering interventions. An effort has been made to develop a capacitive sensor using Magnesium silicate as a sensing material that absorbs limonin from the juice sample selectively in presence of other elements. The sensor exhibits high sensitivity (in 4.38µF/ppm detection limit) with low response time (nearly 5 secs). A linear relationship between limonin concentrations and capacitance of the sensor is obtained. The increase of capacitance was observed after exposure of sample under test due to absorbtion of limolin. The sensor has good shelf life and reusable. This promises low cost, on-site, easy and rapid quantification of limonin content in citrus juices.

Keywords: Limonin, delayed bitterness, capacitive sensor.

PS1-12

Spectroscopic Investigation of Heat-Acid Induced Coagulation Mechanism of Whole Milk Systems with Mapping of Macroscale Physical Properties of Coagulated Product (Chhana)

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The heat-acid induced coagulation mechanism of whole milk system (buffalo-BM, cow-CM and mixed milk-MM) was investigated in this study through fluorescence spectroscopy by using Tryptophan (Trp) as a marker molecule. The fluorescence properties were modified more significantly during gelation than pre-heating and cooling of whole milk systems. CM when coagulated exhibited a significant change in emission spectra due to the alterations in protein interactions, leading to a more dynamic environment for Trp residues throughout the reaction as compared to BM. The variation in the emission spectra from MM1 to MM3 samples was gradual as per variation in their whey protein content, denaturation process and association with micellar casein. These findings were mapped with textural and rheological data of the heat-acid coagulated product (Chhana). BM chhana had higher firmness and elastic modulus as compared to CM and MM chhana samples. Total protein, fat, water, and interaction between them along with extent of hydrogen bonding significantly affected the macroscale properties of the coagulated product. Keywords: Chhana, heat-acid induced, fluorescence, texture, rheology.

PS1-13

Effect of dual modification by dry heating and ultrasonication on physicochemical properties of black kidney bean starch

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The present study is aimed to investigate the effects of dry heating (DH) (120˚C, 2 h) and ultrasound (US) (35Hz, 30 min) modification and their combinations (DH-US and USDH) on the physicochemical and functional properties of black kidney bean starch. The textural properties of starch gels (10%) are evaluated by back-extrusion method, in terms of firmness, consistency, cohesiveness and index of viscosity. Significant increment in firmness, consistency and cohesiveness has been resulted in dry heated starch compared to the native whereas, change in Index of viscosity for all the modified starches are remain statistically non-significant. The SEM images for kidney bean starch show mostly oval and round shaped particles. The surface irregularities with slight surface crakes have found to be imparted after US and US-DH dual modifications. Minute changes in colors as well as declination in the value of Lightness is noticed after modifications, where the ultrasound treated starch shows the lowest L value (47.043) among all. Although swelling power and solubility has been increased for all the modified starches, highest swelling power and solubility has been presented by ultra-sonicated starch (10.29 g/g and 15.04%) as compared to native starch (6.84 g/g, 9.79). Moreover, improvement in freeze thaw stability and enhancement in Resistant starch (RS) content are also attributed after single and dual modification of the kidney bean starch.

Keywords: kidney bean starch; dual modification; dry heat; ultrasound

PS1-14

Cold Plasma assisted inhibition of Enzymatic Browning in pineapple pulp and Modelling inactivation kinetics

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Fruits and vegetables are primarily susceptible to enzymatic browning due to enzymes polyphenol oxidase (PPO) and peroxidase (POD). These enzymes need to be inactivated or inhibited in order to avoid undesirable browning reactions and the loss of sensory or nutritional quality. This work aims to study the inhibition of browning reaction by applying cold plasma on pineapple pulp and modelling the inactivation kinetics. Cold Barrier Discharge plasma was used for the treatment of pineapple pulp. The experiment was conducted at different voltage gradients (15, 20, 25 and 30 kV/cm) with varying treatment times (3, 6, 9, 12, and 15 min) and relative enzyme inactivation, quality parameters and their kinetics were studied. The results showed that cold plasma could reduce the activity of both PPO and POD in pineapple pulp. The relative activity of PPO and POD enzymes was significantly reduced with increasing treatment voltage and time. A maximum of 87% PPO and 90% POD inactivation of pineapple enzymes was achieved by Cold plasma treatment. It was also observed that there were the least significant changes of TPC content and %-DPPH inhibition compared to fresh samples. The color value of the samples treated under different treatment conditions was found to be significantly different ($p<0.05$) from the fresh sample. The enzyme inactivation models such as First-order, Weibull, Two-fraction, Hulsheger,Fermi's and Ginger-Segui's models were studied. In all the cases Two-fraction kinetic model and Ginger-Segui's model were best fitted with $|r| \geq$ to 0.99.

Keywords: Non-thermal, Cold plasma, polyphenol oxidase, peroxidase, treatment time, inactivation kinetics.

PS1-15

Extraction and separation of bioactive compounds from pomegranate peel using pulsed ultrasound assisted cloud point extraction (PUA-CPE)

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Pomegranate peel (PP) is one of the interesting agri-food by-products because of its abundant bioactive phytochemicals. However, the bioactivity of valuable compounds is affected due to the extraction method used. Cloud point extraction (CPE) is one of the novel; environment-friendly; energy; time and cost-effective extraction technique. Therefore, in the present work separation of bioactive compounds from aqueous extract obtained after pulsed ultrasonication from pomegranate peel, using CPE.CPE works onthe principle of entrapping the bioactive compounds in the micelle.Pulsed ultrasound-assisted extraction (PUAE) was carried out to intensify the extraction efficacy in aqueous medium. Influence of several process variables viz.concentration of surfactantand electrolyte, pH, and temperature was studied using empirical quadratic models followed by multi objective numericaloptimization with respect to rotatable centered composite design.The optimal process conditions of 5% (v/v) surfactant, 15% (w/v) electrolyte at pH 4.0, and 30 °C temperatureresulted into 152.32 mg GAE/g total phenolicscontent and 59.67 mg QE/g total flavonoidsin pomegranate peel.Number of other bioactive compounds were identified using liquid chromatography mass spectrometry in the resultant extract obtained under optimized condition. US-CPE showed the significantly higher bioactive yield than conventional, normal CPE, ultrasound and microwave assisted extraction with remarkable antioxidant and anti-inflammatory bioactivities. Hence, it can be recommended that PUA-CPEcould be successfully applied in the extraction and separation of bioactive from anypeel or plant systemsfor clean and green extractives label.

Keywords: PUA-CPE; bio-actives;pomegranate peel; antioxidant bioactivities; pomegranate peel; green extraction

PS1-16

Rheological modification of Mango seed kernel starch with Atmospheric pressure Non-thermal Plasma

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Objective: To investigate the influence of atmospheric pressure non-thermal plasma on the rheological properties of mango seed kernel starch.

Methodology: The alkali extracted mango seed kernel starch was subjected to plasma of input voltages 170-230 V for 15-30 minutes. Starch suspension of 10% concentration was analyzed for the steady shear behavior with varying shear rates of 1 – 1000 s^{-1} at 25 ℃. Also, the dynamic rheology with the temperature sweep of 90-10 ℃ and frequency sweep of 0.1-100% shear strain was done to investigate the retrogradation behavior, stability, and strength of the starch gels respectively.

Results and discussion: The steady shear behavior of plasma-treated as well as control MSKS suspensions (10%) were in parallel with each other despite the observed increase in the apparent viscosity (1 s^{-1}) of plasma-treated samples by 58.27% (max). The storage (G') and loss modulus (G") of cold plasma treated gels were lesser at 90 ℃ (24.98- 5.35 kPa & 3.61-1.20 kPa) compared to the control (36.997 kPa & 6.38 kPa) due to the weak gel formation. During cooling, G' and G" values increase as a result of retrogradation. The plasma-treated MSKS gels showed a significant ($p < 0.05$) reduction in the rate of change in the visco-elastic moduli (G'&G"), which may be caused by a reduction in amylose content after plasma treatment. However, gels from plasma-treated MSKS exhibited higher flow point shear strain values (63.00-78.85%) compared to untreated MSKS (24.30%) showing increased stability of gels due to the cross-linking plasma species with the starch.

Keywords: Starch, Rheology, Cold plasma, Storage modulus, Gel strength, Flow point.

PS1-17

Extraction of plant based proteins by Ultrasonication

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Novel extraction techniques have shown excellent results in food processing such as enhancement of extraction rate and modifying the functional properties. They aresecure,handy, and also decreases the amount of time and solvent used and hence recently, researchers have been focusing on novel techniques to extract various components from food items. One such novel technique is ultrasound assisted extraction (UAE). It is a green technology, which is associated with acoustic cavitation.This technique is used to extract proteins from plants for their functionality such as emulsifying, foaming, gelling, solubility, water and oil binding properties, etc.This novel technique is often used as a pre treatment method along with the conventional methods to extract protein from the plants as it increases the efficiency of the extraction by rupturing the cell wall which exposes more cellular components to the extraction medium. Different parameters such as pulse density, time, solid to solvent ratio, pH, solvent, temperature, and so on affect the extraction rate and yield.These extracted proteins are included in various food items having less amount of protein to fulfilthe recommended daily allowance (RDA) of protein. The purpose of this paper is to study the effect of ultrasound treatment on the extraction yield and functional properties of plant based protein.

Keywords: Novel techniques, ultrasound, Protein, extraction, conventional, functional properties

PS1-18

Optimization of Ultrasound Assisted Extraction (UAE) and Soxhlet Extraction of Oil from Chironji Seed SoVSAS

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In this study, the aim is to investigate the effects of ultrasound assisted extraction (UAE) and soxhlet extraction condition on the yield, antioxidant, total phenolic content (TPC) and acid value of the oil from chironji seed. These ultrasound variables were studied: time, temperature, solvent to sample ratio and ultrasound power. The main aim was to achieve the highest recovery of chironji seed oil with the most desirable antioxidant activity, TPC, and acid value provided by optimized UAE condition. It was observed that through the interaction of ultrasound variables, the least and most significant effects were observed on the antioxidant, TPC and acid value. The oil recovered from Soxhlet extraction was 21.5% and Ultrasound assisted extraction provided a comparatively high oil recovery, which was 47.76% from chironji seed. It has revealed that most desirable oil recovery (T8) 47.76% was achieved when the ultrasound power was 467.50W, temperature was 37.50℃, time was 17.50 min. and solvent was 8.00ml. It has also shown the desirable results on the same parameters for antioxidant activity (0.79 mg GAE/gm), total phenolic content (22.25 mg GAE/gm) and acid value.

PS1-19

Physicochemical properties of Hausa potato (*Plectranthus rotundifolius*) starch oxidized by sodium hypochlorite

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The effect of sodium hypochlorite (NaClO) concentrations (1%, 4%, 5%, 10% of active chlorine) on the properties of Hausa potato (*Plectranthus rotundifolius*) starch was investigated. The native and modified samples were evaluated considering carboxyl content, syneresis, light, colour, amylose, and FTIR. The modified starch showed increase in carboxyl content with increase in the concentration of the oxidant. Oxidised starch obtained higher lightness value (L*) than native starch.10% NaClO showed higher L* among other concentration. When examined at low temperatures, the swelling power of oxidised starches was lower than its native equivalent, and the solubility index increased as temperature and chlorine concentration increased. Furthermore, when compared to native starch, all oxidised starches had decreased syneresis and light transmittance after refrigerated storage. Hausa potato starch oxidation with sodium hypochlorite increased the functional properties of starch, in general can be exploited for the synthesis of biodegradable film.

Keywords: Sodium hypochlorite, Oxidation, Carboxyl content, Syneresis

Poster Session-2

Quality, safety and hygiene in food processing

PS2-1

A detail study on Bio-adsorption for the removal of metals in water and consumer survey for filter using bio-adsorbent: A Review

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Effective usage of bio-waste is bio-adsorption, that is, the adsorption of any constituents, like metals, onto the surface of biological components. Adsorption has originated to be superior for water reuse in terms of primary cost, elasticity and straight forwardness of design. The cell walls of bio-adsorbate consist mainly of polysaccharides, proteins and lipids and have carboxyl, sulfate, phosphate and amino groups to form bonds with metals, and their complexes. A survey is conducted in order to know the consumer view about water purifier using bio-adsorbent for filtration, in which consumer responses are collected and analyzed, using pie charts and bar charts. According to responses, most of the rural population still does not use water purifiers because of its high cost and are interested in using one. This implies that water purifier using bio-adsorbent for filtration could be the option for future Keywords: bio adsorption, bioadsorbate, waste water, consumer survey

PS2-2

Identification of critical control points of the popular street foods in shillong city

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Street vended food are not only treasured for their unique flavours, convenience and affordability, but also contribute to the economy, the role which they play in the cultural and social heritage of the society. However, the safety aspects of street food vending are often a matter of concern. The main objective of the present study relates to identification of the critical control points of the popular street foods in Shillong. A consumer survey among college going students was carried out to determine most consumed item. A total number of 266 students participated in the study. A great figure of the students (86 per cent) consumed these street foods and most of them preferred the vendors located at Fire Brigade (bus stop) near *madan iewrynghep*. The selected street foods were *aloo* muri, *aloo muri* with *mama*, only *aloo*, *panipuri* and *aloo chana* and out of these, *aloo muri* with *mama* is the most preferred type (39.5 per cent) amongst these street foods by the students. Most of the students (42.5 per cent) believed that their preferred vendor is clean and follows hygiene while 27.8 per cent ignored the cleanliness and hygiene practices of the vendor. Due to its popularity, hence, there is a need in documenting the methods of preparation of the selected street foods and to arrange a process flow diagram for identifying the critical control points in the preparation of these street foods.

Keywords: Street foods, *aloo muri*, Critical Control Points, Shillong.

PS2-3

Sustainable Approaches in Food Engineering and Technology

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In the current era where the food wastage and its accumulation are becoming a major problem around the world due to the continuous incrementing growth in world population. The rapid increase of growth in food wastage is introducing remarkable serious warnings to our surroundings like environmental pollution, risks related to health, shortage of dumping land. Introducing a balance between food and supply pressure should be managed sustainably so it will ensure the efficient use of food without wastage because the long-term survival of human species is emerging as one of the most important challenge for the humans in decades. There is an acute requirement to take proper estimates to decrease food waste load by appropriate standard management applications. Presently many kinds of proposals are explored to in waste food processing and management for communalwelfare and applications. The world population growth from the last centuries with the associated requirements has been resulting from the industrialization period and has made the requirement of food production and processing a major issue. This requirement is expected to be increased in the coming half century when the population of the world will exceed 8 billion. To fulfill this requirement various investigations and experiments have been performed and after all the experiments the anaerobic digestion application has emerged as one of the most environment friendly and the effective solution for food wastes management, energetic and healthy production, which will help in providing world's ever-growing energy demands. The other approach has also emerged during the investigation and experiment in which the use of fertilization and pesticide has been increased to fulfill the supply demand, but this approach is harmful for environment concerns for the food production and processing can be tremendous for the biodiversity and aquatic eutrophication because of nitrogenous and phosphorous substances caused by over fertilization, pesticides, water shortage and climatic changes. Here we have briefly explained the key highlights and the different experiments for sustainable approaches in food engineering and technology by different aspects of anaerobic digestion and use of fertilization and pesticides.

PS2-4

Hydration behaviour, Viscography profile and Physico-chemical properties of different types of Pitha (Adai) – a traditional product

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Different Pitha (Adai) products were prepared from rice and various legumes like Bengal gram, Arhar, Masur, Black gram and Moong in their whole grain, dal and germinated forms, after soaking and grinding. Moisture content of above raw materials varied from 6.5 to 12.0%. EMC-S of whole legumes varied from 54 to 64%, for dals from 55% to 65%, for germinated ones 56 to 68%. Hydration behaviour indicated that Black gram whole hydrates very slowly and in increasing order masur whole, followed by Bengal gram whole. In dal form fast hydration was by Black gram. Chana dal showed highest PV (440 cps) and moong dal showed least (147 cps). Moong dal showed least BD indicating it behaves like cross linked starch type material. Set Back (CPV- HPV) was highest for Arhar dal (616 cps) indicating high retro-gradation and least in black gram dal (276 cps). Whole grains showed less values for all the parameters of RVA, indicating that the husk or the seed coat is an hindrance for swelling of starch granules. Ash content varied from .6 to 4.5% and AIA varied from 0.46 to 0.86%. Amylose content was least in Black gram dal (~9.3%), highest was in chana dal (14%). Pitha products had ~17 to 20% as their amylose content. In conclusion, whole grain product sensorily proved to be best followed by germinated grain pitha and last by dal pitha.

Keywords: Hydration behaviour, whole grains, viscography, EMC-S, amylose content, retrogradation.

PS2-5

To study the reproducibility of chewing behaviour in human subjects for different textured Basmati rice cultivars by electromyography (EMG)

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Rice (Oryza sativa) is consumed by large proportion of human population across the globe, making it an essential grain for survival. Along with having the title of 'grain of life', it offers a number of nutritional benefits to its consumers. Basmati is an aromatic rice cultivar, popularly grown in India and characterised by its long and slender shaped grains with pleasing texture. The rice is treated with various hydrothermal techniques to obtain grains with better cooking properties and improved nutrient composition. This investigation was focused on applying electromyography (EMG), an in vivo, innovative and non-invasive technique, to comprehensively study texture of cooked rice samples. For this technique to be applicable, the reproducibility of the bioelectrical activities of human masseter muscles during chewing is crucial. Human subjects, all females aged 19-24 years, were served with six cooked rice samples (raw, steamed and parboiled Pusa Basmati 1121 and Pusa Basmati 1509 cultivars) in duplicate during an EMG session. The reproducibility of different parameters for two different recordings was observed for each session. Upon analysis, it was found that the bioelectrical activities of chewing muscles during mastication of cooked rice samples for two different recordings in an EMG session were statistically significant ($p<0.05$). Thus it was inferred from this study that chewing behaviour is highly reproducible for human subjects in an electromyographic session. Hence, the generated electromyograpic data of chewing muscles can be successfully used in textural investigations of cooked basmati rice samples.

Keywords: Basmati rice, chewing behaviour, electromyography, reproducibility, texture

PS2-6

Effect of Processing Techniques on Sensory Characteristics of Millet based Snack Bar

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A multitude of investigations carried out on millets have demonstrated that these are excellent sources of nutrients, such as proteins, minerals, and vitamins, and they are also observed to contain various bioactive compounds. However, the millets are observed to have limited applications in daily dietaries owing to their coarse nature. Thus, the present research was undertaken to study the effect of various processing techniques on developing a millet-based snack bar. Briefly, the effect of processing techniques such as grinding, roasting, puffing, boiling, soaking and drying, and combined treatments were studied along with control samples (no treatment). The nutritional millet-based composite snack bar was incorporated with Proso millet (*Panicum miliaceum* L.), Foxtail millet (*Setaria italica*), and Barnyard millet (*Echinochloa frumantacea*). The study revealed that the processing conditions significantly influenced the organoleptic characteristics of the composite snack bar. Further, the sensory evaluation of the millet-based snack bar revealed that aroma, taste, texture, color, and overall quality were in the acceptable range with mean scores of above 5. Overall, the study indicated that the snack bar prepared through combined treatment (i.e., roasting and grinding) was observed to have higher acceptability with aroma, taste, texture, color, and overall quality values of 9,8,8,9, and 8, respectively.

Keywords: Proso millet, Foxtail millet, Barnyard millet, roasting, and puffing.

PS2-7

Study On Preparation Characterization And Quality Analysis Of Extruded Food Prepared By Replacement Of Wheat Flour With Green Banana Flour: A Review

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Pasta is one of the most popular and widely recognized food in the world. As pasta increased in

popularity, studies endeavored to analyze the attributes that contribute to high quality pasta despite being a simple food the laboratory-scale of analysis of quality is complex process. This product is also valuable in some medical conditions such as type I and type II diabetes, as confirmed by clinical and scientific studies. The banana is a starchy food with a lot of indigestible components like resistant starch and non starch polysaccharides. The inclusion of banana flour reduced the lightness and diameter of cooked spaghetti while increasing the product's water absorption. It was also shown that adding more than 3% BP to pasta reduced its firmness. The total phenolics content and antioxidant capacity of pasta increased with the addition of BP (banana powder).

Keywords: Green banana flour, Pasta, Quality, Antioxidant capacity, phenolic content.

PS2-8

Textural Analysis of Osmo-Dried Chayote (Sechium edule)

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Osmotic dehydration of chayote cubes of 8mm size were carried out in different composition and concentration of osmotic solution. The osmotic solution to chayote ratio was 10:1 (w/w) during all the experiments. A full factorial design was followed with various process variables viz., concentration and composition of osmotic solution (5% - 25% NaCl, 20º40ºBx sucrose, mixture of 20º- 40ºBx sucrose+2% CaCl2 and mixture of 5% - 25% NaCl+2% CaCl2), osmotic dehydration time (1-5h). In this present study, the effect of various compositions of osmotic agents on textural properties on osmo-dried chayote. The compression test was done for osmo-dehydrated chayote samples. The samples were cut into cylindrical shape of 6 mm diameter and 8 mm height. The probe used was 25mm cylinder (p/25) with load cell of 30kg with the penetration depth of 5 mm. The firmness values to the peak force were found from the force-time curves. From the results, the average firmness value varied in the range of 108.34N - 126.77N for NaCl, 107.94N -153N for NaCl & CaCl2 solution. Similarly, the average value of firmness varied within 58.5N - 153.9N for sucrose and 173.24N - 206.7N for sucrose and CaCl2 solution. An increase of 62.23% in firmness was observed in chayote cubes treated with sucrose and CaCl2 solution compared to only sucrose treated samples.Addition of CaCl2 in NaCl solution did not show any pronounced effect on the firmness of chayote samples.

Keywords: Chayote; Osmotic dehydration; firmness; CaCl2; NaCl; sucrose

PS2-9

Effect of molecular weight on the modification of chitosan by fumaric acid

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In this study, we modified the low, medium, and high molecular weight of chitosan by fumaric acid and study of its physicochemical properties. From the results, it is found that when molecular weight increases, its water solubility, and thermal properties decrease. The pH dependence study reveals that the modified products have enhanced water solubility than respective native chitosan in the wide range of pH. Fourier transform infrared (FTIR) spectroscopy results prove that modification was successful by fumaric acid. X-ray diffraction (XRD) pattern suggested that the native chitosan crystallinity was higher than that of modified chitosan. From the above results, it proves that the enhance water solubility of the modified products might be a great advantage in food, biomedical and cosmetic industry.

Keywords: Modification; Water Soluble Chitosan: Water solubility; Thermal properties; Fumaric acid

PS2-10

FORMULATION, CONSUMER ACCEPTANCE AND FUTURE TREND FOR OIL POWDER: A REVIEW

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In any food processing industry, oils and fatsperform various functions which includeimproving keeping quality, providing lubrication and flavour, enhancing batter aeration and emulsifying properties. These can vary from being in a liquid state to being high melting point plastic fats depending upon their consistency.These pose certain limitations when present in liquid form like product settling when stored at temperatures below 12-14°C. Also, careful handling makes it difficult to transport these for commercial use where large amounts of products are being handled. Powdered fats or fat powders can eliminate the risk of oil spillage, reduce high transportation charges and simplify its storage. Consumer awareness about the concept of oil powder and their views on the possibility of future dominance of oil powder over liquid oil were obtained through an online survey. This study reviews various literature work published by many researchers, authors regarding oil powder formulation, application in common household and industries. Also, consumer acceptance for oil powder is discussed here.

Keywords: Oil and fat, oil powder and consumer acceptance.

PS2-11

Development of Shelf stable imitated shrimp product from lizard fish (*Saurida tumbil*) in retort pouches

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Heat penetration attributes of imitated shrimp products were determined and the results showed that the lower lag period for heating curve and lower come up time led to a rapid heating rate which declined the whole process duration in curry. Cook value was low processed by steam/ air retort. Although the heat penetration characteristics of analogue shrimp curry by steam/ air retort were in acceptable range required to achieve good product quality. If the process duration was reduced, imitated shrimp product was better in nutritional and sensory qualities. But, the come up time was higher in analogue shrimp masala processed by steam air retort due to its slower penetration of heat but the process time was higher. The process time was higher in analogue shrimp masala and there is a slight loss of textural and nutritional quality. Biochemical analysis such as (moisture, fat, ash, protein, total volatile base nitrogen, trimethylamine, thiobarbutric acid, peroxide value, free fatty acid and pH), textural profile, colour and sensory properties of imitated shrimp products in retortable pouches processed by steam/ air and water immersion retort were determined. The commercial sterility results showed that there was a total absence of aerobic and anaerobic, mesophilic and thermophilic, as well as spore and non – spore forming bacteria in all the imitated shrimp curry and masala products even those processed at the lowest process time duration of 34.99 min with a F_0 value of 10.53 min. Based on the study, it is concluded that the imitated shrimp curry processed by steam air retort was reported as good product.

Keywords: F_0 value, cook value, shrimp curry, water immersion, steam air, sterility

PS2-12

Effect of anti-nutritional factors present in plant-based foods on human health and their minimization strategies using processing

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Anti-nutritional factors (ANFs) are certain types of secondary metabolites present in plants and plantbased products. They reduce the nutrient utilization and food intake of the plants and play an important role in determining their uses and consumption rates. They are harmful to humans and they limit the nutrient availability to the body. ANFs are present in varying amounts in different plants, depending on the kind of plant, its mode of propagation, chemicals used while growing, storage, and preservation techniques used for the plant. Certain anti-nutritional factors at a very low level have also shown health benefits. However, these factors when present at a high level should be removed from the plants before human consumption using processing methods like soaking, germination, autoclaving, blanching, fermentation, extrusion etc.

Keywords: Anti-nutritional factors, Health benefits, Adverse effects, Processing methods.

PS2-13

Storage study of rasogolla- an Indian diary product

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Rasogolla is one of the important and popular traditional milk based sweet. There is a good market potential of the product not only in India but also in abroad. Cooking of rasogolla is a time consuming and tedious work. Hygienic condition is not maintained by the sweet makers during its preparation which leads to lesser shelf life. Rasogolla samples prepared at optimum conditions in pressure cooking machine were kept in Polyethelene terephthalate jars long with sugar syrup/sorbitol solution. The containers with rasogolla were kept in room temperature (28±2 ºC) and in refrigerated condition (5±2 ºC). The related changes in microbial count, pH of sugar syrup, hardness and colour of rasogolla with time of storage at room temperature and refrigerated conditions were studied.During storage study of rasogolla samples it was found that total viable count increased very sharply in all the samples as the storage period increased at room temperature. But in case of refrigerated storage condition, total viable count increased very slowly for all the samples. During storage at RT, yeast and mould count was zero till the 5th day of storage and after day 6th the yeast and mould count increased sharply. In case of refrigerated storage the samples were free from yeast and mould growth upto 10 days storage period.During storage at RT coliform count was zero till the 5th day of storage and on the day 6th coliform count increased sharply during storage at RT. The pH of sugar syrup decreased slowly with storage period at RT. In refrigerated storage condition no pH change was found in all the samples throughout the storage period.

Keywords: rasogolla, pressure cooking, hardness, storage study, sorbitol, pH, colour

PS2-14

Value addition to Indian sweetmeat with Ashwaghandha and honey

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Sweetmeat, the sweetened chenna based food product is consumed mainly in India but also getting anincreasing demand worldwide.The chenna (curdled milk) is anexcellent source of protein (casein) for vegetarians, also contain fat and vitamins A, D.But consumption of sweetmeat in large quantity over a long period may be linked todevelopment of prevalent diseases like diabetes, obesity,hypertension. Ashwagandha(*Withaniasomnifera*)is reach in different biologically active substanceslike alkaloids (isopelletierine, anaferine, cuseohygrine, anahygrine),steroidal lactones(withanolides,withaferins), saponins (Sitoindosides) and acylsterylglucosides. Honey contains 38%fructose,31%glucose,vitamins (ascorbic acid,pantothenic acid,riboflavin,niacin)and minerals (copper,calcium,potassium,iron,manganese and zinc).These functional components help to reduce stress, blood sugar, cortisol, inflammation, cholesterol, boost immunity and treat asthma. Our objective is to incorporate traditional herbs in sweetmeat for nutritional value addition and their stability study. Herbal water extract of dried Ashwagandha root was added to prepared chennafrom cow milk within the range of 0.5-1g as permitted range of usage for adults per day (Schedule IV, FSS Act 2016). Honey was added along with fine powdered cane sugar in the ratio of 1:2 on weight basis. Sandesh was prepared mixing fresh chhana and herbs,heating at 75^{o}C for 15-20 minutes.The Sandesh prepared were tested for their microbial quality, physical andsensory attributes.Quality and health benefits of Sandesh from cow milk could be improved through incorporation of medicinal herbs such as Ashwagandha and honey into chennaduring manufacture of Sandesh.

Keywords: Ashwagandha, herbs, sweetmeat, value addition

PS2-15

Physical, chemical, microbiological properties and shelf-life kinetic of forward osmosis concentrated beetroot juice during storage

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Beetroot (Beta Vulgeris L.) juice of 5.0 °B was concentrated by forward osmosis (FO) up to ~60 °B and were stored at ambient (25 ± 2 °C) and accelerated (37 ± 2 °C) storage condition for 12 weeks, during which physical, chemical and microbiological attributes stability were determined at regular interval of 2 weeks. In both storage conditions, results showed that the beetroot juice concentrate (BRJC), quality were affected by storage condition, with minimum changes in the total soluble solids, pH, titratable acidity of FO concentrated juice during the storage. The betalains content and antioxidant activity were affected by the storage temperature and time in FO produced concentrate. The browning index (BI) and HMF of BRJC at 37 °C showed higher values as compared to 25 °C during the storage of 12 weeks. The degradation of betalains content in BRJCs followed first order kinetics. The results showed that FO can be used as a nonthermal method to concentrate beetroot juice as the quality attributes and extended shelf-life were less affected. There was a moderately-strong and strong corelation between the betalains content and total color difference in BRJCs stored at ambient and accelerated conditions, respectively.

Keywords: Beetroot juice concentrate (BRJC), Shelf-life, storage, Forward osmosis, Betalains, Kinetics

PS2-16

Studies on the standardization and quality evaluation of stabilized combo meals as light weight ration

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Steam still retort processing is well established thermal stabilization technique for most of the Ready-to-Eat foods supplied to Defence Forces as MRE Ration and as RTE product in civil markets. Processing of individual ration items not only occupy larges storage space but also demands for additional packing material. The conventional processing includes precooking (>80%), filling and packing in retort compatible materials for stabilization. During prolonged storage the consumers perceived a typical processing flavour resulting into its poor acceptability, therefore, attempts were made to prepare combo meals while minimizing process lethality (F0-3.5), typical processing flavour while ensuring commercial sterilization and retaining maximum desirable flavor.

The products selected for the study weretraditional/Ethnic Indian foods with pan India taste and acceptability *viz.* RTE Combo Khichdi, RTE KadhiChawal. These were studied for their sensory profile, proximate composition, nutritional profile, textural attributes, and invitro digestibility. Storage markers were also studied with respect to its oxidative (peroxide value) and hydrolytic stability (%FFA).

As the method developed was with novel approach of in pack cooking cum sterilization, therefore it resulted into a stabilized product with respect to microbiological standards for such thermally stabilized foods. Preferential tests revealed a clear demarcation and better acceptability with respect to colour, flavour and textural of the grains used for simultaneous cooking. These all were stable for more than a year at ambient storage conditions.

KeyWords: Combo-meal, stabilization, process lethality, invitro digestibility retort

PS2-17

Assessment of antioxidant activity, and quantitative estimation of polyphenols using LC-MS/MS in edible macroalgae

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Evaluation of antioxidant activity and quantification of bioactives using LC-MS/MS in *Sargassum wightii.* Abundantly cultivated edible macroalgae on the southern Indian coastline, *Sargassum wightii* (brown) was examined for the phytochemical content (total phenolic (TPC) and total flavonoid (TFC) content) and antioxidant activity (2,2-diphenyl 1-picrylhydrazyl (DPPH) and ferric reducing antioxidant power (FRAP)) in aqueous extraction and phenolic group was determined by FTIR spectroscopy. Quantitative assessment of bioactives in *S. wightii* through Liquid Chromatography tandem mass spectrometry (LC-MS/MS). FTIR spectroscopy suggested presence of phenolic groups in *S. wightii* (at 1259 cm^{-1}). *S. wightii* showed phytochemical content (total phenolic (10.99 mg GAE/g extract) and total flavonoid (2.75 mg QE/g extract) content) and antioxidant activity (as determined through DPPH (28.49 %RSA) and FRAP (5.15 mg TE/g extract) assay). Further, aqueous extract of *S. wightii* was characterized for bioactives by LC-MS/MS, wherein phloroglucinol (55.34 mg/kg dw), gallic acid (0.59 mg/kg dw), ferulic acid (12.72 mg/kg dw) and caffeic acid (0.59 mg/kg dw) were quantified. Results signify that largely ignored edible macroalgae of Indian coastline, *S. wightii* could be a good candidate for the extraction and purification of bioactive polyphenols for their potential exploitation in functional foods and nutraceuticals.

Keywords: Seaweeds; FTIR; phytochemical content; antioxidant activity; phloroglucinol; LC-MS/MS

PS2-18

Physicochemical and quality characteristics of co-extracted nigella seed and flaxseed oilsat different incorporation levels in peanut oil

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The study examined the effect of premixing whole nigella seeds and flaxseeds (at 10, 20, 30, 40 g/100 g incorporation levels) in raw peanut seeds and their subsequentmechanical co-extraction to obtain different oil blends.The pure oils (flaxseed oil, nigella oil and peanut oil) along with their blends were evaluated for oil yield, fatty acid composition (FAC), total phenolic content (TPC), radical scavenging activity (% RSA), oxidative stability andpigments content (carotenoid and chlorophyll).Moreover,oxidation stability of oils was determined by measuring the acid value (AV), peroxide value (PV), *para*-anisidine value (*p*-AnV) and induction time (using rancimat).The resultsshowed that oil yield reduced from 30.87% (pure peanut oil) to 26.36% and 26.60% for both nigella seed and flaxseed, respectively (at 40 g/ 100 g incorporation level). Rancimat analysis revealed that the highest induction time of 7.83 hwas observed for nigella seed oil having 40 g/100 g incorporation, while the lowest of2.66 h was observed for flaxseed oil with the same incorporation level. However, higher *p*-AnV, AV and PV were observed for nigella seed incorporated oil blends. Both nigella seed and flaxseed incorporation decreased the monounsaturated and saturated fatty acidcontents, while it increased the polyunsaturated fatty acid content.Nigella seeds incorporated oil blends showed higher TPC and chlorophylls as well as carotenoids content and % RSA in comparison to those having flaxseed incorporation. Overall, it was noticed that coextracting peanut seeds having incorporated nigella seeds improved oxidative stability. On the other hand, flaxseed incorporationimprovedthe nutritional value of pure peanut oil.

Keywords: Nigella seeds, Flaxseeds, Induction time, Oil yield, Peanuts

PS2-19

Studies on rheology, thermal, and functional properties ofkodo and kutki millet flour

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To study the rheology, thermal, and functional properties of kodo and kutkimillet flour. Kodo and kutki millets were dehulled and ground into flour with particle size of 100microns.Rheology, proximate, functional and thermal properties were evaluated for both the flours. Both the millet flours were analysed for proximate composition, kutki flour showedhigher value of moisture (11%), fat (4.19%), and ash (2.19%) than kodo flour whereas protein was significantly (p<0.05) higher in kodo flour (8.42%). Functional propertieslike water holding capacitywas significantly (p<0.05) higher in kodo flour (2.46%) and oil holding capacity was similar in both flours. The thermal properties obtained from thermogram showed endothermic peak at transition temperature ranged from 106.6^{o}C to 273.4^{o}C with enthalpy of 2.02 J/(g*K) in kodo flour and transition temperature ranged from 94.3^{o}C to 280.9^{o}C with enthalpy of 2.15 J/(g*K) in kutki flour.Rheological measurements showed flow behaviour index in the range of 0.30 to 0.32 indicating shear thinning tendency of both the flours. The consistency index (K) of flour samples were in the range of 5.25 to5.33 Pa s^{n}. Results indicated, both the flours are nutritionally rich and could be used in the development of the functional foods.

Keywords: Kodo millet, Kutki millet, rheology, thermal characteristic, functional properties

PS2-20

Anthocyanin rich natural deep eutectic solvent (NADES) aided poly (vinyl alcohol) based edible films for targeted use as pH indicator for food quality monitoring

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The research reports the fabrication of anthocyanin rich natural deep eutectic solvent (NADES) aided poly (vinyl alcohol) (PVOH) based edible films to be used as edible pH indicator during storage life of food products. NADES is utilized to replace the traditional plasticizers for food packaging to combat the present need of the society. The different ratios of lactic acid and fructose based NADES have been used to prepare the films using solution evaporation method. The influence of anthocyanin rich NADES on the functional, structural, mechanical, thermal, and barrier properties of PVOH films has been investigated. The FTIR spectroscopy has showed that the intensity of FTIR peaks of PVOH has been varied due to aiding anthocyanin rich NADES. The addition of NADES has resulted in a significant increase in elasticity of PVOH edible films. A significant change in color of film was observed on applying various levels of pH buffers indicating pH indication property. Based on this discussion, the specified edible films are considered as a potential candidate to be used as edible pH indicators in monitoring food quality during storage, where, the specific indicator can be ingested along with food products.

Keywords: Natural deep eutectic solvent; Anthocyanin; Poly (vinyl alcohol); pH indicator; Edible films.

Poster Session-3
Functional, Nutraceutical and Health Foods

PS3-1

Exploring the nutritional properties of selected edible flowers of Assam

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Edible flowers have been consuming traditionally since time immemorial in worldwide due to their aesthetic appearance along with fragrance, flavors, nutritional and medicinal effects. Though they have immense numbers of health beneficial or functional properties still it is not popular and many people are neophobic to eat flowers. In this study, estimation of some proximate parameters along with phytochemicals of commonly edible flowers of Assam such as Night jasmine (Nyctanthus arbortristis), Drum stick (Moringa oleifera), Pumpkin flower (Cucurbita moschata) and Nongmangkha (Phlogacanthus thyrsiflorus) were conducted. Results found that moisture content of night jasmine, pumpkin, drum stick and nongmangkha were 93.7, 92.48, 86.91 and 79.9 % respectively. Ascorbic acid was found highest in nongmangkha 0.113 mg/100g, followed by night jasmine 0.057 mg/100g, drum stick 0.047 mg/100g and pumpkin 0.046 mg/100g. Lowest amount of fat was detected as 0.035, 0.04, 0.01 and 0.13 % in pumpkin, drum stick, nongmangkha and night jasmine respectively. Flavonoid content was found in pumpkin, drum stick, night jasmine and nongmangkha were 32.974, 32.900, 49.185 and 72.744 mg quercetin/g. This study highlighted the different chemical properties of edible flowers to increase its awareness, to influence further research, market growth, and innovation in food technology.

Keywords: Edible flowers, Nyctanthus arbortristis, Moringa oleifera,Cucurbita moschata, Phlogacanthus thyrsiflorus, phytochemicals.

PS3-2

Study on Developing Technology of Functional Fermented Whey-Based Herbal Beverage Using *Plumbago zeylanica* Extract and Lactobacillus strains

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Global demand for "healthy" food and drink has developed in recent decades. Today's advancements in scientific research support the ancient dietary practise and the precautionary functioning through immune stimulation of certain illnesses. So far the most active function group is considered to be the beverages. They include nutrients and bioactive elements including vitamins, mineral substances, antioxidants, ω-3 fatty acids, herbal extracts, fibres, prebiotics and probiotics as a great way of supplements. This study thus emphasises on the development of whey-based herbal beverages fermented with potential probiotics. The beverage was prepared using whey, sugar (7%), citric acid (0.3%), orange flavour (0.02%) and fermented using the strains of Lactobacillus (1:1 ratio of Lactobacillus fermentum KGL4 and Lactobacillus plantarum KGL3A), and Plumbago zeylanica extract (5%). Further shelf life study has been carried out on the basis of sensory analysis both in the room (25℃) as well as refrigerated temperature (6℃), in every 5 days of interval for 20 days. The study was focused on various parameters like pH, TA (titratable acidity), microbial count, anti-oxidative and antibiotic activity. The highest scores in pH, TA, microbial, anti-oxidative and antibiotic susceptibility were found to be 4.316±0.037, 1.821±0.027, 10.549±0.032, 89.04±3.32, and 40.00±0.00 in the beverage respectively. The results however demonstrated that the whey beverage, when consumed under refrigerated conditions (6℃), were most functional till the 15th day of its storage life.

Keywords: Fermented whey beverage, Lactic Acid Bacteria, *Plumbago zeylanica*

PS3-3

"Development of germinated multigrain instant beverage mix with Bhim kol (*Musa balbasiana*)" and study of their physicochemical, functional and neutraceutical properties

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Multigrain beverage mix was prepared from brown rice (*oryza sative L*), finger millet (*Eleusine coracana*), barley (*Hordeum Vulgare*) and wheat (*Triticum*) before and after germination. Ash content of raw samples varied from 1.24 to 2.3% with finger millet showing highest and least by brown rice. Protein content ranged from ~ 7.8 to ~ 12%, lowest was in rice and highest was in barley. Crude fiber ranged from 1.5 to 6.2% with highest by barley and lowest in brown rice. Carbohydrate content was highest in brown rice and least was in barley. Equilibrium moisture content on soaking at RT , protein content , crude fiber, carbohydrate content , gross energy increased to different extents after germination. In multigrain beverage mix and germinated multigrain mix (GMGBM) ,ash content varied from 2.4 to 3.4%, protein, carbohydrate content and total energy content was high in GMGBM. Amylose content varied from ~ 19% to 23% in native grains and after germination it increased and varied from 22 to 28%. MGBM showed around 20% and GMGBM showed ~ 27% amylose content. Alpha amylase activity ranged from 1 to 2.2 in native but after germination it increased from 11 to 30 (U/g/min), mixes showed ~2 and 16 (U/g/min). Sensory studies viz aroma, taste, mouth feel was high for GMGBM compared to normal MGBM. Water absorption index varied from 2 to 4 g/g . water solubility index of GMGBM was quite high. All these parameters were also studied in Bheem kaul powder. Its combination with GMGBM will be discussed while presentation.

Keywords: Barley, germination, amylase activity, crude fiber, gross energy, sensory studies.

PS3-4

DEVELOPMENT OF VITAMIN FORTIFIED HERBAL GHEE

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Ghee or clarified butter is one of a traditional dairy products that has found its way from rural development to modern industry and is widely consumed as dresser and as a rich calorie source. Ghee also has a significant medicinal and nutraceutical applications and has developed a significant need in this current and post COVID scenario. Ghee is a significant source of conjugated linoleic acid which helps in combating obesity and cancer. Ghee contains high concentrations of MUFA and due to trace presence of lactose and casein, ghee is a good source of fat for lactose intolerance patients. It is also a great source of Vitamin A, D and E which shows antioxidant properties. During processing of ghee from cow milk, these essential vitamins experience significant loss, especially during conversion of butter to ghee due to thermal exposure. The sun is a dynamic source of vitamin D, but due to current situation, the synthesis of vitamin D, an immune boosting vitamin is restricted so supply of vitamin D through such fat rich product can be promoted from industrial point-of-view. Current research was initiated in regard to processing operations via traditional ghee making to evaluate the vitamin D profile and other essential nutrients. *Awshagandha*and *Bramhi* extracts were admixed with the ghee base maintaining an acceptable proportions. Acceptability was judged with respect to sensory parameters with good scores. The study focuses on how the various line operations can be performed to improve the existing product. Subjecting the butter to thermal treatment to obtain ghee without compromising the colour and flavour; at the same time fortifying with vitamins and polyphenols as per daily consumption of an adult.

Keywords: Fortified-ghee, herbal ghee, *Awshagandha,Bramhi*, Post COVID dairy product

PS3-5

Plant-based non-dairy alternative milk on the food industry

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Non- dairy alternatives have been topic of debate over the years. People are still in the dilemma whether which is better a source. The consumption of plant-based products has increased over the years and is supposed to reach 26 billion approximately in the coming years. As plant-based or non-dairy milk alternative is the fast-growing segment in newer food product development category of functional and specialty beverage across the globe. Over 68% people in world are lactose intolerant and face lactose malabsorption. Plant based milk products here gives alternative solution to these people. Some of them consume it with the goal of consuming more nutritious and tasty products while some demands sustainability and healthy lifestyle. With so many options in market between different types of plant-based milks to choose which one is most suitable is a task. The present study was carried thus out to standardize the process for development of plant- based milk alternative using soymilk, coconut milk and almond milk. Formulations for manufacture of non-dairy milk samples were optimized on the basis of their sensory as well as nutritional properties. Also, we will be comparing the properties of plant-based milk samples to find out which is the most appropriate. The nutrient content of nondairy milks varies substantially, although across the board they're lower in fat compared to cow's milk.

Keywords: Non-dairy; plant-based; milk; fat analysis; lactose.

PS3-6

Study on resistant starch rich gluten free bars as functional food for celiac disease patients

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The gluten protein of wheat triggers an immunological reaction in some gluten-sensitive people which leads to Celiac disease (CD) with symptomatic damage in the small intestinal villi. Most of the market available nutri /energy bars are generally rich in high sugar which actually can take a lead role for some chronic diseases like obesity, type – 2 diabetes along with celiac disease in our young generation. Fruit based products are major part of healthy diet ever since human life began on earth.Epidemiological studies also suggest that regular consumption of fruits may reduce the risk of chronic diseases. Resistant starch is a non-digestible starch fraction and is classified as fiber. Beyond naturally occurring fiber sources, starches can be modified to resist digestion, increase their fiber content and provide physiological benefits. The current research is undertaken to develop a nutrient rich cereal bar using the major ingredients like oat (rich of resistant starch), germinated pea protein flour and dates. The developed nutri bar based by utilizing date paste, oats and germinated pea protein flour is not only improving nutritional quality (fat, proteins, fiber and mineral contents), but also the textural and sensory properties.

Keywords: Nutritional bar, Resistant starch, Germination, Nutritional value, Sensory evaluation

PS3-7

DEVELOMENT OF BREAKFAST FOODS UTILIZING EXOTIC PLANT PROTEIN SOURCE

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Breakfast is the first heavy meal of the day, taken in the morning. A breakfast food should supply adequate amount of energy. But most of the Indian breakfast items (home-made or processed) are mostly rich in carbohydrates. Major component of the traditional breakfast items, is different types of cereal.

In the current pandemic scenario, protein source is gaining extreme importance as an immunity booster. Therefore, the present research work aims at developing proteinaceous breakfast item with the objective of providing additional health benefits to the consumers.

Granola-mix has been identified as a suitable breakfast food item to be enriched with protein source. Study reveals that cereals and few legumes (chickpea, lentil) have already been utilized in preparing granola mix. A novel combination ofsweet lupine flakes, defatted flour of groundnut and soybean is identified as the protein source for the granola premix. Raw lupine(whole) contains 36% protein (Kefale B, et al., 2018); which is supposed to enhance total protein content of the final granola-mix.

PS3-8

Studies on the phytochemical and functional properties of noodles prepared from red rice, by incorporation of carrot

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Noodles are considered one of the staple diets in the Asian countries. The north east India produces different pigmented and non-pigmented varieties of rice. In the present study, attempts have been made to prepare noodles from a local red rice variety and their functional and phytochemical properties were studied along with carrot as an additive. Six types of noodles were prepared using raw and parboiled rice of the same variety in dehusked rice form. Total phenolic content decreased in case of noodles compared to their respective natives. It increased in the noodles incorporated with carrot powder compared to their control samples i.e., without carrot powder. Total flavonoid content also followed the same trend as in case of phenolic content. Highest flavonoid content was observed in noodles from 20 minutes parboiled red rice with incorporation of 5% carrot which was ~3.43 mg/g of quercetin equivalent. The highest water solubility index was observed in 10 minutes parboiled rice noodle with carrot (~5.3%). The water absorption index was lower in raw rice flour and its noodles, compared to the parboiled ones. Water absorption was highest in the raw rice noodle. The solid loss in the prepared noodles were within limits as per BSI standards. Microstructural information by SEM studies showed that there was positive correlation with parboiling and addition of carrot powder on noodle quality. Overall acceptability according to sensory analysis was found to be highest in noodles from 20 minutes parboiled rice. Amylose content of these rice and noodles will be presented.

Keywords: Pigmented rice noodle, parboiling, carrot powder, phytochemicals, solid loss, microstructure.

PS3-9

Prebiotic potential of bottle gourd dietary fiber and its encapsulation with probiotics for development of a probiotic juice

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Bottle gourd (*Lagenaria siceraria*) is a vegetable rich in dietary fibersandcan be one of the substrates for a non-dairy probiotic drink. Molecular tools were used to recognize two potential probiotic strains namely*Lactobacillus plantarum*and *Limosilactobacillusfermentum.* The strains were isolated from fermented bamboo shoot and rice beer samples of Northeast India.Soluble dietary fibers were extracted from bottle gourd. *In vitro* fermentation of the dietary fibers was conducted using minimum salts medium (MSM) in an incubator at 37°C for 48h. Isolated bacterial cultures were used to represent the actual gut micro flora. Inulin a provenprebiotic fructooligosaccharide was taken for the comparison. It was observed that *Lactobacillus plantarum* cell grew to a cell count of 7 log CFU/ml, but *Limosilactobacillusfermentum* had lower cell count in both the media containing inulin and bottle gourd dietary fiber. The bottle gourd fiber was further co-encapsulated with the isolated bacterial strains using sodium alginate as an encapsulating material and incorporated into bottle gourd juice. A storage study of the probiotic bottle gourd juice was conducted in both room temperature and at 4°C.

Keywords: Lagenariasiceraria, dietary fiber, prebiotic,*in vitro* fermentation, encapsulation

PS3-10

Comparative evaluation of non-conventional sources with respect to a functional phytocomponent

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Resistant starch, a potential functional phytocomponent, is defined as the starch fraction that cannot be digested enzymatically in the small intestine and get fermented by the gut microbiota in the colon. Thus, it is not involved in energy metabolism process of our body and can be treated as a functional component close to dietary fiber. Due to increasing health awareness among consumers, food manufacturers are aiming to develop functional foods with additional health benefits along with providing basic nutrition. Several non-conventional starch sources are abundantly available in local region but are not explored much for utilization of their functional constituents. The objective of this research work is to evaluate three non-conventional sources e.g. taro, turmeric, green banana on comparative basis with respect to their resistant starch content and its properties. For taro starch and green banana flour, it is found that heating, auto-claving, steam-cooking, debranching, cooling and drying significantly increases resistant starch content from its native counterpart. Treated taro starch contains 35.1% resistant starch, whereas green banana flour without any treatment contains 40.99-58.5% resistant starch. Spent turmeric flour is reported to contain 63-65% starch, in which significant percentage is resistant fraction, known as Starmeric. Comparison on Glycemic indices (GI) and physicochemical properties of flour would help to select the constituents for development of functional foods.

Keywords: Functional phytocomponent, Resistant starch, Non-conventional, Taro, Glycemic indices (GI).

PS3-11

Comparison of medicinal plants kwath and Spices based kwath benefits: A Review

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During pandemics, kwath consumption skyrockets, prompting India's Ministry of AYSUH to suggest "Ayush kwath" to boost immunity and fight infection. Ayush kwath is a combination of medicinal plants and spices based Kwath. The purpose of this review is to explore the effects of medicinal plant-based kwath and spices-based kwath, both of which have beneficial medicinal properties. Spices are mixtures of a wide range of volatile and non-volatile staple dietary additives that act as a natural defense system for host plants and have been used as medicine for centuries. Seed spices have an impact on a variety of body systems, including the gastrointestinal, cardiovascular, reproductive, and nervous systems. Seed spices contain a wide range of natural phytochemicals with complementary and overlapping functions, such as antioxidants, anticancer, anti-diabetic, antimicrobial activity, digestive aid, hypertension, and detoxification enzyme modulation. Tulsi, giloy, turmeric, and ashwagandha act as antioxidant sources to combat the ever-increasing oxidative stress in the body by scavenging free radicals for holistic growth. The modulation of transcription factors and inflammatory cytokines has also been linked to the antioxidant-mediated cellular response. The main distinction between medicinal plants and spices is that spices have similar flavoring and seasoning qualities and contain more dietary fibers, while medicinal plants have a better taste and contain less dietary fiber.

PS3-12

Development of instant UPMA mix with incorporation of Bengal gram and soy flour

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In the present investigation, the instant UPMA mix was prepared with incorporation of Bengal gram and soy flour. The instant UPMA mix was developed with variation of Bengal gram and soy flour i.e sample A (15%, 5%), B (10%, 10%) and C (5%, 10%) and keeping the quantity of semolina as constant. The spice mix is added for betterment of product in the proportion as 20%. The prepared mix was analysed for its proximate composition such as protein, carbohydrate, fat etc. On the basis of sensory evaluation by hedonic scale, the mix prepared with equal quantity of Bengal gram and soy flour (sample B) was found organoleptically accepted as compared to other samples. The proximate composition revealed, the sample B has lowest moisture content (6.12%) as compared to control sample (6.81%), A (7.52%) and C (7.32%). The protein, fat, carbohydrate and ash content of sample B was found to be 13.34%, 8.12%, 59.88% and 4.12%. The overall accepted prepared mix provides energy to about 376.89 Kcal/100 gm.

Keywords: Instant mix, UPMA mix, soy flour, ready to cook products, pulses based food products

PS3-13

Study of the parameters for fibre enrichedcookies and their consumer acceptability

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Cookies (Biscuits) are one the most popular baked product normally low in fibre. Enriching cookies with dietary fibres can improve its digestibility and regulate absorption of high calorie ingredients making it a healthier product.Dietary fibre has very specific function in body beyond nutrition like improving digestion, immunity, reduction of LDL in blood.As per RDAa minimum dietary fibre is required to maintain by 80 % of the Indian population. Our previous study showed that regular consumption of dietary fibre for a period of 3 months can lower blood cholesterol.In this study primarily we observed that most Indians don't fulfil the minimum RDA for dietary fibre. But on increasing dietary fibre content in cookies the sensory quality and consumer acceptability rapidly decreases. So this study is designed for developing fibre enriched cookies with improved consumer acceptability. In this study, wheat flour ispartially replaced with dietary fibres from banana peel powder. The effects of fibre addition on the physical, nutritional and sensoryproperties of cookies are observed. Fortification with 2 g of crude Banana peel powder per 100 g of flourcaused moderate-large reductions in overall acceptability, flavour acceptability, and altered appearanceofthe cookies, but fortification with refined fibre which are mostly water soluble, improves consumer uptake, obtained by a comparative evaluation with control ones without fibre.The addition of refined soluble fibres from banana peel improved the quality, acceptability and also nutritional value.

Keywords: RDA, Cholesterol, Banana peel, nutritional value

PS3-14

Physico-chemical, antioxidant, textural and sensory analysis of fruit bars formulated with the incorporation of beetroot extract and guava pectin

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Fruit bars are convenient food products which are highly popular in all age groups especially children. Their main ingredients are pectin (natural or commercial) and fruit extract or artificial flavour. Consumers' are becoming aware about the health benefits of fruits and vegetables and thus the demand for products with natural functional ingredients is increasing. This study aimed at formulating beetroot natural (guava) pectin bars (BNB) and beetroot commercial pectin bars (BCB) bars with incorporation of beetroot extract at the levels of 0, 2.5, 5, 7.5 and 10%. The formulated bars were analysed for their physico-chemical properties, antioxidant activity using DPPH method, colour using Hunter Lab colorimeter, textural parameters using texture analyser, and sensory attributes on nine point hedonic scale. The moisture, pH and ash content were high in BNB as compared to BCB at all levels of incorporation of beetroot extract. These values also increased with the increase in the incorporation of beetroot extract in both type of bars. The antioxidant activity as well as a* (redness) values increased whereas L* (lightness) values decreased significantly ($p \leq 0.05$) with the increased level of beetroot extract addition. The antioxidant activity for 10% BNB was the highest i.e. 98.28%. The TPA results showed that the hardness, cohesiveness, springiness, gumminess and adhesiveness values increased as the level of beetroot extract increased in the formulated bars. Among all the formulated fruit bars, 10% BNB received the highest sensory score for appearance (8.4), taste (8.1), texture (8.5) and overall acceptability (8.2).

Keywords: fruit bar, beetroot, physico-chemical, antioxidant, texture, sensory

PS3-15

Preparation of an herbal healthy drink from Clitoria ternatea (Butterfly pea) and Hibiscus rosa-sinensis (Hibiscus) flower petals

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Clitoria ternatea flowers and Hibiscus rosa- sinensis flowers are well known for its medicinal properties. Both are good source of antioxidants and are effective as antihypertensive medications. In this study, preparation of an herbal healthy drink from butterfly pea flower and hibiscus flower has been done. The ingredients used are 5 hibiscus flowers, 5 butterfly pea flowers, hot water, lemon juice, honey, mint leaves and ice cubes. Both flowers were collected from home garden followed by separation of the petals from sepals were done.The anther present in hibiscus flowers is removed after washing. These flowers were put in different vessels and hot water was added into it. It took almost 10-15 minutes to infuse the flower colour in hot water, until that time the vessels were kept aside. Once infusion is over, the flower petals were removed and it was observed that the water with hibiscus flower obtained red color and the water with butterfly flower got blue color. These two waters were mixed in 1:1 ratio and this mixed water was poured into a tumbler with ice cubes, which is followed by addition of 2 tea spoon of honey, one table spoon of lemon juice and mint leaves. This health drink was served to 20 people for sensory evaluation. The parameters such as color, aroma, taste, aftertaste were assessed and the overall acceptance of the drink was 8 in 9-point hedonic scale.

Keywords: Butterfly pea flower, Hibiscus flower, Herbal drink, Antioxidant property.

PS3-16

Spirulina as a Dietary Supplement to combat malnutrition

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Spirulina is a microscopic and filamentous cyanobacterium that has a long history of use as a safe functional food. Data regarding its nutritional value complement this, making *Spirulina* an excellentfood supplement to fight against malnutritional deficiencies in developing countries. In recent years, it has gathered enormous attention from research fraternity and industries as a flourishing source of nutraceutical and pharmaceuticals.These studies indicate *Spirulina* is an enriched in antioxidant, antiviral and anticancer properties as well as its capacity to combat obesity,inflammatory allergic and diabetes. It also shows greathypocholesterolemic, immunomodulatory, and hypoglycemic potential. The chemical composition includes carbohydrates, proteins, essential amino acids, essential fatty acids, minerals (especially iron), pigmentsand vitamins. Three major bioactive components,sulfated polysaccharides, protein phycocyanin, and *γ*-linolenic acid are found in it. The mineral makeup of spirulina is attractive as the iron level is 12 times higher than other food. It is also rich in magnesium, potassium, and calcium. It makes it good for blood rejuvenation and healthy function of a teeth and bones. The growing world population and consequential deficiency in protein, calcium and mineral supply for human nutrition has led to increased activity in exploring novel and alternative sources like single-cell proteins (SCPs). Due to the low nucleic acid content and high level of essential amino acids, algae are preferred over fungi and bacteria as a source of SCP for human consumption. Many food products can be produced by using *Spirulina* or their compounds, for instance, isotonic beverages, cereal bars, instant soups, pudding, cake powder mix, and biscuits.

Keywords: Malnutritional, nutraceutical, antioxidant, inflammatory, Single-cell protein.

PS3-17

FORMULATION OF INSTANT MILKSHAKE POWDER

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Fruits are healthy food sources which contain nutrients and phytochemicals. The production of healthy and a lot of convenient product are often contributed to extend the consumption of fruits. In this study an instant food product which is more nutritive was developed using millets and fruits. The main purpose of this project was to develop a product with extended shelf life. Different trials were done and the most acceptable formula for instant milkshake powder was: millets(bajra, ragi) (48%), pineapple pulp(10%), malto dextrin (32%), milk powder (5%), sugar (5%).The instant milkshake powder was developed using extrusion technique which was economical compared to other techniques. Sensory evaluations were done for the obtained product. The proximate analysis values obtained for the instant milkshake powder was: protein (5.68%), fat (3%), moisture (4.3%), ash (1.14%), and fiber (6%). This developed instant powder was rich in protein and dietary fiber compared to other commercially available instant milkshake powders. Cost evaluation of the product showed that1kg of instant milkshake powder costs Rs.120 only.

Keywords: Bajra, Ragi, Pineapple pulp, Maltodextrin, Extrusion

PS3-18

Application of instant decompression assisted steam curing for improving turmeric (*Curcuma longa L*) powder quality

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The objective of the investigation was to deliver turmeric powder with improved quality using instant decompression assisted steam curing (IDASC) process.The IDASC method was executed on peeled turmeric slices in ICPD treatment chamber, and, was followed by the hot air drying (IDASC-HAD). The process conditions, namely, treatment pressure (TP), treatment time (TT) and temperature of drying (TD) were optimized for minimization of hot air drying time (DT), and maximization of yellowness value (YV) and curcumin content (CC) of the turmeric powder, by a hybrid approach of response surface methodology (RSM) and particle swarm optimization (PSO). Furthermore, IDASC-HAD based turmeric powder was compared with the conventional product for various functional properties. Besides, scanning electron microscopy (SEM) was implemented for analyzing micro-structure of the various turmeric samples. The IDASC-HAD based turmeric powder samples exhibited higher values of DPPH, TPC, and TFC as compared to the conventionally produced ones. The improvements in the particle size and micro-structural characteristics were justified from the results of SEM. Turmeric powder produced by IDASC-HAD method as applied to turmeric slices can be asserted as a product with improved antioxidant properties, which can be utilized as a beverage with potential health benefits as well.

*Keyword**:*** Instant Decompression, Steam Curing, Turmeric Powder, Response Surface Methodology, Particle Swarm Optimization

Poster Session-4
Functional, Nutraceutical and Health Foods

PS4-1

A study on nutrition labelling usage by working women population of Varanasi, India

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The present study was conducted on 100 working women of Varanasi, aged between 20-50 years with the aim of assessing their knowledge, attitude and practice and thereby correlating them to have a better understanding about their nutritional background. It is a cross-sectional study conducted online (due to the spread of COVID-19 pandemic), through a self-structured questionnaire. The data collected was compiled and analyzed in IBM SPSS Version 21.0 wherein, Karl Pearson's correlation (r) was applied to obtain the appropriate results.

Nutrition labels are the prominent first-glance article which needs to be eye-catchy and comprehensible. The food labels displayed on the pre-packaged foods always have an influencing role on the practices of the customer during shopping. It can be inferred from the study that 58% of the total respondents surveyed were aware about the labels, 61% had a positive attitude towards the same but only 52% practiced healthy shopping more often. 68.3% subjects were satisfied with labelling format whilst other women participants had various suggestions for improvement. About 70% of the participants preferred back-of-pack labelling rather than front-of-pack because the former provides elaborative information. Qualification and occupation had negative associations with satisfaction of the display format. The people having knowledge regarding traffic light labelling showed a positive association with the usefulness of the same. The average practice percentage adopted by the consumers had negative association with factors like qualification, income, occupation. The need for simplifying the display-format and providing basic nutrition information to the population is highlighted through this study.

Keywords: correlating, nutritional background, prominent, comprehensible, display-format.

PS4-2

Studies on the Processing and Preservation of Dragon Fruit by Formulating Low Calorie, Jam/Jelly

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In India the indigenous fruits are processed into a number of value added products like, jam, juice, jelly, cheese, preserves etc. But the exotic fruits like dragon fruit,kiwi, avocado and their processed fruit products are rarely available in our markets.Dragon fruit is rich in nutritive value.From the literature we can able to find, the dragon fruit pulp contains 82.5-83% moisture, 0.16-0.23% protein, 0.21- 0.61% fat, 0.7-0.9% fiber, 6.3-8.8 mg calcium, 30.2-36.1 mg phosphorous, 0.5-061 mg iron, 8-9 mg vitamin C& 0.20-1.04% pectin. It also contains nutrients, such as carbohydrate, flavonoid, thiamine, niacin, pyridoxine, glucose, and polyphenol. The dragon fruit contains beta-carotene, lycopene and vitamin E, with average concentrations of 1.4 mg/100 g, 3.4 mg/100 g and 0.26 mg/100 g of edible portion, respectively. The seed of dragon fruit contains 50 % essential fatty acids, i.e. 48 % linoleic acid and 1.5 % linolenic acid. The mildly sweet taste and low in calorie of the fruit actually fitted best as a diet for the people suffering in chronic diseases like diabetes, obesity etc.

Therefore, this study is planned to overcome the technological challenges for making proper gel network at best possible low sugar content keeping in view on medicinal and nutritional importance of dragon fruit whichwould provide opportunity for commercial exploitation of this fruits.

Keywords: Dragon fruit, Gel network, Low calorie, Consumer, Evaluation

PS4-3

Protein Enriched Fruit Bar Using Different Source of Plant and Animal Protein and Analysis of Consumer View on Protein Enriched Fruit Bar: A Review

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Fruits are house of healthy vitamins and minerals which provide good nutrition and are typically consumed by all the age people but mostly are seasonal and are not available throughout the year therefore fruit preservation can be done by many ways and converting them into fruit bar is one of them. Fruit bar are usually low in protein and fat content and high in calories as containing sugar in good amount. Since protein is been consider as one of the most important components in a daily diet, therefore protein enriched fruit bar may fulfill the demand of consumer.Nowadays with increase demand of healthy, convenient and minimally processed food with improved nutritive profile and sensory quality having good taste and texture with natural ingredients is rapidly growing the protein bar sector. Different studies on formulation of protein enriched fruit bar using various plant and animal protein sources such as whey protein isolate, coconut powder, rice flour,soy protein, protein seeds like sesame,chia,flaxseeds etc have been discussed in this study. In this study, a market survey was also performed through google form to understand and analyzed the consumer view on protein enriched fruit bar.

Keywords: Protein enriched fruit bar, Plant & animal protein and Consumer view.

PS4-4

Development of yoghurt using pomegranate and dates extract and its characteristics studies

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Yoghurt is a basic dairy product that has been consumed for centuries as a part of diet. With time, yoghurt has been continuously modified to obtain a product with better appeal and nutritional effects. The popularity of yoghurt depends mainly on its sensory characteristics, of which aroma, tasteand texture are most important. Utilizing Dates andPomegranatesextracts yoghurt has been developed for the current research to achieve benefits of added functional components in addition with other sensory attributes. The methodology was under gone utilizing the pure culture strain (DVS) of 0.1-0.3% with respect to control as well as for yoghurt with fruit extract.SMP was added at the range of2%. Settingtime was kept for 7 hours at the temperature range of 40 --42 degree centigradein incubation.Final acidityof developed productswas(0 .62--0.7%), total soluble solid of final product was found to be 36% around.Developed yoghurts were measured with respect to some attributes like physical (colour, firmness,setting), chemical (pH, total titratable acidity, total phenolic content, antioxidantactivities) andother sensoryattributes. Theproportion of milk and date extract were maintained as95:5,92:8,90:10,88:12 and 85:15 with respect to 100-gramvolume. The varied proportion of pomegranate juice also used in order to increase the ascorbic acid, catechin, iron and amino acidcontent in the yoghurt.The presence of active functional ingredientswill make the yoghurt a therapeutic food.Regular intake of it may treat inflammation, diabetics,cancer etc. The product is rich in mineral and fibre content along with its probiotic. Hence theproduct could be said synbioticyoghurt.

PS4-5

Feasibility study on Chia (Salvia hispanica) as a potential textural modifier : Plant based egg alternative ingredient

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This paper reviews about the potential health benefits and extensive application of Chia seeds. Now a days, people concern their health very much. In recent times, people switching to vegan diet. Egg is a widely utilized structural ingredient in the bakery product. Chia (Salvia hispanica) can be an alternative healthy ingredient for egg. Researchers developed wheat bread blended with chia flour with the maximum concentration of 8% in the total formulation. Evaluated sensorial attributes gave satisfactory results. Researchers reported that chia flour addition enhances the nutritional benefits of products. Chia is rich in protein, dietary fibre – soluble fiber, calcium and omega 3 fatty acids. Fiber rich chia has hydrocolloidal property which can be effectively utilized as potential textural modifier in developing soft and moist dysphagia foods. Since chia flour is loaded with health benefitting fat, researchers investigated the possibilities of replacement of shortenings with chia flour in the bakery products. In the development of gluten free product also chia plays a significant role as a potential textural modifier.

*Keywords:*Chia, textural modifier, protein rich food, gluten free products

PS4-6

Development of flaxseed and rice flour based gluten free cookies and its industrilization

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The quality of the dough in terms of elasticity and texture of the dough mainly depends on gluten. But, for patients suffering from celiac diseases, gluten enriched food products cause problems. Besides, utilization of trans-fat during preparation of cookies also create unhealthy prospect for the consumers. Hence, in this study special type of cookies were developed by utilizing flaxseed and rice flour. This develops a consideration for the gluten free products also. A composite flour of wheat flour, rice flour, flax seed and bael powder was utilized for the development of the dough. Based on this dough, special types of healthy cookies were developed. Sensory evaluation and texture properties were determined for the assessment of the cookies. It was observed that these special types of cookies had higher acceptability in terms of sensory attributes also. Hence, this type of cookies can be claimed as a revolutionary food product for the patients and common people.

Keywords: cookies, flaxseed, rice flour, gluten free

PS4-7

Physicochemical, functional, textural and organolepticproperties of pasta prepared from traditional Himalyan crops *viz.* Barley and Buckwheat

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In this study, nutritionally enhanced pasta was prepared with common wheat and fortified with high altitude traditional crops of Himachal Pradesh i.e. hull-less barley and buckwheat. Pasta samples were prepared using different ratios of barley and buckwheat from 0-40% and evaluated for theirnutritional, functional, phenolic, textural and organoleptic properties.Pasta prepared using 20% of barley and buckwheat each, exhibited highest protein content (19.73±0.12 %) and total ash content (2.48±0.08 %) when compared to other pasta formulations. The color evaluation showed that incorporation of barley flour decreases the brightness and redness in pasta samples. Water activity of pasta samples was ranged from 0.259±0.04 a_w to 0.596±0.04 a_w. Addition of barley and buckwheat flour enhanced the phenolic and flavonoid content as compared to control pasta. Significantly increased cooking loss was observed in pasta(10.30%)in which barley is absent. Incorporation of barley and buckwheat into pasta reduced the optimum cooking time as compared to control pasta.As per the organoleptic results of the pasta samples, addition of barley and buckwheat had a positive effect on the colour, taste, and texture of pasta. Pasta prepared from 20%of barley and buckwheat each,was overall acceptable.Incorporation of barley and buckwheat flour seems very promising in producing pasta with fairly good antioxidant potentials, high protein content and other essential nutrients for good health, as these easily attract the health-conscious consumers.

Keyword: Pasta, Hull-less Barley, Buckwheat, phenolic, organoleptic

PS4-8

Physicochemical, structural & textural characteristics of insoluble dietary fiber incorporated instant noodles

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In an effort to enhance the nutritional values of instant fried noodles, insoluble dietary fiber (IDF) extracted from waste fruit peels namely totapari (A), and safeda (B) were incorporated at various concentration (1%, 3%, 5%, & 7%) to refined wheat flour. The proximate analysis exhibited maximum increase in ash, crude fat and crude fiber contents among A7%, and B7% formulations. Similarly, functional properties also exhibited significant increase ($p<0.05$) with maximum quantity in A7%, and B7% formulations. Cooking quality that includes water uptake and cooking loss were observed to be significantly different ($p<0.05$) among all formulations. The cooking loss was observed minimum in A7%, and B7% formulations as 4.43±0.03%, and 3.81±0.02% respectively. The change in microstructure with incorporation of IDF was observed using scanning electron microscopy (SEM). The textural analysis revealed the significant difference ($p<0.05$) in control and substituted instant noodles with maximum hardness in A7%, and B7% formulations. The noodles were further analyzed for sensory acceptability evaluated on the basis of color, texture, appearance and over acceptability. The noodles with 7% IDF incorporation exhibited maximum overall acceptability. Thus, the present study contributes in development of functional food utilizing IDF extracted from waste bio-resource loaded with enhanced nutritional values.

Keywords: Instant fried noodles, insoluble dietary fiber, Structural property, functional property

PS4-9

Convenient Speciality Food Breakfast Solutions

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Breakfast, “the most important meal of the day”, so breakfast should be very much nutritious with proper balance of carbohydrates, proteins and fats and also full of vitamins & minerals. But now-a-days due to lack of time we need some convenient (ready-to-eat) breakfast solutions which must be a nutritious one. One of today’s major nutritional problems is the consumption of high amounts of fat and low amounts of fiber associated with various disease. The demand for low fat/calorie foods and those enriched with dietary fiber in the market has been increasing over the years. So keeping in mind all the factors “OATS CAKE” must be a good option. Oats is gluten free whole grain and a great source of important vitamins, minerals, fibre and antioxidants. Oats contain Mn, Mg, Cu, Fe Vit B1, Vit B5 etc. Oats can lower cholesterol levels, blood sugar. 100g oats contain 389 calories, 8% water, 16.9g protein, 66.3 carbohydrates, 10.6g fiber, 6.9 fat. The bakery industry in India is the largest organized food industry, with an annual turnover of Rs. 800 crores. The production of bakery products has doubled over the last 10 years from 1.8 MT to about 3.5 MT. On the other hand, Cake products are enjoyed by many, but they are less nutritious. Oats cake gives all nutritional values and provide us with healthy snack food. As this project focused on Geriatrics people oats cake is also beneficial for them and also for others.

PS4-10

Studies on the standardization and quality evaluation of stabilized combo meals as light weight ration

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Steam still retort processing is well established thermal stabilization technique for most of the Ready-to-Eat foods supplied to Defence Forces as MRE Ration and as RTE product in civil markets. Processing of individual ration items not only occupy larges storage space but also demands for additional packing material. The conventional processing includes precooking (>80%), filling and packing in retort compatible materials for stabilization. During prolonged storage the consumers perceived a typical processing flavour resulting into its poor acceptability, therefore, attempts were made to prepare combo meals while minimizing process lethality (F0-3.5), typical processing flavour while ensuring commercial sterilization and retaining maximum desirable flavor.

The products selected for the study weretraditional/Ethnic Indian foods with pan India taste and acceptability *viz.* RTE Combo Khichdi, RTE KadhiChawal. These were studied for their sensory profile, proximate composition, nutritional profile, textural attributes, and invitro digestibility. Storage markers were also studied with respect to its oxidative (peroxide value) and hydrolytic stability (%FFA).

As the method developed was with novel approach of in pack cooking cum sterilization, therefore it resulted into a stabilized product with respect to microbiological standards for such thermally stabilized foods. Preferential tests revealed a clear demarcation and better acceptability with respect to colour, flavour and textural of the grains used for simultaneous cooking. These all were stable for more than a year at ambient storage conditions.

Keywords: Combo-meal, stabilization, process lethality, invitro digestibility retort

PS4-11

Value addition to Indian sweetmeat with Ashwaghandha and honey

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Sweetmeat, the sweetened chenna based food product is consumed mainly in India but also getting an increasing demand worldwide. The chenna (curdled milk) is an excellent source of protein (casein) for vegetarians, also contain fat and vitamins A, D. But consumption of sweetmeat in large quantity over a long period may be linked to development of prevalent diseases like diabetes, obesity, hypertension.

Ashwagandha(*Withaniasomnifera*)is reach in different biologically active substances like alkaloids (isopelletierine, anaferine, cuseohygrine, anahygrine),steroidal lactones(withanolides, withaferins), saponins (Sitoindosides) and acylsterylglucosides. Honey contains 38%fructose,31%glucose,vitamins (ascorbic acid, pantothenic acid, riboflavin, niacin)and minerals (copper, calcium, potassium, iron, manganese and zinc).These functional components help to reduce stress, blood sugar, cortisol, inflammation, cholesterol, boost immunity and treat asthma.

Our objective is to incorporate traditional herbs in sweetmeat for nutritional value addition and their stability study.

Herbal water extract of dried Ashwagandha root was added to prepared chenna from cow milk within the range of 0.5-1g as permitted range of usage for adults per day (Schedule IV, FSS Act 2016). Honey was added along with fine powdered cane sugar in the ratio of 1:2 on weight basis. Sandesh was prepared mixing fresh chhana and herbs, heating at 75^{o}C for 15-20 minutes. The Sandesh prepared were tested for their microbial quality, physical and sensory attributes.

Quality and health benefits of Sandesh from cow milk could be improved through incorporation of medicinal herbs such as Ashwagandha and honey into chenna during manufacture of Sandesh.

Keywords: Ashwagandha, herbs, sweetmeat, value addition

PS4-12

Esterification of non-conventional talipot starch for improving the functionality and resistant starch content

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Talipot starch obtained from the trunk of talipot palm (*Coryphaumbraculifera*L.) is starch with a high yield (76%) and high amylose content (28.13%). Resistant starch (RS) possessvaried physiological benefits by acting as a dietary fiber and reduces the risk of many degenerative diseases. The process of starch esterification considerably increases the RS and improve other starch characteristics like reducing gelatinization temperature and retrogradation tendency. In the present study, talipot starch was esterified with two organic acids; lactic acid and acetic acid. By the introduction of the ester group (C=O), the modified starch showed a significant reduction ($p \leq 0.05$) in amylose content, relative crystallinity, and swelling power of starch. The lactic acid- and acetic acid-modified starch also showed a significant decrease ($p \leq 0.05$) in syneresis value, gelatinization temperature and peak viscosity. Between the organic acids, lactic acid showed a higher impact on starch characteristics and RS formation than acetic acid. Esterified talipot starch with a comparatively high yield can be used in the preparation of low-calorie foods.

Keywords: Lactic acid, acetic acid, resistant starch, retrogradation tendency, ester groups, low-calorie foods.

PS4-13

Polyherbal formulations (PHFs) for therapeutic uses: A review

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Use of Herbal Products has been in a trend for the past few years in many countries. Herbal products or extracts obtained can be much more effective when combined with two or more herbal products which is known as the Polyhedral Formulations (PHF). Herbal products contain many phytochemicals such as carbohydrates, lipids, phyto-sterol, sulphur compounds, flavonoids, stilbenes, terpenoids, phenolic acids, alkaloids and other nitrogen containing metabolites which are useful for the treatment of various type of illness and diseases. The main reason for using monoherbal or polyherbal formulations is to speed up the recovery without having any side-effect to the body. The healing of wounds or infections can be speed up by using polyherbal formulations. PHF can be extracted or made from any parts of the plants depending upon its effectiveness to the wounds and infections. Thus, it is very much necessary to analyze the effectiveness of different parts of the plants such as leaves, fruits, stems, seeds, flowers etc., depending upon the type of illness for the treatment of diseases and to study its anti-microbial and anti-inflammatory activities.

Keywords: Poly herbal formulations, illness, anti-microbial activities.

PS4-14

Formulation and characterization of nanoemulsion incorporating orange oil

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The formulation and characterization of orange oil based nanoemulsion was the primary aim of this research. Essential oil based nanoemulsions have great utility in the food industry as they have enhanced properties when compared to conventional emulsions and can be used as delivery vehicle for different nutraceuticals. The antimicrobial activity of the EO-based nanoemulsion is an added advantage. Orange oil based nanoemulsions were prepared using high energy emulsification method (ultrasonication) where orange oil was used as the dispersed phase, distilled water as a continuous phase and non-ionic surfactant Tween 20 played the role of an emulsifier. Different sets of nanoemulsion was prepared using fixed concentration of orange oil i.e. 5% v/v and varying the amount of surfactant. Seven samples with ratio 1:1,1.1.5,1.2,1.2.5,1:3,1:4 and 1:5 was prepared. Droplet average diameter, zeta potential, viscosity, turbidity, whitening index and thermodynamic stability have been assessed. Droplet diameter of nanoemulsion decrease with increase in amount of surfactant used. Turbidity was in 0.2- 0.131 for orange oil based nanoemulsion. A decrease in the value whiteness index and increase in the viscosity for nanoemulsion is observed when amount of surfactant is increased in the formulation. All the samples of nanoemulsion of orange oil which were tested for their stability during centrifugation, heat-cooling cycle and freeze-thaw cycle were found to be resistant to all kinds of stress and were thermodynamically stable.

Keywords: Orange Oil; Nanoemulsion;Tween 20; High energy emulsification method

PS4-15

Camellia sinensis as a feedstock forantioxidants and therapeutics: A review

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Green Tea (*Camellia sinensis*), known for its unique essence is a widely consumed drink all over the world. It is obtained from drying the leaves of tea plants. Drinking of tea is though ancient but studying the chemical components of tea is quite recent. The polyphenol compounds found in green tea has been a subject of attention as they have immensely contributed to various health benefits. In green tea the polyphenol content comprises mainly of the catechin derivatives in majority like epicatechin, epigallocatechin, epicatechin-3-gallate and EGCG. EGCG is reported to be one of the major and most biologically effective catechin of green tea. Such compounds have proved to be very effective as antioxidants, anticarcinogenic, antihypertensive, regulation of lipid metabolism, etc. Since oxidative reactions are regarded as being detrimental to the body, extensive research over recent years has been undertaken to seek out ways of combating these processes. This review focuses and provides insight into the antioxidant activity of green tea and talks about the future perspectives in the related context.

*Keywords:*Green Tea, antioxidants, anticarcinogenic.

PS4-16

Physico-Chemical and Sensory Evaluation of Honey based Whey Drink

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Consumer world has redefined its eating habits as to live a healthy and active lifestyle. Nowadays, high-protein and vegetable rich diets are the most-in-demand. Whey liquid, obtained as a by-product of paneer or cheese, constitutes 20% of total protein in milk. The value added products of whey are simple and economic solution to utilize the by-product of dairy industry. Keeping this in view, the aim of this study was to develop a whey drink with added nutritional benefits. This drink constitutes primarily whey along with honey, lemon juice, ginger juice and/or turmeric in just right proportions to make it appealing. The samples of whey drink (with or without turmeric) were analyzed for different physico-chemical parameter and evaluated for sensory attributes. The physicochemical parameters viz. pH, TSS, Acidity, Total Sugar, Protein, Vitamin C, Total Phenolic Content (TPC) and Antioxidant activity for the samples of whey drink with turmeric were 4.02±0.03, 21.50±0.00, 0.75±0.01, 18.01±1.12, 0.45±0.02, 15.44±1.82, 49.40±0.55 and 17.29±4.78 and without turmeric were 4.08±0.05, 23.00±0.00, 0.83±0.01, 15.37±1.18, 0.46±0.01, 15.09±1.19, 43.84±1.07 and 9.37±2.26, respectively. It was observed that by addition of turmeric, the antioxidant activity of the drink became double. The sensory score for overall acceptability of both drinks was closed to 7 and further can be recommended for consumer acceptance.

Keywords: Whey, Honey, Lemon Juice, Physico- Chemical, Turmeric, Ginger Juice

PS4-17

Energy bar production using underutilized Chironji seeds(Buchanania Lanzan)

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The basic aim of this study wasa new product development using underutilized seeds, so we made energy bar using underutilized Chironji seeds (Buchanania Lanzan) found in local confectionery and general stores all over India.The ingredients used for the production of energy bars were Chironji seeds, Oats, puffed rice, Dates, Condensed milk, Jaggery, Butter, Coconut flakes, Raisins, Almonds, cardamom powder and Milk chocolate coating. Chironji seeds are rich in Protein, Fat, dietary fiber, Phosphorus, calcium, magnesium and iron. Chironji seeds have many essential minerals and vitamins including Vitamin C, B1, B2and Niacin. Raw material like Chironji seeds, puffed rice, Oats and dry fruits were used after roasting and Dates were soaked and then all are semi grinded before making energy bars. Butter, Jaggery and milk chocolate are melted before using. Theenergy bar developed was devoid of any preservatives. The bar is full of natural goodness with no additives of flour or any other binding agents and the taste is enhanced by using all the natural sweeteners like Condensed milk, Dates and Jaggery. The bar producedwas further analyzed for nutritional and sensory characteristics and showed good results.

Keywords: Energy bar, Underutilized seeds, Chironji, nutritional analysis, sensory analysis.

Poster Session-5: Quality, safety and hygiene in food processing

PS5-1

Upgrading the value of *Citrus limetta* peels as a potential source of pectinand its characterization

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Citrus limetta (Mosambi), is a well-known citrus fruit in India that is widely appreciated for its nutritional and sensorial attributes along with numerous pharmacological benefits. Increased industrial processing of this fruit generates high quantity of biodegradable by-products, especially, peels (45-50% wt. of fresh produce) which is considered as a promising source of pectin. Pectin is a natural polysaccharide with high functional value having numerous applications in food sector. Therefore, keeping in view the increasing importance of waste to wealth concept and role of pectin in food sector, this work is focused on the valorization of *C. limetta* peels for pectin extraction. In current research work, pectin was recovering reducing acidic extraction method under different extraction conditions, i.e., time, temperature, pH, and liquid: solid ratio (LSR), and further physicochemical and structural parameters of pectin isolated at optimum parameters were investigated. The highest pectin yield was observed at 80 ºC temperature, 1.5 pH, and 1:30 LSR after 90 minutes. Furthermore, the extracted citrus pectin exhibited low degree of esterification, high molecular weight, and good emulsifying and foaming properties. Moreover, it has been observed that the microstructure of *C. limetta* peels were damaged and disrupted after extraction. Therefore, the results concluded that *C. limetta* peels can be considered as a potential and inexpensive raw material for the extraction of pectin with suitable properties and this developed environment friendly process can also add value to this agro-industrial by-product.

Keywords: Pectin, citrus peels, extraction, degree of esterification.

PS5-2

Using LASSO and Classification and Regression Tree to predict *E. coli* Prevalence in Pasture Poultry Farms in Southeastern United States

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Poultry is identified as a reservoir for pathogenic *E. coli*. It is important to identify farm practices factors associated with *E. coli* in pastured poultry environment. The objective of this study was to develop models that can predict *E. coli* counts and select farm practices factors contributing to *E. Coli* counts in pastured poultry farms. Fecal, soil, whole carcass rinse after processing, final product after chilling and storage, and ceca samples were collected for *E. coli* counts from 11 pastured poultry farms. Classification and regression tree (CART) and lasso method were developed for each sample type. The farm management practices and processing factors such as source of eggs, appearance of other animals on farm, and chilling method were used. Models were developed to predict the counts of *E. coli* and select the most important features used in predicting *E. coli*. Model performance were compared using prediction error. For fecal samples, whether cattle were present on farm, flock size, and animal source were the top three important variables affecting *E. coli* counts by lasso method. The CART method selected flock, animal source, flock age in days, length of feed restriction before processing as the most important rules in predicting *E. coli* counts. The prediction error of lasso method was 1.01 where CART method was 1.061. The two methods performed almost the same in predicting *E. coli* counts. The predictive models will provide practical and effective tool to predict *E. coli* counts and identify farm practices factors that affect *E. coli* counts.

Keywords: E. coli, pastured poultry farms, farm management practices, predictive modeling, LASSO and CART

PS5-3

Preservation of functional component in grated coconut kernel

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Coconut trees are mostly available in coastal tropical areas. Distribution of the kernel across the country is quite difficult as they easily prone to get spoiled during transportation. Grated coconut kernel is not shelf stable under ambient condition due to high moisture and fat content. Hence packaging, storage and transportation temperature are the crucial factors to be considered. Proximate composition of kernel has moisture content 43.5%, fat 38.8%, protein 6.2%, ash content 0.9%, carbohydrate 10.6%, crude fiber 11.7% and many other functional components such as tocopherols, tocotrienols and phenolic compounds which are changed over processing and long-term storage. This work is aimed at preservation of functional components of fresh grated coconut. Freshness of scraped coconut was maintained by applying hurdle technique where kernel is treated with humectant to reduce a_w, acid ulantto reduce pH, Sodium benzoate as anti-microbial agent, BHA as antioxidant. It is found that use of NaCl at 3 % is effective as humectant. It has been observed that yeast, mold, total plate count of grated kernel is significantly decreased with an increase in salt concentration at refrigeration temperature. Grated coconut can be preserved for a significant duration with 2% salt, at refrigerated temperature in LDPE/Nylon flexible pouches. Sensory analysis after one month at refrigeration temperature indicated higher overall acceptability than at ambient temperature. Furthermore, when the kernel is osmo-dehydrated with sugar syrup, refrigeration could be avoided. The product becomes more cost effective. This technique also improves organoleptic score as well as functional quality of the product.

Key words: Coconut kernel, functional components, preservation, organoleptic score.

PS5-4

A study on the Physico-chemical, Nutritional, Functional and Thermal Properties of Pomelo (*Citrus maxima*)

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Pomelo (Citrus maxima) is one of the under-utilized fruits, largely available in the northeastern part of Assam. Although the production, nutritive importance, market potential is good, utilization of these fruit is less due to lack of information regarding nutritional value, perishability, astringency and poor processing technologies. The research work is aimed to study the physico-chemical, nutritional, functional and thermal properties of Pomelo (Citrus maxima). From the results, it was found that this fruit has high moisture content 90.12 % (wb) that results for high softness and perishability of the fruit. The biochemical properties for the Pomelo (Citrus maxima) including pH, TSS, TA, DPPH, TPC, TFC and Vitamin C were found as 3.69, 9 (°Brix), 1.65%, 43.97%, 431 (mg GAE/ml), 71.27 (mg of QE/ml) and 52.92 (mg/100ml), respectively. The dimensional properties includes geometric mean diameter, arithmetic mean diameter and equivalent mean diameter for Pomelo (Citrus maxima) were estimated 10.53-15.52 cm, 10.53-15.53 cm and 10.53-15.53 cm, respectively. Surface area and volume of Pomelo (Citrus maxima) were noted as 348.19 – 756.75 cm 2 and 530 - 1070 cm3 , respectively. The sphericity of Pomelo (Citrus maxima) was found to be spherical and length, width and thickness were ranged between 10.6-16.2 cm, 10.2-15.5 cm and 10.8-14.9 cm, respectively. Thermal properties of Pomelo (Citrus maxima) including thermal conductivity (K), thermal diffusivity (α) and specific heat capacity (CP) were found 0.592-0.594 J/ms, 0.189-0.206 m 2 /s and 3.928-3.936 kJ/kg°C, respectively. The results of this study will be helpful in the commercial production of pomelo juice products through development and designing of processing machines.

Keywords: Pomelo, Physico-chemical, Nutritional; Functional, Thermal properties, Citrus maxima.

PS5-5

Monitoring of changes in composition of sunflower oil during deep-fat frying with elephant apple slices

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Deep fat frying is one of the most often used food preparation procedures worldwide. It is a method of cooking food items by submerging them in oil (at a temperature of 180 to 220°C) for a certain amount of time.In this research, sunflower oil was used by performing frying experiments with elephant apple slices at five different frying temperatures (140, 160, 180, 200 and 220℃) with a predtermined frying protocol at varius frying periods (2, 4, 6, 8, and 10minutes). Oil samples were taken on a regular basis to assess quality criteria (Saponification Value, Total Polar Content, Color, Specific gravity, and Viscosity). The impact of process factors (heating time (HT), frying time (FT), and frying temperature) on the fried oil quality metrics was investigated.Resultes depicted that, the process factors had a substantial impact on the final quality of the fried sunflower oil. According to the observations, the quality of repeatedly fried oil and fried samples varies depending on frying temperatures and periods. The Free Fatty Acids value and acid values of sunflower oil are range from 0.1128% to 0.676% and 0.16 Mg KOH/g to 0.96 Mg KOH/g respectively after five hours of heating time. The initial saponification values of the fresh sunflower oil and deep-fried oil under investigation were seen to ranges from 185 Mg KOH/g to 200 mg KOH/g oil respectively. The fried sunflower oil understudy had native viscosity values ranged from 34.5 to 85 cP. Sunflower oil had significantly the highest value of TPC was 15.50% at the end of the heating period five hours, this value was about seven times as high as that of fresh sunflower oil. The specific gravity of repeated cooked oil is increased from 0.903 at 140℃ to 0.94 in the five hours of heating at 220℃temperature. In the sensory evaluation, the frying sample at temperature 180℃ was the most stable. Sunflower oil may be utilized for daily uses by households and small along with medium-scale food processors as the price and quality of the fried products is good and can give us better results of cooked products as well as proper health benefits.

Key words: Deep fat frying, Sunflower oil, TPC, Elephant apple slies.

PS5-6

Amino acid profile, mineral composition, antioxidant and functional properties of different oilseed cakes

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The oilseed cakes (OSC) left over after expelling oil from oilseeds are the major waste of oil-processing units that need to be managed and utilized as food ingredients. In this study, mineral, amino acid (AA) composition, antioxidant and functional properties of flaxseed (FSC), sesame (SSC), mustard (MSC), nigella (NSC) and groundnut (GSC) seedcakes were compared and analyzed. GSC and SSC had high protein (45.47%) and fat (23.64%) contents, respectively. High levels of minerals (P, Mg, Mn and Cu) were quantified in FSC. MSC exhibited the highest antioxidant activity (9.61 µmol TE/g) and total phenolic content (2.83 mg GAE/g) while GSC had highest total flavonoid content (6.51 mg QE/g). NSC showed higher oil absorption capacity (2.10 g/g) and emulsifying activity index (89.52 m2 /g). Twenty-one AA including citrulline and ɣ-aminobutyric acid (GABA) were detected in OSC. GSC had high contents of hydrophobic, acidic and basic AA. The essential AA (methionine, isoleucine, tryptophan, threonine and lysine) were higher in MSC and SSC was rich in valine, GABA and citrulline. This study points out the enormous potential of OSC as a food ingredient for fortification to meet nutritional requirements.

Keywords: Oilseed cake, Phenolic content, Antioxidant activity, Functional properties, Amino acid composition.

PS5-7

Effect of drying methods on quality of amla powder : A review

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Indian gooseberry or Amla (*Emblica officinalis*) is a type of small to medium sized deciduous tree, found in different countries India, Pakistan, Uzbekistan, Sri Lanka, South East Asia, China and Malaysia. Amla is highly nutritious and is one of the richest sources of vitamin C. In this study, amla segments were dried under different drying methods namely refractance Window drying, tray drying, sun drying and freeze drying. Amla powder yield varied and significantly affected by drying methods viz., sun drying(10.11%), refractance window drying (9.22%), tray drying (7.43%)and freeze drying(2.23%). Total phenolic content was varied from 7.45-19.42 GAE/100g with lowest in sun drying and highest in freeze drying. Freeze dried powder showed the highest content of ascorbic acid (560mg/100g) and tray dried sample showed lowest amount of ascorbic acid (181.15mg/ 100g). Highest solubility index was observed in freeze dried sample and lowest was in tray dried sample. Among all dried powder samples, the freeze-dried sample was lighter in color and has highest sensory score.

Keywords: Amla fruit, Amla Powder, Hot air oven drying, Sun drying, freeze drying, Refractance window drying.

PS5-8

Quality of elephant apple (*Dillenia indica* L.) powder as affected by drying methods

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Elephant apple (*Dillenia indica* L.) locally known as outenga in Assam is native to southeastern Asia. Fruit growth and nutritional composition of elephant apple fruit were investigated between September-November 2019, to identify the suitable stage of fruit development and the drying method for maximum retention of quality of elephant apple fruit powder for getting its benefits during the off season. Flowers tagged at first opening. Nutritional composition was investigated at 75, 100, 120 and 150 days after flowering under different drying methods (oven drying at 50ºC and 70ºC, sun drying, solar drier drying, shade drying). Significant differences in the nutritional parameters were observed in respect of growth stages of fruit and drying methods employed. Interaction between fruit development and drying methods was also found significant except for total carbohydrates. Solar drying was found better in maximum retention of crude fibre, total carbohydrate, ascorbic acid and anthocyanin. Oven drying at 70ºC was found better for moisture, ash & tannin and sun drying was found better for crude protein and total flavonoid. Fruit of 120 day after flowering was found nutritionally superior over other growth stages. Lowest antioxidant activity of the elephant apple powder was observed in fruit of 120 day after flowering dried under shade drying, whereas highest activity was found in fruit of 120 day after flowering dried under oven drying at 50ºC, but 100 days old fruits showed better inhibition than the others.

Keywords: Dillenia indica L., drying, growth stages, Antioxidant activity

PS5-9

Healthy Freeze-DriedFruit Juice Powder for Astronaut in Microgravity

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Microgravity is the condition in which people or object appear to be weightless. The effect of microgravity can be seen when astronauts and objects float in space. Microgravity changes the body performance. At this condition, body becomes deficient in some essential functional components also. Blueberry due to its high antioxidant capacity of their abundant polyphenolic compounds was first popularized as super fruit. Generally, blueberries in a fresh form, consisting of water (84%), carbohydrates (9.7%), proteins (0.6%) and fat (0.4%) may be utilised to be effective in replacing the deficiencies among astronauts. Malvidin and delphinidin the major components of blue berry constitute almost 75% anthocyanins play an important functional role in maintaining proper cardio-vascular activity for astronauts.The purpose of this work is to develop a blueberry freeze-dried fruit juice powder enriched in anthocyanin and other bioactive components and their stability. Blueberry juice is mixed with maltodextrin in variable proportion like 80:20, 75:25,70:30; freeze-dried and packed. The novel drying technique like freeze drying is adopted for space food. Fruit juice blended with maltodextrin is frozen at -20^{o}C for 24 hours, then dried at 0.1 mbar, -55^{O}C for 48 hours. Foil laminate (Polyester-Nylon-Al foil-PP) is used as a packaging material. The dry fruit juice powder is placed in the package and flushed three times with nitrogen. The septum is inserted and the ready package is sealed. The shelf life of the product was obtained 9-12 months with best result for 70:30 ratio. Added maltodextrin help the juice powder with a good stability against oxidation, ease of handling and extended shelf life.

Key words: Micro-gravity, blueberry, anthocyanin, malto dextrin, freeze dry, foil laminate.

PS5-10

Oxidative stability and sensory acceptance of microencapsulated olive oil powder incorporated ice cream

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The microencapsulated olive oil powder was incorporated at different levels in ice cream, viz., 1%, 3% and 5% and based on the sensory scores, 3% level of incorporation was found to be the best and selected for further analysis. The 3% microencapsulated olive oil powder incorporated ice cream was analysed for proximate composition viz., moisture, protein, fat, total ash, carbohydrate and total solids. The higher fat content was found in the treatment with casein/ maltodextrin / guar gum at 1:1.98:0.02 ratio of wall matrix. There were highly significant differences between control and treatment groups. Oxidative stability of microencapsulated olive oil powder incorporated ice cream was analysed in terms of peroxide value and anisidine value which were found to be maximum of 5.98 and 3.77 respectively. The peroxide value in meq O_2/Kg reached the maximum of 12.24 at room temperature storage with MD / GG as wall material at 1.98:0.02 ratio and 6.40 at refrigerated temperature storage with casein / MD as wall material at 1:1 ratio. Total phenolic content of microencapsulated olive oil powder incorporated ice cream showed slight decrease in values as the storage period extended. The shelf-life of ice cream incorporated with different microencapsulated olive oil powder was recorded for 180 days at -18ºC.

Key words: Microencapsulation, ice cream, peroxide value, phenolic content.

PS5-11

Utilizing essential oils as an effective way for food preservation

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Food preservation is required to increase the shelf life of food, thereby ensuring food safety and quality. It is one of the primary aspects of the food industries and the government agencies. Shelf life is defined as the time span under definite storage conditions during which the food remains safe and edible. An additive is essential to increase or uphold the shelf life of food, i.e. preservative.

Microorganisms (like bacteria, yeast and molds) are primarily liable for the spoilage of food. An estimation of more than 20% of world's food is wasted due to spoilage. To counter this problem, synthetic preservatives have been used in the industries for several years. New substitutes of food preservation and conservation are evolving; for instance, numerous studies indicate that consumption of chemical additives and synthetic preservatives is leading to allergies, cancer, intoxications. Consumers are giving up chemical additives, which means there is a requirement of a new alternative. In recent years, there has been a growth in the interest for the search of new antimicrobial agents which has raised to the exposure of new natural source i.e. "ESSENTIAL OILS".

Essential oils are concentrated, volatile and aromatic extracts from the medicinal and aromatic plants. Essential oils have antimicrobial-activity against a wide range of microorganisms and antioxidant activity which is generally recognized as the phenolic effect of essential oils. The reasons behind the potential of essential oils to be a powerful antimicrobial agent is that they have active constituents like terpenes, terpenoids, carotenoids, coumarins, curcumins which have abundant implication in the food industry. Various properties of essential oils suggest the potentials of consuming natural, safe, eco-friendly, cost-effective and effortlessly recyclable antimicrobials for food preservation in future.

Keywords: essential oil, food preservation, food industry, preservatives, aromatic extracts, additives, food safety, antimicrobial agent.

PS5-12

Adulteration checking of liquid food products such as oil, honey, ghee, milk etc by sensing dielectric property

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Abstract Electromagnetic radiations have many agricultural applications like imaging, non-invasive measurement, dielectric heating, pre- and post-harvest treatment. The thermal heating brought about by the RF/microwave can be efficiently used to disinfect food as well as non-food materials, soil and importantly it can be used to kill pests and bacteria. Non-invasive measurement of quality parameters such as moisture content, adulteration check of the agricultural and animal produce are very serious concerns in our society. Adulteration in food is a major threat all over the world now. It is required to check at various levels to alert people regarding adulteration. Quality control of liquid products such as oil, ghee, honey and milk etc is becoming more stringent. As a result, there is a substantial need for methods of analysis that could provide real-time in-situ monitoring especially for quality control purposes during production process and storehouses. One such rapid, simple and non-destructive technique for detection of adulteration in food is the dielectric spectroscopy. It measures the dielectric properties of the material under test as a function of frequency. The dielectric property changes when the product gets adulterated or contaminated. Hence thus by comparing it with pure one, adulteration can be checked and monitored. This paper discusses the lab based non-destructive testing for a adulteration check and the possibility of the development of microwave based non-destructive and non-invasive hand held system for adulteration check.

Keywords: Adulteration, Dielectric Spectroscopy, Liquid Food Products, Microwaves, Nondestructive testing.

PS5-13

Effects of alkaline salts and pigmented rice on quality characteristics of rice noodle

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The food processing industry is being continuously challenged for redesigning local foods into healthy foods that contain nutrients and also to have potential food properties. Noodles are a safe and nutritious food product that follows the set food standards of various countries. There has been an increase in the need for conveniently processed food products to keep up with the fast pace of modern lifestyles. Alkaline noodles are reported to have characteristic aroma and flavour, a slight yellowish in colour and a firm, elastic texture. These salts are widely used in the noodle industry as a dough conditioner or quality improver at a much lower level. Pigmented rice (*Chakhao poireiton*) is a rich source of antioxidants and it is naturally gluten-free, which can be used for the production of functional food formulation. Effects of alkaline salts in Incorporation of pigmented rice in high amylose rice for the noodle-making were carried out. Moisture content, ash content, solubility, swelling, pasting temperature, thermal properties, rheology, RVA of the flours were carried out. It was observed that, with the increase in the pigmented rice, the colour of the noodle turned darker, the stickiness was increased, Pasting temperature ranged from 58^{o}C to 73^{o}C, Peak viscosity from 652 to 2760 cP, hold viscosity from 2284 to 598 cP, breakdown from 9 to 476 cP, and final viscosity from 1169 to 6298 cP. The setback was recorded from 544 to 3776 cP. It is found that the rice dough has good viscoelastic properties or they are more elastic than viscous. Increasing in the elastic (G') and viscous (G") moduli was seen with the addition of alkaline salts. The amount of the modulus was seen increasing, which implies that the dough became stronger. The elastic modulus was greater than the viscous modulus at all of the concentrations studied in all cases.

Keywords: Alkaline salts, pigmented rice, rheology, RVA, noodles

PS5-14

Effect of *Euryale ferox* seed shell extract on antioxidant, textural, and sensory properties of bread

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Euryale ferox Salisb. are known for their antioxidant property which may be attributed by the shell that contains phenolics and flavonoids. Bread samples were prepared by incorporating 0.25%, 0.5%, 1%, and 2% of *Euryale ferox* seed shell extract (EFSSE). Color of bread samples were analyzed by using Hunter Lab colorimeter. Textural properties of the bread were measured using texture analyzer and specific volumes of the bread were also determined followed by sensory evaluation. The total phenolic content (TPC) in the extract of bread samples was determined using Folin–Ciocalteau method. The ABTS assay was performed to determine antioxidant activity. *In vitro* starch digestibility was measured.

This study evinced that with an increase in the level of EFSSE incorporation, the specific volume of the bread decreased from 3.83cm^3/g to 2.66±0.02 cm^3/g. Bread crumbs with EFSSE addition were all darker than the control, 'L' value ranged from 67.88 to 61.62 and the "a' value increased from 0.82 to 1.09. EFSSE had little effect on textural properties, indicating the feasibility of using EFSSE without compromising the sensory attributes. The slight increase in the hardness of fortified bread is related to lower specific volume and denser crumb structure, sensory evaluation revealed good overall acceptance. Addition of EFSSE increased the phenolic content and antioxidant activities. The TPC in the extract of bread samples increased from 15.36 GAE mg/g sample to 22.5 GAE mg/g sample. The ABTS percentage increased from 22.50 to 45.21. The decrease in rapidly digestible starch ranged from 27.4% to 8.5% suggesting a possible inhibitory effect of EFSSE on the activity of α-amylase and α- glucosidase. The study indicates the potential of transforming bread into a low glycaemic index food.

Key words: *Euryale ferox*, antioxidant, glycaemic index, bread, functional food, sensory

PS5-15

Development and Evaluation of Physico-Chemical and Sensory Characteristics of Kinnow Jelly

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Kinnow a well-known and favorite fruit from mandarin group in the Punjab region of India. Nutritionally, Kinnow is an excellent source of Vitamin C. Unlike any other fruits, the lesser number of kinnow based products are available in market. From value addition perspective, the aim of this research was to develop Kinnow Jelly on a commercial level and to study its physico-chemical and sensory attributes. Kinnow jelly was prepared by addition of 0.8% pectin, 0.3% citric acid in respect of total weight of kinnow extract. The samples of kinnow jelly has been evaluated for physico-chemical and sensory attributes on 9-point hedonic scale. The physicochemical parameters viz. pH, TSS, Acidity, Total Sugar, Protein, Vitamin C, Total Phenolic Content (TPC) and Antioxidant Activity for the sample were 3.65±0.03, 76.67±0.58, 0.45±0.03, 58.66±2.52, 0.76±0.05, 11.40±1.98, 17.67±1.39 and 49.17±4.02 respectively. Overall the prepared kinnow jelly was liked moderately by the semi trained panelists. So, being a good source of ascorbic acid, polyphenols and higher antioxidant activity it can be manufactured on commercial scale.

Keywords: Kinnow Jelly, Physico-Chemical, Antioxidant Activity, Sensory Attributes

PS5-16

Development of extraction and analytical method for determining folic acid and cyanocobalamin in fortified rice kernels by HPLC

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Fortified rice kernels (FRK) are extruded rice-shaped kernels manufactured by blending broken rice flour and vitamin-mineral premix. Folic acid and cyanocobalamin are water soluble vitamins recommended as fortificants along with ferric pyrophosphate in FRK to address the burden of anemia. There is a requirement for an easy and efficient standard protocol for analyzing these vitamins in FRK for quality control of the FRK manufacturing process. This study aims to develop a simple extraction and analytical protocol for folic acid and cyanocobalamin from the FRK matrix. Three different extraction solvents (NaOH: Acetonitrile, KOH: Acetonitrile, Phosphate buffer; with and without ascorbic acid) and three different extraction methods (vortex, ultrasonication probe & bath type) were studied for folic acid. Similarly, heating and US assisted extraction at different time-temperature (Heating water bath: 60 – 80oC for 15-35 mins) combinations were studied to extract cyanocobalamin. The extracts obtained were analyzed in HPLC equipped with a variable wavelength detector. The extraction of folic acid and cyanocobalamin was varied from 29 to 125% and 36 to 123%, respectively. US probe assisted extraction (5 min) in phosphate buffer (0.25M, pH 6.5) with ascorbic acid (as antioxidant) at room temperature gave the highest extraction percentage for folic acid. On the contrary, heating the sample at 70°C for 25 min in sodium acetate buffer gave the highest extraction percentage for cyanocobalamin. The methods suggested could be employed in the routine quality check during commercial manufacturing of FRK to ensure the success of the fortification process.

Keywords: Fortified rice kernels; Folic acid; Cyanocobalamin; Analytical method development; extraction; HPLC;

PS5-17

Effect of thermal treatment and addition of olive oil on the antioxidant properties of tamarillo puree

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The study intended to determine the effect of temperature (100-200ºC), time (2-6 min) and oil on the bioactive properties and colour parameters of tamarillo puree. The increase in heating temperature up to 175ºC and time increased the phenolic content, flavonoids content and antioxidant activity. However, carotenoids were found to increase from 0.65 to 1.06 (mg β carotene/ g) in puree with oil heated at 200ºC for 6 min. In puree with oil, the lightness (L*) and redness (a*) values of puree were found to be reduced, but yellowness (b*), hue angle and chroma improved with treatment temperature and time. Addition of oil exhibited positive influence on retaining the bioactive compounds in comparison to puree without oil which can be attributed to their enhanced extractability. Significant difference in the experimental results of phenolic, flavonoids, antioxidant activity, carotenoids and colour values were found in the sample prepared without oil and with oil. In conclusion, the desirable effect of heating temperature and time, and addition of virgin olive oil will be helpful in canning of oil enriched tamarillo puree.

Keywords: Tamarillo, thermal processing, phenolic, antioxidant activity, carotenoids content, colour characteristics.

Poster Session-6

Engineering aspects in food processing

PS6-1

Quality kinetics and storage stability of mango juice with ultrasound combined with ultraviolet treatment

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Mango juice is a perishable product, and heat processing might affect the quality of the product. The purpose of this study was to examine the kinetic model of microbiological disintegration (total plate count, yeast and mould count) and antioxidant qualities loss (total phenolic component, total flavonoid content) in mango juice that had been treated to Ultrasound combined with UV light (10 min, 600 W) during storage. Chemical and physical characteristics of mango juice treated with US-UV processing, as well as storage stability during cold storage at 4°C, were assessed in comparison to a pasteurized sample (85 °C 15 s). The first-order kinetic model best suited the kinetics of microbial degradation and antioxidant property loss, with coefficient of determination (R2) values ranging from 0.97 to 0.99. pH, Brix, % titratable acidity, total phenolic, and total flavonoid content all showed significant differences. Considering on microbiological shelf life, US-UV treatment might extend the shelf life of mango juice by around 7 days when stored at 4°C compared to the control sample. The results of this study suggest the use of US-UV treatment as a viable strategy for preserving mango juice quality, preventing microbiological deterioration, and extending shelf life during cold storage.

Keywords: Ultrasound, Ultraviolet, Mango juice, Storage stability, Quality kinetics.

PS6-2

Sustainability Approaches in Food Engineering and Technology

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The world population is expected to exceed 10 billion people by 2050 (United Nations, 2019). Agriculture is nearly fully utilized, the majority of arable land is already in use, and issues such as climate change and urban expansion pose significant challenges to the future of agriculture. Increasing the intensity of agriculture, farming, fishing, and fossil oil extraction alone will not suffice to meet future demand. The application of high-tech engineering and molecular genetics approaches, such as phenomics and genetic engineering, has significantly increased productivity, cost-effectiveness, and efficiency The challenge for the food processing industry's sustainability is to develop strategies that improve social, environmental, and economic sustainability while remaining within planetary boundaries, addressing the United Nations' sustainable development goals. The emphasis is increasingly on providing sustainable diets with low environmental impact and improving population well-being now and in the future. There is a need for the development of renewable and sustainable food sources. Meeting the growing global demand for proteins sustainably is a significant challenge. Traditional protein sources are plant-based (57%) or derived from meat (18%), dairy (10%), fish and shellfish (6%), and other animal products (9%). (29). Despite all, microalgae are a diverse group of unicellular photosynthetic organisms that are emerging as next-generation resources with the potential to meet urgent industrial and agricultural demands in agriculture. Microalgae in particular are among the world’s fastest-growing organisms, with some species capable of doubling in volume in just six hours and algae contain twice as much protein as meat does. It’s also packed with vitamins and minerals — including more beta carotene than carrots and more iron than spinach which means it has the potential to become the superfood of the future. The most commonly used macroalgae as food include the red algae Porphyra (nori, Kim, laver), Asparagopsis taxiformis (limu), Gracilaria, Chondrus crispus (Irish moss) and Palmaria palmata (dulse), the kelps Laminaria (kombu), Undaria (wakame) and Macrocystis, and the green algae Caulerpa racemosa, Codium, and Ulva. They are cultivated in shallow, marine environments where they are collected. Better yet, microalgae don’t take up a large amount of land and can grow in non-potable water and on non-arable soil. it can be grown quickly, almost anywhere, and in a way that reduces greenhouse gases, without putting pressure on the environment. Globally, there is growing interest in algae as a production organism. And algae contain lipids(oil), proteins, and carbohydrates (sugars), and especially marine algae have been used as food, feed & fertilizers for centuries. Commercial farming of macroalgae(seaweeds) has a long history, especially in Asia.

PS6-3

Microwave Technology based BRIX Meter for Sugar Industry

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In sugar plants, the quality of sugar greatly depends on the degree of super saturation of syrup when seeding is attempted. Seeding has to be carried out within a narrow band of syrup super saturation. Concentration of sucrose in sugar solution is expressed in ºBrix. If it is too low, the crystallization rate suffers and above the maximum limit, spontaneous nucleation takes place, both of which results in poor quality and low recovery of sugar from syrup. Hence it is most desirable to know the syrup concentration at all times during the sugar boiling process so that its super saturation may be held within certain limit. Several measuring techniques have been used in the past for judging the syrup oversaturation. One, still widely used, is the Electrical conductivity of boiling syrups and massecuites. This will give a rough estimation but not specific since conductivity is affected by crystal crop, soluble electrolyte content of the syrup etc. Another method which was greatly accepted was by using the Refractive index of boiling syrups. Though reliable results were obtained, it presents mechanical maintenance difficulties and is a slow measurement due to the time required to change the viscous syrup film adjacent to measuring prisms. Microwave based technology gives reliable results and can be deployed online in-situ condition. Microwaves are not affected by dust, vapour or colour and have proved overall to be the best option in terms of ease of use, reliability, accuracy and cost effectiveness. This paper discusses the design and development aspects of a compact and cost effective microwave based Brix meter for the sugar industry. In this method, microwaves between the transmitter and the receiver pass through the material being measured. During this process their propagation speed is slowed down (i.e., phase shift) and their intensity is damped (i.e., attenuation) depending on the dielectric constant and loss factor of the material under test. The sucrose concentration (Brix) in the sugar syrup can therefore be determined by measuring the phase shift and/or attenuation compared to that of a reference signal path.

Keywords: Sucrose, Crystallization, Brix, Microwave, Phase shift, Attenuation

PS6-4

Production of Fruit Juice Powder by Refractance Window Drying Method and Cosumer View on Packed View vs Fresh Juice: A Review

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Traditional drying methods adversely affect the sensory qualities like taste, colour, nutritional qualities and preservation of bioactive compounds due to high-temperature exposure of the product. The substitute for traditional drying processes is consequently necessary to impart superior quality and preserve greater nutritional value in processed fruit juice powder. Refractance window drying (RWD) is one such technique that gained a lot of attention in recent years, because of numerous benefits it claims. This technique involves drying fruit juices placed over a thin infrared transparent film that essentially forms a 'window' through which drying occur. Refractance Window drying system has high heat and a mass transfer rate that speeds up the rate of drying process and more nutrients are retained. Refractance window drying produce high quality fruit juice powder with low aroma and flavor loss. In this study, effect of RWD on fruit juice has been discussed and also consumer view is analyzed though Google form for their preference in packaged juice and fresh juice.

Keywords: Traditional drying, Refractance Window drying, Fruits juice powder, Consumer acceptance

PS6-5

A comparative study of preprocessing on microwave and freeze drying of mycelium

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Expanding populations and limited natural resources are leading to demands for alternative dietary proteins. The world food supply needs to be increased to feed the increasing population with the same limited resources. To overcome the hunger problem, alternative protein sources such as fungal "Mycelium" can be regarded as a novel, sustainable and safe dietary protein to support health with limited resources (water, land) having lower carbon footprint. Although, mycelium is rich in various minerals, vitamin D_2, fibers, essential amino acids along with protein, its storage life is relatively short due to its high moisture content (89 % w.b.). Thus, drying of mycelium would facilitate shelf life enhancement for further processing. Going along the way; pressing as a pre processing step was done to reduce the initial moisture of mycelium so as to reduce the drying time and cost by a significant level. Effect of pressing conditions (force and time) on mycelium has been tried from 3 to 5 N force for 30 s time provides optimum moisture. It is further dried through microwave drying at different power (300-500 W) and time (18-36 min) combinations. The water activity (0.217-0.587), protein (19.94-25.57 %), water solubility index (5.68-8.56 %), and browning index (19.55-27.82) have been evaluated. The optimized microwave dried sample was compared with freeze dried sample on WSI, WAI, protein, bulk density, browning index, and carr's index. Pressing at 5 N for 30 s reduced drying time by 50-55 % approximately. SEM analysis shows that FD sample contains porous fibrous structure whereas MD sample contains hard structure with no pores.

Keywords: Mycelium, Vitamin D_2, Pressing, Drying, SEM.

PS6-6

Atmospheric pressure non-thermal pin to plate plasma system for the microbial decontamination of Oat-milk

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Objective: To study the application of cold plasma treatment on microbial decontamination of oat milk and physicochemical properties of oat-milk.

Methodology: Extracted oat milk of solid content (13.65± 1.23 %) is treated in atmospheric pressure pin-to-plate plasma system at plasma input voltages of 170-230 V for the exposure time of 5-15 minutes. The total bacterial and yeast & mold enumeration are done to evaluate the microbial decontamination and the effect of cold plasma on physicochemical properties such as pH, titratable acidity (TTA), color, total soluble solids (TSS) was also studied.

Result and Discussion: The microbial reduction was increased with increase in voltage and exposure time of cold plasma in both total bacteria and yeast & mold. The maximum log reduction of 4.14 and 1.36 was obtained at 230 V and 15 min treatment for bacteria and yeast & mold respectively. The cold plasma treatment also affected the physicochemical properties of the oat-milk. The pH has no significant ($p<0.05$) change though there was a slight increase (6.39 – 6.59) observed in plasma treated oat-milk as compared to control (6.36 ± 0.034). TTA of oat-milk increased (0.114-0.162% lactic acid (l.a.) significantly ($p<0.05$) after plasma treatment from 0.054 % l.a. of untreated sample. Similarly, TSS also increased from 0.1° Brix to the maximum of 1.8° Brix after the plasma treatment and showed increasing trend along with the exposure time and voltage. There was no significant changes in colour (L, a*, b*) values are observed after plasma treatment. Thus, the cold plasma treatment can be a potential decontamination technique for plant based milk extracts.

Keywords: Oat-milk, Cold plasma, Microbial decontamination, Physico-chemical.

PS6-7

Intensification of vaporization by decompression to vacuum: A reconstitution and texturing method for defatted kernels

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Intensification of vaporization by decompression to vacuum (IVDV) is a novel method, carried out to reconstitute the distorted seeds after defatting to texturize the product while regaining its original shape and size and to enhance the textural, physiochemical and sensorial properties of the finished product. The IVDV concept is based on a thermo-mechanical treatment consisting of four main stages that are exemplified in plate. Initially, moistened and equilibrated kernels are placed in a processing chamber and are subject to a pressure drop from atmospheric to vacuum pressure. This vacuum setting aims to ease the steam diffusion and rapid heating of the product; in a second stage, a brisk increase in pressure (in less than a second) is stimulated by a rapid steam generation system. The product endures a treatment under high steam pressure "P" (up to 15×10^5 Pa) for a short time "t" lasting from 1 to 200 s. This treatment time is essential to let the product acquire the required rheological and thermal equilibrium to expand; the final stage corresponds to an abrupt pressure release towards a vacuum inducing a rapid cooling of the product, a porous structure and a significant expansion of the flattened peanuts primarily provoked by an auto-vaporization of the internal water content. Subsequently, in order to avoid thermal degradation, an additional rapid cooling occurs further to an atmospheric air injection under vacuum. Then, a final return to atmospheric pressure allows the recuperation of the expanded partially defatted product.

Keywords: Defatted peanuts, Steaming, Vacuum, Vaporization

PS6-8

Microwave freeze drying system for fruits & vegetables

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Microwave frequency spectrum in the frequency band of 300 MHz to 300 GHz has found vast agricultural applications. Microwave heating is one the unique technology used extensively in drying of crop and high value solids as it has number of advantages like shorter drying time and enhanced food qualities. Freeze drying of vegetables and fruits at very low temperature and extremely low pressure has several advantages but with very high capital requirements and operating cost. Efficient incorporation of microwave heating system along with freeze drying system can speed up the drying rate and increased vegetable and fruit quality.

Principle: In the frozen condition of temperature below -10 °C, power losses in the water content of fruits and vegetable is very less. Microwave energy at frozen level is mainly absorbed by the fruits and vegetable molecules results in direct apply of energy .Thus phenomena causes microwave freeze drying system for fruits and vegetables are more efficient and faster.

Heating pattern of conventional freeze drying is from surface to the core which causes loss of energy and time consuming in materials like vegetables and fruits. In Microwave assisted drying system, greatest advantages are due to the volumetric heating in the penetrated depth which drastically reduces the time required for the drying. When the water in the vegetables and fruits frozen temperature less than -5 °C, depth of penetration of Microwaves will increases enormously and they can penetrate deep in to the bulk of fruits or vegetables.

Keywords: Microwave heating, Agriculture, Microwave-assisted freeze drying

PS6-9

3D printing technology: a boon to the food industry

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Climate change is adversely affecting our global food system, to mitigate these impacts we need to adopt novel technologies to improve our food system and to reduce the food loss. 3D printing technology also known as additive manufacturing (AM) is one of the novel techniques which has the capacity to reduce wastes, can enhance sustainability, improve health and nutrition and alleviate the hunger. 3D printing technology is also a boon for consumers who avoid animal protein due to their religious, dietary and moral beliefs that can sustainably fabricate customizable products with complex shapes and textures. 3D printing technology work similarly as other printing technologies but the ink use here are liquid or mud like food that can be easily extruded through the nozzle. In 3D printing the prototype is first introduced into the computer aided design (CAD) software which is then converted into STL file by slicing software and after this layer by layer deposition is done to create complex 3D objects from inks. As it is still an emerging technique therefore, more research is still required in this field. The aim of the current paper is to study about 3D printing and how it benefits the food industry in various ways.

Keywords: 3D printing, novel, software, food industry, food products

PS6-10

Effect of extruder variables on bulk density and expansion ratio of horsegram extruded product

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Horsegram is an underutilized legume rich in protein, calcium and iron content. Several researchers have tried to increase the commercial utilization and application of horsegram. Horse having more of anti-nutritional factors leads to off flavor development and taste which leads to reduction in acceptability. Prior treatments like soaking and germination reduces the anti-nutritional factors upto the acceptable limit. Similar kind of pretreatments were given to horsegram before developing extruded product with the aim to make commercial product available to consumer having good amount of calcium, iron and protein content. Twin screw extruder was used for the development of horsegram based extruded product. Different process and extruder variables were conducted to see their effect on expansion ratio, bulk density of the product. A central composite rotatable design of Response surface methodology was used to develop prediction model. It was observed that process variables like moisture added, feed components and extruder variables like screw speed and temperature played important role on the dependent variables of the extruded product.

Keywords: Expansion ratio, Extrusion, Horsegram, Protein, Screw speed

PS6-11

Optimization of conventional and microwave assisted extraction of pectin from Assam lemon (*Citrus limon* Burm F.) peel

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The conventional extraction and microwave assisted extraction techniques were used to extract the pectin from Assam Lemon (*Citrus limon*Burm F.). Box-Behnken design was used to study the effect of microwave power, time and solid liquid ratio on the yield and degree of esterification of pectin under constant pH (1.5-2). The results depicted that the optimum conditions for maximum yield of pectin (41.95%) was obtained at extraction temperature 90℃, 1:30 (w/v) solid liquid ratio and extraction time of 22 min for conventional extraction. While for microwave extraction, the optimum conditions for maximum yield of pectin (20.5%) were obtained at microwave power 450 W, 1:30 (w/v) solid liquid ratio and extraction time of 4.9 min. Under optimal conditions, the degree of esterification of pectin was 39.5% and 48.8% for conventional extraction and microwave assisted extraction, respectively. The equivalent weight of pectin extracted from microwave assisted extraction (293.10 g) was significantly high compared to conventional extraction (145.21 g). In addition, pectin extracted under optimal conditions was having highly acceptable purity as the anhydrouronic acid content was more than 65%. The FTIR analysis of the extracted pectin confirmed the presence of functional groups in the fingerprint region used for identification of polysaccharide.

Keywords: Assam Lemon; Microwave assisted extraction; Pectin; Yield

PS6-12

Development of Starch Ionic Gel and its Effect on Phase Transition, Kinetics and Physicochemical Properties

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The effect of 1-butyl-3-methylimidazolium chloride (BMIMCl) on gels phase transition, rheological, and physical properties of high amylose rice starch was studied. The gels phase transition temperature and storage modulus of starch were varied significantly ($p \leq 0.05$) in the presence of BMIMCl. The gels phase transition temperature of native starch was varied between 53.99-39.7°C, whereas, for starch with ionic liquid varied between 49.50 to 40.6°C. The changes in storage modulus (G') during the gels phase transition were suitable with firstorder kinetics. The temperature dependent rheology of starch during the gels phase transition was efficiently ($0.93 \leq R2 \leq 0.98$) explained using the Arrhenius model. The thermal stability of the gel was improved in the presence of BMIMCl. The textural and electrical properties of the gel were significantly affected by the presence of BMIMCl. The inter-relationships between the parameters were developed and the initial temperature, resistance, and storage modulus showed a strong interrelation.

Keywords: High amylose starch; ionic liquid; gels; phase transition; temperature dependent rheology.

PS6-13

Optimization of development of high fibre fortified mushroom (*Volveriella sp.)* biscuit using Response Surface Methodology (RSM)

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Volveriella sp. Is also commonly known as Paddy straw mushroom. The present study focus on optimization for development of high fibre content biscuit from the paddy straw mushroom. The experiment was designed to optimize the wheat flour and mushroom powder concentration for the development of high fibre content biscuit by the application of central composite rotatable design (CCRD) of Response Surface Methodology (RSM). The levels of incorporation of wheat flour and mushroom powder were taken as variables whereas crude fibre, hardness and overall acceptability(OAA) were taken as responses. The optimized level of wheat flour and mushroom powder using numerical optimization was found to be 6.042% and 88% respectively.

Keywords: Mushroom biscuit, Response Surface Methodology(RSM), High fibre biscuit

PS6-14

Deep learning and Machine Vision intervention for combating Covid 19 challenges in Bakery sector

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Demand for quantity and quality has forced high volume artisan producers and larger plant bakers to upgrade equipment while driving up efficiency and cracking down on waste. Ensuring food quality and safety is a complex process, and all stages of food processing must be considered, from cultivating, harvesting and storage to preparation and consumption. However, these processes are often labour-intensive. Nowadays, the development of machine vision can greatly assist researchers and industries in improving the efficiency of food processing.

The impact of Covid 19 has forced bakers to refocus on optimizing processing and equipment to keep flexible efficient and cost effective practices in an unpredictable market while continuing to tackle wider healthy eating trends. Image processing can take advantage of machine learning and deep learning models to effectively identify the type and quality of food. Subsequently, follow-up design in the machine vision system can address tasks such as food grading, detecting locations of defective spots or foreign objects, and removing impurities. In this presentation we intend to provide an overview on current approaches, challenges, and the future trends of the traditional machine learning and deep learning methods, as well as the machine vision techniques that can be applied to the field of bakery food product processing.

Keywords: Bakery, Image processing, Deep learning, Optimisation

PS6-15

Impact of Solar Greenhouse Drying for Agricultural Produces

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Solar greenhouse drying is one of the most efficient and cost-effective, renewable, and sustainable technologies for food processing. the pre-eminent effects of their use on product quality, as well as their economic, environmental, and social impacts. The dryer consists of a parabolic roof structure covered with polycarbonate plates on a concrete floor. Greenhouse drying supported by thermal energy storage and solar air collector. It's very much popular in the Indian sub continents and Africa for the drying of agricultural produces. As per case study in India it is using on turmeric, ginger, chilli, banana, coconut, paddy, herbal crops, fruits, fish etc. In this drying system maximum temperature found 55-60^{0}C with best quality of products. In greenhouse dryer under forced convection mode is found to be best for high moisture content crops. Drying kinetics data fitted with the help of mathematical modelling.

Keywords: Solar Greenhouse Drying, Solar thermal energy, Kinetic, Modelling

PS6-16

Application of Transfer Learning in Sorting Assam Lemons Based On Their Weights

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We utilize the concept of transfer learning in sorting Assam Lemons (Citrus limon L. Burmf) based on their weights. The transfer learning concept applies the idea of reusing pre-trained Convolutional Neural Networks (CNNs) to learn new features. This technique eliminates the need of building and training very large-scale datasets. Eight pre-trained deep learning models namely ResNet50, VGG16, MobileNetV2, Xception, VGG19, NasNetMobile, DenseNet121 and EfficientNetB2 were fine-tuned to classify the lemons. The lemons were divided into three classes based on their weights, viz. 90g. To build the dataset, 200 lemons were procured and data in form of 800 RGB images were obtained in a standard environment and preprocessed using OpenCV library. The performance of the models was compared based on accuracy, precision, recall, and F1 score of individual classes. The final evaluation shows that the VGG16 model showed the best performance followed by the ResNet50 model. The results indicate that transfer learning can be implemented in the backend of a machine vision system to sort fruits and vegetables with greater reliability in the pack house industry.

Keywords: Transfer Learning, Convolutional Neural Networks, Assam Lemon, Image Classification

Poster Session-7: Food Packaging

PS7-1

Effects of an Edible Coating of Natural Deep Eutectic Solvents and old Storage on Shelf-life and Microbiological Quality of Strawberry

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Strawberry is a nutritious, but highly perishable fruit. Natural deep eutectic solvent – starch based edible coatings (lactic acid , glucose and high amylase rice starch) were applied to postharvest strawberry fruit during cold storage (4°C), and their effects on fruit quality and antioxidant enzyme system were investigated in the present study. The results showed that NADES –starch coatings showed a significant delay in fruit softening and rot and reduced changes in total soluble solid and there is not much significantly changes in the pH during 18 d storage. NADES-starch coatings also maintained higher ascorbic acid contents than control from day 2 and significantly inhibited fruit decay after 12 d storage. Additionally, Nades containing high percentage starch coating had the most positive effects on fruit quality amongst all Nades-starch based edible coatings and presented the highest relative activities of microbial safety and reduce membrane damage. These results indicated that NADES-based edible coatings were helpful in postharvest quality maintenance of strawberry fruit.Morever NADES-starch based coatings have microbial safe and prolonged the shelf life of strawberries.

Keywords: Natural deep eutectic solvent; dibble coatings; starch; strawberry

PS7-2

Development of Jujube puree-pectin based edible film

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Jujube fruit (*Ziziphusmauritiana*) also known as “Berr” has been a useful fruit in India from age old days.It has antioxidant, anti-inflammatory and antibacterial properties.They arerich incompounds like vitamin C, thiamine, riboflavin etc.The puree of jujube in combination with pectin and plasticiser can produce edible films that can be used for food preservation. Pectin is a primary component in plant cell that is composed of poly α 1, 4-galacturonic acids. Pectin added at concentrations of0 %, 1 %, 2 %, 3 %, 4 % and 5 % in jujube puree (100g) along withglycerol (10 ml) as a plasticizer todevelop thefilms and were analysed in terms of thickness, film color, moisture content, solubility, water vapor permeability, water activity, tensile properties and sensory analysis. It was found that, increasing concentrations of pectin in films formulation lead to significant increase ($p < 0.05$) in the solubility, thickness, water activity, water vapor permeability, tensile strength and percent elongation of the films. But the moisture content tends to decrease and with increase in the concentration of pectin in film forming solutions and the colour gets darker as l value decreases. The physiochemical and mechanical properties studied in the work showed a significant difference among tested samples. The work leads to successful development of jujube puree – pectin edible film that can create a positive influence on shelf-life stability and sensory acceptance of food matrix.

Keywords: Jujube fruit, edible film, pectin, tensile properties, water vapor permeability.

PS7-3

Determination of Shelf life of the Value added Rice-based-snacks of the Khasi tribe

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The aim of the study was to determine the shelf life of the value-added as well as the existing rice-based snacks (RBS) of the khasi tribe at Shillong, Meghalaya. The experiment was conducted on the four most commonly consumed RBS namely- *putharo, pumaloi, pukhlien*and*pusla*using Total plate count (TPC). The sample size totaled eight which included four value added and existing snacks respectively. The TPC was observed at zero, second and third day as the products were highly perishable. Three varied temperature viz., normal room temperature, lower and elevated temperature ware taken into consideration to study the shelf life. The snacks were usually packed in a leaf [*Pyrniumpubinerve* Bl. (Marantaceae)], in addition, another package trial was performed using a zip lock (polyethylene with 5 microns)for the study. It can be inferred that the keeping quality of the RBS are short live irrespective of the temperature or the type of packaging. For*putharo*it can be kept for two days, for*pumaloi* and *pukhlien* it is for three days while for*pusla,* it can be stored for more than three days except for the one stored at elevated temperature and packed in the zip lock cover. Future recommendation is to improve the shelf life of these snacks.

Keywords: Shelf life, Putharo, pumaloi, pukhlien,pusla, khasi, Shillong

PS7-4

Effect on quality parameters of *Khaja* during storage

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Khaja is a popular traditional sweet of India which is prepared by frying of layered dough and dipped in sugar syrup. In this study the shelf life of *Khaja* was investigated by checking quality parameters in terms of change in color, moisture content, fat oxidation and sensory score after 15 days interval. The change in color was not significant however, a slight increase in moisture and fat oxidation was obtained in LDPE packaged *Khaja*. The study revealed that the fat oxidation during shelf life of 90 days was very low with peroxide value of 3.96 Meq O_2/Kg, and the free fatty acid (FFA) of 0.79%. The sensory analysis showed good acceptability of packaged *Khaja* even after 90 days. Increasing demand for traditional sweet and tough protocols of preparation are the major factors for undertaking this work. This study will help in maintaining good quality and safe storage of *Khaja* for domestic and export market.

Keywords: Storage, Color, Moisture, Peroxide value, Free fatty acids, Sensory

PS7-5

Evolution of Anti-microbial Agents in Food Packaging Systems

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Food contaminations caused by pathogenic microorganisms remain an overwhelming challenge for the food industry whichfaces significant hurdles in developing packaging solutions that retain the safety and quality of packaged products. The ever growing consumer demand for natural and safe food items devoid of any infectious elements has further prompted a vigorous research in the packaging sector. To combat such grievances, antimicrobial agents have been used extensively as direct food additives.The primary objective of antimicrobial food packaging is to reduce surface contamination in processed and prepared foods. These agents can be used to manage the microbial population and target specific bacteria, resulting in enhanced quality controlof the final product.The use of such packaging materials is not intended to replace basic sanitation methods but to enhance food safety by imparting an additionalscreen to the proliferation of harmful and toxic microorganisms. The application of natural antimicrobials in food packaging systems has been the subject of recent research projects. Antimicrobial food packaging can include naturally occurring phenomena such as bacteriocins, phytochemicals and enzymes. Organic acids and their salts including other antimicrobial agents such as triclosan, silver zeolites, and fungicides have all been studied in polymeric as well as edible film structures. With the advent of novel polymeric material and antimicrobials, research and technology of antimicrobial materials for food applications such as packaging and other food contact surfaces is likely to increase over the next many years.

Keywords: Anti-microbial agents, edible films, food packaging, polymer, quality control

PS7-6

Recent advancements in smart packaging using natural indicators: A review

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Smart packaging is an advanced packaging innovation that combines the concept of both active and intelligent packaging. The developments in smart packaging help to maintain the overall quality and safety of food. Many researchers across the world are contributing to making this technique more efficient and feasible for commercial application. Smart packaging can reduce the amount of food wasted in the supply chain. The conventionally practised “use before” and “best before” terms are just recommendations without detailing the true status of food. This can be an ethical controversy in a world where millions of people are starving to death. So developments in smart packaging could address the complex sides of food safety. Smart packaging can also aid in increasing shelf-life by using its active packaging functions. The use of bio-based materials for smart packaging can make this technique more sustainable and eco-friendly. This paper presentation will be focusing on the recent studies done in smart packaging using natural indicators for food application. It will also include the advantages and limitations of these bio-based smart packaging in a commercial application for up-scaling of this technique. The term indicator is sometimes replaced with biosensors in packaging studies because of its ability to sense a change or alteration in the quality parameters of the material it contains.

Keywords: Smart packaging, natural indicators, biosensors, sustainability, active and intelligent packaging

PS7-7

Biodegradable active antioxidant packaging material containing pineapple peel extract: A waste to wealth approach

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This research study explores the fabrication of polyvinyl alcohol (PVOH) and corn starch (ST) with pineapple peel extract (PPE) as a natural antioxidant agent, which is an abundant by-product from the food processing industry via casting method. The effects of PPEs concentration (5%, 10%, 15%, and 20%) on the antioxidant capacity, optical, thermal, mechanical, barrier properties, and changes in PVOH-starch molecular structure of PVOH/ST films were investigated. The results revealed that with the increasing concertation of PPEs, prepared films' thickness and water vapor permeability slightly increased. Elongation at break of PVOH/ST films enhanced with PPEs concentration. All PPEs incorporated films exhibited enhanced thermal stability as the degradation occurred above 300 °C. The addition of PPE to PVOH/ST films remarkably increased the antioxidant properties. Finally, prepared PVOH/ST/PPE films demonstrated to be a capable material for developing active biodegradable packaging material due to its proven antioxidant activity and mechanical property, which can be helpful in the packaging of food products that get spoiled due to oxidation reactions.

Keywords: Pineapple peel extract; Food; Active packaging; Characterization; Antioxidant activity; DPPH

PS7-8

Effect of IR heating on physical and mechanical strength of potato starch film

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Potato starch powder was infrared (IR) heated at 250W for 45min, 65min and 85min. The maximum temperature obtained at 85min of IR heating is recorded as 92.5^{o}C and the final moisture content of the potato starch powder was measured as 4.34%. The biopolymer film was prepared from the native potato starch and modified potato starch after infrared heat treatment along with the addition of glycerol as a plasticizing agent.The physico-mechanical properties of developed films were characterized by thickness, solubility, tensile strength, tearing and bursting strength. The thickness of the developed film is varied from 0.104 to 0.142mm. The results showed that the modified starch had significant effects on the and physical and mechanical properties. The tensile strength showed increased value from 2.47 MPa to 3.99 MPa, solubility of modified starch film decreased as compared to native starch, and bursting strength (3.33kg/cm^2) were increased and there was no change in the colour L, a and b (82.04, 4.59 and -13.04) and transparency of the films.

Keywords: Potato starch film, Physical properties,Infrared heating, Tensile strength

PS7-9

Sustainable Packaging in foods

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Packaging has a lot of impacts on the environment. Some materials like plastic are dumped almost everywhere causing an adverse effect to the ecosystem. Food packaging materials aren't only harmful to the environment but also to other animals. The weight of packaging materials on the overall environmental impact of food is variable, ranging from very low to very high, and this variability determines different appropriate measures to improve sustainability. There must be some strategies to minimize the harmful impact of packaging materials on the environment. Waste management is one approach that guards human health and also saves the environment and natural resources. Other practices that can be performed such as using less packaging, designing products that last longer further as reusing products and materials or using such materials that do not degrade the environment. Some other strategies include the use of bio plastic packaging materials, recyclable materials, plant-based packaging, edible packaging, plantable packaging, compostable and biodegradable plastic alternatives. Some of the packaging materials having minimum impact on the environment include Glass (reusable, recyclable, and durable), stainless steel (durable, rust-free, heat resistant, reusable and recyclable, rice husk (low cost, renewable, and biodegradable), Bamboo (biodegradable, durable and heat resistant). Edible food packaging materials are also used these days as they are environmental friendly and can be used for packaging of fruits, vegetables and dairy products.

Keywords: bioplastic, biodegradable, recyclable, edible, durable, rice husk

PS7-10

High barrier k- carrageenan based bio-nanocomposite films reinforced with cellulose nanocrystals derived from Indian gooseberry

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The current study aimed at the development and characterization of a novel bio-nanocomposite film based upon κ-carrageenan (KCGN) reinforced with cellulose nanocrystals (CNC). CNCs were extracted from gooseberry pomace via acid hydrolysis method. The films were prepared using solution casting technique. The film forming solution containing the mixture of κ-carrageenan, glycerol and CNCs in varying proportions (1%, 3%, 5% and 7%) was casted. The films were evaluated for their morphological, structural, mechanical and barrier properties. In comparison to the neat films, it was found that incorporation of CNCs into the films resulted in enhancement of mechanical and barrier properties. As the CNC loading was increased from 1% to 5%, tensile strength and elongation at break of the films increased from 23.40 MPa to 38.93 MPa and 6.3% to 10.42%, respectively. The water vapor permeability decreased from 3.19 g mm/m^2 day kPa for neat film to 2.23 g mm/m^2 day kPa for the film with 7% CNC. The FTIR results indicated that addition of CNC induced no structural changes. XRD results depicted that the crystallinity of the films increased with the increase in the CNC. This biodegradable nanocomposite film can be utilized for several potential applications in food packaging sector and open new opportunities in barrier packaging films.

Keywords: Bio-nanocomposites; Cellulose nanocrystals; κ-carrageenan; Indian gooseberry; Barrier packaging.

PS7-11

A detail study on development and market survey of edible film using potato peel

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Potato peel is considered as a wastage derived from potato processing industries, which has very little value. It is produced in high amount by various food processing industrieswhich is 15- 40% of the initial product mass. Usage of potato peel can be a very positive approach towards conversion of low valuable product to highly valuable product at low cost as well as is a major concern that can be dealt with new rising technologies.Potato peel is rich in the bioactive compounds thus, making the value-added goods. The valorisation makes it useful as an adsorbent, bio-composites and packaging materials. In this study valorisation of potato peel has been discussed. Most useful utilization of potato peel can be the development of edible films. High-pressure, gamma-ray, and ultrasound techniques can be used for development of edible films based on potato peel. A market survey was also conducted to investigate the view of consumers about the composition and usage of potato peel as a value-added product. Whole responses were analyzed and represented in bar chart and found that major consumers between age group of 20 to 40 years think that usage of potato peel in development of edible film will be a low-cost alternative along with being a nutritious option in the market.More than 50% consumers are ready to buy ultrasonicated food item coated with edible starch film if available inmarket.Development of edible starch-based films will be a great response in the market as the new consumers are well aware about the nutritional benefits of these edible film packaged food items.

Keywords: Potato peel, value added goods, bioactive compounds, edible films, market survey.

PS7-12

Edible gum coating to increase the shelf life of some tropical fruits and vegetables: A review

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Edible coating on raw food product increases its shelf-life; hence this method has seen a remarkable increase owing to the advances in material science and processing technology. Coatings are desired to be composed of cross linking agents, emulsifiers, reinforced with bio active compounds like antimicrobials and neutraceuticals which improve its functionality and structural ability. Researchers have carried out experiments to formulate coatings with edible gums. Gums are polysaccharides which can be used as emulsifier, stabilizer and thickener to inhibit the formation of ice-crystals due to their hydrocolloid properties. Natural gums have shown potent results in formulating edible coatings and improving the properties of the food products. The treatment of fruits or vegetables with gum helps to form a semi permeable barrier that blocks the stem-end scars preventing post harvest decay. This review summarized the characterization of new biodegradable edible coatings based on natural gums on quality and shelf-life of some tropical fruits and vegetables. The edible coatings fabricated from natural gums could provide some benefits such as extended shelf life, delaying ripening, decrease the rate of respiration, good mass transfer barrier characteristics and economically affordable. Gum coatings are excellent alternative method for preservation, providing characteristic antioxidant and antimicrobial properties which prevent oxidative and microbial spoilage on the food. Moreover minimal processing is required to coat any food stuff with edible gum.

Keywords: Cross-linking agents, antimicrobials, neutraceuticals, polysaccharide, hydrocolloid, post-harvest decay, antioxidant

PS7-13

Effect of pulping conditions and surface coatings on properties of banana fibre based dense paper

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Fibres extracted from banana pseudostem were cut into pieces of 4-5 cm and kiered using rotary digester at different combination of temperature (120, 140, 160, 180°C) and time (90, 120 min). Active alkali concentration, sulfidity and mass to liquor ratio-MLR were kept constant at 8.58%, 9.71% and 1:10 respectively. Digested pulp was thoroughly washed followed by refining to 60°SRpulp freeness and handsheets were formed using the refined pulp (40±3gsm). Evaluation ofmechanical and barrier properties showed that handsheetsmade from pulp kiered at 160°C for 120 min had maximum tensile index 66.82Nm/g, breaking length 6815 m, burst index4.96, tear index15.9, opacity 88.54 %, air resistance 13.82 s/100ml and minimum COBB value of 155. The pulp handsheetsmade at optimum conditions were coated with natural biopolymers: sodium alginate and carboxymethyl cellulose at two levels (3% and 5% w/v) and evaluated for different mechanical andbarrier properties. Maximum tensile index, bursting index and air resistance was observed for sheets coated with 5% carboxymethyl cellulose. Contact angle measurement (46.25º) showed moderately hydrophobic nature of dense paper. Turpentine oil test for grease resistance (1800+) suggested possible use of coated dense paper for packaging of fatty foods like butter.

PS7-14

Preparation of Lemon Flavoured Paneer Whey Drink and Its Shelf Life Study.

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Ready-to-drink beverages offer the advantages of convenience and portability to today's busy consumers. Whey proteins are often the preferred source for ready-to-drink protein beverages because of their excellent nutritional qualities, bland flavor, ease of digestibility, and unique functionality in beverage systems. Whey beverages are generally classified into four basic types: mixtures of whey (processed or unprocessed, including UF permeates) with fruit or (rarely) vegetable juices; dairy-type, 'thick' beverages (fermented or unfermented); thirst-quenching carbonated beverages and alcoholic beverages (beer, wine or liqueurs).Whey is highly contaminated, with a high organic load around 100,000 mg O_2/L COD (chemical oxygen demand), and is not used for further processing. The sustainable use of whey for production and conversion in different types of products can uplift the bio-based economy of industries and thereof national/international economy. Acid whey has high mineral content which is higher than that of cheese whey and this highly nutritious whey can be used to produce fruit flavored beverages thus making it an affordable drink and also adding commercial value to the whey. Due to the acidic taste of the whey it goes well with citric fruits. Hence this lemon flavored whey drink will be a flavor filled, hydrating and electrolyte rich drink for people of all age. The lemon flavored whey protein drink was prepared with varying concentration of sugar such as 8.5%,9% and 9.5% and then the shelf life study and proximate analysis was carried out for a time period of 30 days for the prepared drink to determine the stability and the acceptance of the prepared drink.The sensory evaluation was carried out and the drink with 9.5% of sugar was found to be the most preferred.The autoclaved drink had a stable shelf life over the period of 30 days and had no growth of E.coli and spores.There was slight increase in acidity and drop in the pH level by 0.1 through every single week and all the other parameters remained constant.The prepared drink was overall a successful one and was proved safe to be consumed from the shelf life study results.

Keywords: paneer whey, lemon flavored whey drink, ready to drink beverage.

PS7-15

Degradation kinetics of encapsulated product from dragon fruit (*Hylocereus undatus*) peel during storage

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The stability of encapsulated betacyanin was investigated in this study at three different storage temperatures. The peels of dragon fruit can be utilized in the production of pectin, extraction of phenolic compounds and pigment (betacyanin). The betacyanin was extracted from dragon fruit peel by using ultrasound assisted extraction method at ultrasonic temperature of 60 °C, solvent to solid ratio 25:1 mL/g, ethanol concentration 60%, and ultrasonic treatment time of 20 min. The extract was then encapsulated in an encapsulator using calcium chloride (0.5M) and sodium alginate (0.5%) as wall materials. The betacyanin retention of the encapsulated betacyanin extracts was observed during 60 days of storage. For encapsulated products, the betacyanin retention study was carried out under three different temperatures 4°C, 25°C, and 37°C. The betacyanin degradation during storage followed first-order kinetics with higher coefficient of regression (R^2) greater than 0.987, lower chi-square (χ^2) and root mean square error (RMSE) lesser than 0.003 and 0.048 respectively. The first order rate constant for the encapsulated product stored at a storage temperature of 4, 25, and 37°C was varied 0.189 h^{-1}, 0.267 $h^{-1,}$ and 0.328 h^{-1} respectively. The half-life time (t½) of the betacyanin at 4, 25, and 37°C was found to be 88.17, 62.21 and 50.66 days, respectively. The sample stored at 4°C showed a half-life of approximately 1.74 times higher than the sample stored at 37°C. The results indicated that storage temperature had a significant effect on the degradation of encapsulated betacyanin pigment. Overall, the obtained results showed that encapsulated dragon fruit peel extract was efficient for development of value-added foods such as jams, jellies, juices, pasta

Keywords: dragon fruit peel, betacyanin, encapsulation, storage study.

PS7-16

Pine needles lignocellulosic ethylene scavenging paper incorporated with nanozeolite for active packaging applications

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The pines needle falls approximately 2–3 ha−1 year−1 on the forest floors resulting in a considerable amount of lignocellulosic biowaste. The present study was aimed to the development of pine needles based lignocellulosic active paper and the investigate the effect of 5, 20, and 30% (v/w) nano zeolite addition on the physical, mechanical, and microstructural property of the papers. The developed papers were characterized by scanning electron microscope, transmission electron microscope, Fourier transform infrared spectrometer and Xray diffraction. As the zeolite concentration was increased from 5% to 30% in paper, enhanced water permeability was seen from 5.18 ± 0.34 to 3.88 ± 0.33 g/cm2 /day (PN/ZL 30% paper). The addition of 5% zeolite increased the tensile and burst strength from 19.53 ± 3.53 Nm/g and 3.63 ± 0.23 kg/cm2 , respectively. The porosity was increased from 340 ±20 to 1170 ± 60, and Cobb value increased from 338.3 ± 1.5- 406.7 ± 1.5 g/m2 . The alterations in terms of surface microstructure in the paper with 20, 30% zeolite were noticed whereas XRD illustrated the high compatibility among the cellulose network of pines and zeolite. The pine needle paper with 30% zeolite possessed remarkable ethylene scavenging properties (62%), opening a way to valorize pine needle waste into a value added products and utilize them for food packaging application efficiently.

Keywords: pine needle; paper, active packaging; biomass; ethylene scavenger; zeolite

Poster Session-8: Waste utilization and management in food processing

PS8-1

A comparative study of extraction and modification of insoluble dietary fibre from pea peel using different techniques

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A comparative evaluationof pea peel insoluble dietary fibre (IDF) was investigated using various extraction methods viz., alkaline extraction (ADF), ultrasound assisted extraction (UDF)and ultrasound assisted alkaline extraction method (ODF) and examined its effect on yield, thermal stability and morphological properties. The ultrasound-assisted alkali extraction (ODF) was standardized using rotatable central composite design and the optimized conditions were 30 min, 30%, 1:20 and 1.2 mol/L for time, amplitude, solid to liquidratio,and NaOH concentration, respectively.The ultrasound-assisted alkali extraction method for IDFevinced to be the best extraction method with higher water and oil holding capacity. Pea peel IDF was further modified to enhance its functionality and improved the physicochemical properties when complex enzymes viz., cellulose and xylanaseand extrusion methods were used. Scanning electron microscopy revealed thatafter modification of IDF, it revealed rough and loose structure. Complex enzymatic modification resulted in higher water holding capacity, oil holding capacity, water swelling capacity and glucose adsorption capacity, thus having better properties than extrusion modification. In overall acceptability, both the modifications effectively improved the functionality of IDF and have potential for applications in foods.

Keywords: Pea peel, insoluble dietary fibre, extraction method, modification

PS8-2

Green Approaches for Extraction of Bioactive compounds from Citrus By-products

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Modernization has changed the lifestyle of people with respect of time, convenience, health and diet management, due to which, demand of nutrition-rich foods is rising. To meet these demands, researchers are looking for inexpensive and natural sources of nutrition. Citrus processing industry has been discarding tons of waste; thus, a lot of nutraceutical potential goes in vain. Citrus by-products are rich in various bioactive compounds such as pectin, polyphenols and flavonoids, water soluble and insoluble antioxidants, and essential oils.Traditionally, citrus by-products have been used for biogas production and cattle feed. Some conventional extraction techniques have also been utilized for extraction of bioactive compounds from these by-products. The conventional extractions are carried out using toxic solvents, at higher extraction temperatures and require longer times. These drawbacks can be overcome by novelextractions such as. ultrasound, microwave and supercritical. Ultrasound is effective and inexpensive technique which uses less solvent and lower extraction times, whereas solvent-free microwave extraction and supercritical fluid extraction hold the potential to solve the problem of a toxic solvent. Apart from this, in comparison to conventional techniques, lower energy consumption and reduced degradation of the extracted compounds has been observed in green extractions.The green extraction techniques could additionally promote the valorization of citrus by-products, provide high quality bioactives,and profits to the manufacturers.

*Keywords:*citrus by-products, functional foods, green techniques, extraction, bioactive compounds

PS8-3

Production of Biofuel from Hotel Food Waste

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Waste management is an important concern prevailing in the countries. Managing waste is essential to keep the environment clean and healthy. By proper utilisation of waste an eco-friendly environment can be achieved. Waste can be segregated and energy can be obtained from it. The food waste can be converted in biofuel which is a very effective way.Pyrolysisof food waste was obtained by the thermal decompositions by thermogravimetric analysisSo the aim of the research is to collect the food waste from the hotels and then convert the waste to biofuel. Food waste samples are collected from different fast food restaurant and hotels of Guwahati city. The research is aimed to convert the food waste to useful biofuel and study its characteristics.

Keywords: Waste, waste management, biofuel, food waste

PS8-4

Utilization of Waste and By-Products in Food Processing Industries: A Review

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The food sector generates a considerable amount of trash or by products each year from a number of sources all around the world. With the aids of science and creativity could be generating by products and boost their profits from food waste. The efficient use of by products has a direct impact on the country's economy and pollution level. By-products from the food sector are high in proteins, minerals, fatty acids, fiber, and bioactive substances. Food waste or by-products are beneficial for the human health. One of the most important aspects of the food industry is waste control. People are becoming more aware about their diet and good health. The effective use of food industry by-products can help to lower negative costs, minimize pollution, and demonstrate food industry sustainability, all of which have a direct impact on the country's economy. Consumers feel that the foods they eat have a direct impact on their health, whether positive or negative. Foods are now used not only to fulfill our appetite, but also of offer important nutrients for people, with these nutrients providing health benefits. Food sector is helping to create a zero waste society and country.

Keywords: Waste, Food, Consumer, Pollution, Economy.

PS8-5

Waste Valorization of Pinecones Through Extraction of Microfibrillated Cellulose and it's Characterization

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The main aim of the current study is to extract microfibrillated cellulose (MFC) from a novel and unexploited waste material, Pinecones. The collected pine cones were grounded and subjected to bleaching and alkali treatments to extract the microfibrillated cellulose, which was then characterized by different techniques to study their structural properties. The chemical analysis revealed that pine cones consist of around 37% cellulose, making them a potential candidate for the isolation of microfibrillated cellulose. FTIR results confirmed the removal of amorphous constituents like lignin and hemicellulose. X-ray diffraction results demonstrated a significant increase in the crystallinity index of MFC (39.59%) compared to raw fibers (18.89%). The pine cone microfibrillated cellulose was determined to have a diameter of about 14.30 µm, which was much smaller than that of raw fibers, as shown by the FESEM images. This study will help to provide a holistic approach to address critical challenges in waste management through the sustainable valorization of pine cones waste and promote the concept of the circular economy.

Keywords:microfibrillated cellulose; pine cones; lignocellulosic material; waste valorization

PS8-6

Waste utilization of fruit and oilseed industry for the development of plant based meat analogue

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World is heading towards vegan diet which is an emerging trend. As plant based diet is unable to suffice the amino acid profile, protein malnutrition is a common problem all over the world and also in India. Therefore creating a sustainable plant based meat analogue with Iron fortification by utilizing the waste from soy bean and jackfruit industry leads to a complete essential amino acid profile which can be comparable with a balanced diet design. The major source of protein is being isolated from the waste of soy bean oil industry. Iso-electric precipitation was done to have more purified quality of protein. It is then combined with jackfruit by-product along with other ingredients such as water, starch, vegetable oil and flax seed(a major source of Iron); this concoction is then undergone extrusion.In sensory properties, meat analogue with 50% jackfruit by-product,10%vital wheat gluten and 16% soy protein hydrolysate was most preferred in terms of texture, aroma, taste, hardness, gumminess and overall acceptability. It may be concluded that utilizing Green Technology, meat analogue with better protein bioavailability and digestibility can be developed. Whilst mimicking the texture, colour and amino acid profile of animal protein, it can be a palatable yet healthy alternative without compromising flavor, protein, starch and other micro nutrient intake.

Keywords: Food-industry-waste utilization, Meat analogue, Jackfruit by-products, Oilseed byproducts, soya protein hydrolysate.

PS8-7

Development of fibre enriched black rice (Oryza sativa) cookies using "kew" variety pineapple (Ananas comosus) waste

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The present study aimed at the utilization of dietary fibre (DF) extracted from pineapple peel as functional ingredient for development of black rice cookie. The DF from pineapple peel was extracted using alkaline extraction (AEDF) and combined alkaline-ultrasound extraction (AUEDF) process, and the composition, structural, thermal and functional properties of the extracted DFs were compared. Through response surface methodology, the extraction parameters of AUEDF were optimized to maximize yield. Under optimal conditions, the maximum yield of AUEDF was 62.24 % with total DF (93.57 g/100 g) which was higher than AEDF. Higher crystallinity (48.30%) and greater thermal stability was confirmed in AUEDF, as compared to AEDF. Moreover, AUEDF exhibited better water-holding and oil-holding capacities than AEDF. Improved textural property with acceptable sensory attributes was observed in cookie fortified with 6 % of AUEDF and 30 % of black rice powder in flour mixed. The addition of AUEDF and black rice powder to the flour mix enhanced the DF of the cookie when compared to the cookie developed just with wheat flour (control). Moreover, flour mixed with AUEDF and black rice powder confirmed higher water-holding and oil-holding capacity than wheat flour. Addition of black rice flour indicated decreased in lightness and showed presence of monomeric anthocyanin in the cookie.

Keywords: Pineapple peel, ultrasound extraction, dietary fibre, black rice, cookie.

PS8-8

Waste Utilization and Management in Food Processing

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Food processing wastes are those end products of various food processing industries that have not been recycled or used for other purposes. There are two types of food wastes, solid and liquid. Solid food wastes include shells and residues, and liquid food wastes, include waste water and sludge. Food processing waste has significant potential to pollute land, air, and water because of its high Chemical Oxygen Demand (COD) and sheer volume. These wastes pose severe problems related to disposal and pollution, because *they are highly complex.*

Waste utilization is both a necessity and a challenge. Food Wastage not only leads to negative environmental impact but also causes economic loss. According to an FAO report, approximately one-third of all food produced for human consumption is lost or wasted. The economic costs of this food wastage are substantial and amount to about $1 trillion each year. Given the current global financial crisis, rising food prices and international food shortages, the management of large amounts of different degradable materials poses a social and ethical challenge. If only one-fourth of the food lost or wasted globally was consumed it would be sufficient to feed 12 per cent of the world's current population. Therefore, this paper is an attempt to focus on the factors contributing to food waste, effective cost-benefit food waste utilization, and management methods; its implications on the environment, challenges, and treatment in food processing industries.

Keywords: Food Waste, Utilization, Management, Implications, Challenges, Treatment.

PS8-9

Ultrasonication extraction as an effective green technique for the recovery of phenolic compounds from mango seed kernel

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The large amount of waste generated by mango processing industries raises serious environmental issues and brings economic losses. Mango seed kernel, a major by-product obtained after mango processing can be valorized as a potential source of phenolic compounds. The extraction of phenolic compounds using conventional techniques require high temperature, longer time and large consumption of solvent. These drawbacks can be successfully overcome by using green techniques. In view of this, present study was carried out to find the effect of extraction parameters on the recovery of phenolic compounds from mango seed kernel using ultrasonication method. The highest phenolic content was obtained with 1:40 solid to liquid ratio, 50% ultrasonic amplitude after 10 min treatment time. The results indicated that mango seed kernel is a potential source of phenolic compounds with high antioxidant activity. Therefore, it holds great significance inapplications of food system and development of functional foods.

Keywords: Mango seed kernel, ultrasonication, total phenolic content, valorization

PS8-10

Utilization of Fruits and Vegetables waste as a dietary supplement in baking of Cake

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One of the most essential components of diet is dietary fibres. It has numerous medical advantages like it diminishes the odds of cardiovascular infections, diabetes, and gastrointestinal problems. According to Indian council of medical research (ICMR), it is suggested that a grown- up should burn-through 40gm of dietary filaments each day to make his/her eating regimen complete. Dietary fibers like cellulose are added in many bakery products to attain its fluffiness and maintain the daily intake. As there are no health benefits from commercial cellulose as it is not absorbed by our body so it can be substituted with different substance which will boost the nutritional value and at the same time give the fluffiness to the cake. Fruits and Vegetable peels, core, rice straw etc. contain many dietary fibres but these are often discarded and its value is not utilised. This in term go about as an ecological issue. So, to conquer both the circumstance banana strips, potato strips, orange waste, carrot pomace, and green peas strip is utilized instead of cellulose in the preparing of the cake. Here a comparative study is being carried out to find out which composition is best for commercial uses. The product containing 1.5% banana peels is viewed as steadier and can be commercialized.

Keywords: Dietary fibers; fruits and vegetables waste, Banana peels; cellulose; cake

PS8-11

Development of protein-fibre enriched pasta using soyflour and extracted dietary fibre from pineapple pomace (Ananas comosus)

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The production of quality functional extruded product from non-conventional raw materials exhibits a challenge. Extracted dietary fibre (DF) of pineapple pomace using alkaline extraction (alkaline extracted DF, AEDF) and ultrasound-assisted extraction in combination with alkaline extraction (ultrasound-assisted extracted DF, UAE DF) was used as a functional ingredient. Difference in composition, structural, thermal and functional properties of the extracted DFs were studied. Through response surface methodology, extraction parameter of UAE was optimized for maximizing the yield. Under optimal conditions, maximum yield of UAE DF obtained was 69.0264% with total DF (87.27g/100g) which was higher than AEDF. Higher crystallinity (51.21%) and greater thermal stability was observed in UAE DF than AEDF. Moreover, better water-holding capacity and oil-holding capacity was observed in UAE DF than AE DF. A partial substitution (8g/100 g) of durum wheat semolina with 5g soyflour and 3g of UAE DF showed the best textural property and sensorial attributes while increasing the level of protein and dietary fibre of pasta. The reduction of pasta elasticity shows the disruptive behaviour of fibre on the proteinstarch binding during the formation of the pasta matrix.

Keywords: Pineapple pomace, dietary fibre extraction, dietary fibre

PS8-12

Energy Conservation in Malting Industry – A Sustainable approach

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The Indian Brewing Industry has witnessed a renaissance in the past 10 years and various marketing researchers and All India Brewing Association announced that the craft beer forecast is to grow by 108% in terms of volume. The key ingredient in the brewing is malt which is produced by oldest biotechnological method of malting from Barley. With all the food and beverage and other energy intensive industries are reducing their energy and carbon emissions, the malting industry will need to improve its energy efficiency. Till date it is indicated 15% of the cost of a tonne of malt is contributed by the energy utilized during its processing. Although the goal of reducing emissions seems highly ambitious as kilning is a major part of malting, the malting process provides numerous innovative options to achieve this goal and to remain sustainable. Malting process consists of three main steps: steeping, germination and kilning. Electricity usage is spread over all process steps whereas gas and coal usage are pretty much restricted to kilning. Kilning is the heavy user of heat and electricity, making it the main target point to reduce the carbon footprint. This article summarizes all the innovative approaches and products malting industry has to offer to produce sustainable malts.

Keywords: Malting, Kilning, Sustainability, Carbon emissions, Energy

PS8-13

Utilization of Agro Waste for Biopolymer Film Development

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Agriculture based industries generate a tremendous amount of agro-waste such as fruit and vegetable peels, seeds, pomace, husks, other by-products which remain underutilized and are generally disposed off as waste. Biomass by-products are a significant source of natural biopolymers like polysaccharides, proteins, lipids. Development of biodegradable polymers from agro-food waste is a great area of interest. The extensive use of synthetic plastics such as polyesters, Polyvinyl chloride (PVC), polyethylene terephthalate (PET), polystyrene (PS), polypropylene (PP) have caused an increase in environmental concern all over the world. Most of this plastic waste ends up in landfills which leads to environmental pollution and have adverse effect on various life forms on earth. Recently, biopolymers have found applications in food, pharmaceutical and textile industry. A good alternative to conventional plastic is the development of biodegradable polymer by utilizing agriculture and food by-products as an eco-friendly and cheap raw material resource. This paper reviews the concept and production of sustainable packaging material from renewable resource which will not only minimize the food waste but also contribute to plastic waste management. It summarizes the development of biopolymer film using Mosambi peel as a substrate along with sago, glycerol and gum arabic to obtain a low-cost and biodegradable food packaging material.

Keywords: Agro waste, Polymers, Biodegradable film, Mosambi peel.

PS8-14

Utilization of Agricultural Waste to Produce Biodegradable Eating Plates

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The uncontrolled development and usage of plastic has created a drastic impact on our earth. Plastics are synthetic organic polymer with a backbone of CeC bonds, the raw materials are mainly from fossil fuel, coal and natural gas. Plastic can't be decomposed naturally and they accumulated in land, ocean, and fresh water bodies. It has become an important crisis in the present generation and the usage of plastic can be reduced up to a small point by replacing with biopolymers like cellulose. Biopolymers are easily biodegraded by soil microbiome. The other facet agro industries are concerned about the waste management of their by-product. From a waste management outlook, biodegradable plates made of agricultural waste could be a useful replacement for current non-degradable single use plastic plates.

The aim of this study was to develop a biodegradable eating plate made of agro wastes as a substitute for single use plastic plates and to analyse its physical property. Pineapple waste, banana peduncle waste and coca waste were used as the raw material. Out of these three formulations were made. The cooking time (120min) of chemical pulping at temperature (60 degree Celsius) and the dose of pulp by moist weight (300 g) to a pulp frame (30 × 30 cm2) were made on making the plate samples. The plates were tested for their physical properties. The sample one was made of pine apple waste has a thickness of 2.00mm, grammage of 3121gsm, water absorptiveness 600g/m2 and water absorbency 1min 16sec. Sample two was combination of banana peduncle and pineapple waste, has a thickness of 2.00mm, grammage of 3726.11gsm, water absorptiveness 340g/m2 and water absorbency 2min and the sample three was combination of banana peduncle and cocoa waste has a thickness of 2.51mm, grammage of 4012gsm, water absorptiveness 163g/m2 and water absorbency 2min 27 sec. All three samples were undergone biodegradation within a 15 days under soil. Soil burial degradation method used for checking the biodegradation.

According to physical studies, biodegradable serving plates made of banana peduncle and pineapple waste gave the best result having least leachability, optimum water absorbency and most acceptable appearance.

Keywords: Agricultural waste, banana peduncle, pineapple waste, cocoa waste, biodegradable plates

PS8-15

3D printing of sugarcane bagasse for the development of biodegradable food package casing

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The study examines the material supply properties, printability, biodegradability, water sorption and applicability of the developed food package casing. Sugarcane bagasse was found to be printable without the addition of any additives in a 'box' shaped model by using CARK delta printer. The material supply shows shear thinning behavior that helps in smooth flow out of the nozzle. The extrusion of material supply was performed using 1.28 mm diameter nozzle with the speed of the motor at 240 rpm and 3.2 bar pressure. The printing parameters were optimized at the 500 mm/min printing speed, 0.304 ± 0.003 g/min printing rate, and 0.450 mm nozzle height. The printed food package casing was found to be degradable in soil due to the microbial attack on the food package. The high-water sorption capacity at higher relative humidity was observed. The applicability test was performed for the storage of cake over the period of 9 days. The flexural properties showed utilization of sugarcane bagasse package for the low moisture containing foods. Thus, the utilization of agricultural biomass for 3D printing of food package suggests a sustainable approach for minimizing waste. Further, the work provides an alternative to petroleum-based plastic packaging material.

Keywords: 3D printing; waste utilization; biodegradability; sugarcane bagasse; sustainability; petroleum-based plastic

PS8-16

The effect of various solvents on the extraction of cashew nut shell liquid (CNSL) and isolation of major phenolic constituents (anacardic acid and cardanol) from extracted CNSL

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The aim of this study was to determine the effect of various solvents used for extraction of CNSL from raw cashew nut shell and to isolate the major phenolic constituents (anacardic acid and cardanol) from the CNSL extract. One of the most well-known Anacardiaceae species is cashew (*Anacardium occidentale* L.). Cashew nut shell liquid (CNSL) is a by-product of the cashew nut processing industry. Anacardic acid, cardanol, and cardol are the main phenolic components of CNSL. Prostaglandin synthase, tyrosinase, and lipoxygenase are all enzymes that anacardic acid inhibits. Antitumor, antibacterial, and antiacne capabilities have also been discovered. Cardol is also effective against the filarial parasite Setaria digitata, which infects cattle. In varnishes, paints, and braking fluids, cardanol can be found in the form of phenolformaldehyde resins. Resins made from CNSL are widely used in friction materials, vehicles, surface coatings, adhesives, laminates, rubber compounding, and a variety of other applications. The concept of sustainable chemistry is promoted by the utilisation of a low-cost renewable source like CNSL. Due to its phenolic composition and diverse biological qualities such as antibacterial, anti-inflammatory, anticancer, antioxidant, and insecticidal properties, cashew nut shell liquid (CNSL) is a product with low commercial value but tremendous technological possibilities due to its phenolic constitution. The extraction of CNSL from CNS was done using the soxhlet apparatus. To extract CNSL, all polar and non-polar solvents were utilised (acetone, ethyl acetate and hexane). Among all the solvents used, acetone gave maximum amount of CNSL. The Kirby-Bauer disc diffusion susceptibility test was used to characterize isolated anacardic acid. The potential pathogenic effect of Anacardic acid against representative bacterial strains, both Gram positive and Gram negative are obtained. Gram-positive bacteria Staphylococcus aureus and Gram-negative bacteria Escherichia coli were chosen as the test microorganisms. Cardanol was characterized using HPLC and the Supelcosil LC-18 (4 mm 150 mm) column. The purity of cardanol was determined by comparing with the standard samples. The extracted cardanol was found highly pure.

Keywords: Cashew Nut Shell Liquid, Cardanol, Anacardic Acid

PS8-17

Utilization of Agro Waste through the Development of Edible Cutlery

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In the present times, Agro waste is one of the major concerns in the whole world. Agro waste is produced from various agricultural activities and food processing industries which include plant stalks, hulls, leaves, peel, pulp, seeds and other fruit and vegetable matter. It may cause various environmental and health problems if not discarded safely. This is a known fact that agro waste comprises of various components which if garnered properly can be of various uses. In general, it contains various constituents in the form of organic acids, sugars, cellulose, lignin, fats, oil waxes, resins, pigment, and minerals. Traditionally, it is either used by farmers as a bio fertilizer or as an animal feed but this is not the sustainable solution for this enormous problem of agro waste. In the recent years a lot of research has been done for the extraction and utilization of these components in the foods but still the target of whole utilization of the waste is yet to be achieved. Work is in progress in the product development from this waste like the development of edible cutlery. This will lead to the overall utilization of agro waste especially citrus peel and will also aid in the circular economy. This paper gives an overview on the production of edible cutlery from the fruit waste, its application and overall benefits.

Keywords: Agro waste, edible cutlery, Mosambi peel.

Poster Session-9: Food Microbiology and Bioprocessing

PS9-1

Influence of Bruising Damage and Storage Temperature on Banana Respiration and Ethylene Production Rate

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Mechanical damage can occur at any phase of the supply chain of banana fruit because of the technologies utilized in pre-harvest and post-harvest periods. This study aims to demonstrate the physiochemical changes of banana fruit induced by mechanical damages kept under two storage conditions. Drop impact test was used to produce damage at different levels (low, medium, and high) on banana fruit. The selected temperatures were refrigeration temperature (13°C) and room temperature (22°C). The evaluated characteristics were bruise area, bruise volume, bruise susceptibility, weight loss, respiration, and, ethylene production rate. The assessment was conducted for 48 hours. A two factorial analysis of variance was carried out to study the effect of impact leveland storage temperature on the quality attributes of banana fruit. The results showed that the highest impact level showed a higher incidence of bruising, therefore, inducing higher changes in respiration and, ethylene production rate. Storage at low temperature retained the weight of a banana during storage. Also, storage at 10°C and the lowest impact level delayed the increase in bruise area, volume, and bruise susceptibility. Overall, storage management and proper handling of banana fruit during the supply chain are essential to reduce the occurrence of mechanical damages like bruising. Therefore, maintaining the quality and safety of any fresh produce and increase the marketability and economical values.

Keywords: Banana, Drop impact test, Respiration rate, Bruising, Ethylene production rate, Bruise susceptibility

PS9-2

Assessment of Anti-inflammatory activity of probiotic strains Lactobacillus plantarum AMD6 and Lactobacillus plantarum MBS17 isolated from fermented foods in lipopolysaccharide - induced CaCO-2 cells

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Probiotics are known to modulate the inflammatory response either with its cell-wall associated components, secretory products or modifying the composition of gut microbiota. Thus, the present study was aimed to assess the anti-inflammatory activity of isolated lactic acid bacteria, via screening for their efficacy to downregulate the LPS (Lipopolysaccharide) induced nitric oxide (NO) production in CaCO-2 cell line and check its antimicrobial activity against pathogenic strains. It was found that nitric oxide production was significantly high (100%) in CaCo-2 cells treated with LPS alone compared to cells treated with supernatant of L.plantarum AMD6(51.57 %) and L.plantarum MBS17 (45.22%) strains.

Almost 33 different microbes were isolated from fermented food products collected from Northeast India and were screened for their probiotic characteristics such as resistance to gastrointestinal conditions, bile tolerance, autoaggregation assay, co-aggregation assay, cell surface hydrophobicity assay and capability to adhere to Caco-2 cells.16S rRNA gene sequences of the strains were submitted to NCBI GenBank as L. plantarum strain MBS17 (MW043712) and L.plantarum strain AMD6 (KP404632).

L.plantarum AMD6 and L.plantarum MBS17 strains showed remarkably good antimicrobial activity (zone of inhibition >12mm) against five species indicators (Pseudomonas aeruginosa, Salmonella sp., Staphylococcus aureus, Klebsiella pneumonia and Listeria monocytogenes). Therefore, these strains can be useful to treat food borne infections.

Keywords: Probiotics, CaCo-2 cells, Anti-inflammatory activity, Lipopolysaccharides, Antimicrobial activity

PS9-3

Characterization and evaluation of bacteriocin produced by bacterial isolates from fermented foods

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Food spoilage and preservation is one the most demanding aspects to be researched upon. When we talk about fermented food items there is a fortunate possibility of secretion of some antimicrobial components by food bacteria against the food spoilage bacteria or food borne pathogens. Thus, microorganisms producing such active principles can be used as a weapon for food safety. One of such substances is bacteriocin, which inhibits the growth of closely related bacteria. This approach could be enhanced and modified according to our system. The study here proves the inhibitory action of fermented food bacteria against standard pathogenic strains. Upon interpreting the present results, it is speculated that the presence of test pathogen induces the production of bacteriocin against it due to survival competence. Some such food borne pathogens are *S. typhi*, *P. aeruginosa*, *L. monocytogenes*, *Y. enterocolitica*, *E. coli* etc. The growth of pathogens was inhibited in the range of 80% and above. Antibacterial activity was demonstrated against *Salmonella enterica typhi* extensively with agar overlay assays, as well as broth micro dilution assays. Next, to obtain the desired bioactive component, precipitation was done using Ammonium Sulphate method; checked the activity against *S. typhi* after dialysis too. Protein precipitation had an approach for optimization to get maximum inhibition of S. typhi by the extract. Maximum inhibition percentage of around 80-95% was found to be at 40-45% of the salt. The results show consistent inhibition of *S. typhi* by the crude protein extract obtained out of the bacteriocinogenic isolates. Future perspectives of the work include purification of active component in large scale using appropriate chromatographic methods; in furtherance, incorporation of bacteriocin in food systems as a preservative of natural origin to increase shelf life.

PS9-4

Bio-Functional and Microbial analysis of traditional rice cake of Khasi and Jaintia hills of Meghalaya using S. cerevisiae and Pearl millet

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Rice cake is a popular snack in Meghalaya's Khasi and Jaintia Hills. The bio-functional properties of traditional and laboratory-prepared (LP) rice cakes containing Saccharomyces cerevisiae (WTS1A) and pearl millet were investigated in this study. Pusla, Pusyep, and Putharo are three popular rice cakes that were made. Traditional rice cakes were made in the laboratory and served as a control, whereas value added rice cakes were made by inoculating 3 % cell biomass of S. cerevisiae and pearl millet was added in a 9:1 ratio. Antimicrobial and antioxidative analysis, short chain fatty acid production, and Vitamin B2 production are among the bio-functional studies. The antimicrobial activity of rice cakes was determined using an agar well diffusion assay. LP Pusyep rice cakes exhibits higher antimicrobial activity against pathogens. The antioxidative potential of rice cake was determined using the ABTS method, with higher values found in LP Pusla rice cake. SCFA was determined using HPLC, with the highest value observed in LP rice cakes. Vitamin B2 production was investigated, and it was discovered to be lacking in PSL rice cakes. The rice cakes' microbial analysis was evaluated and studied for yeast and mould counts, as well as coliform counts. It was discovered that the yeast and mould count was higher in LP Pusyep rice cake. The study shows that incorporating S. cerevisiae and pearl millet may improve shelf-life, indicating the need to develop effective starters to increase the value of rice cakes and open new avenues of research in this field.

Keywords: antimicrobial, Pearl millet, Pusla, Pusyep, Putharo, Saccharomyces cerevisiae

PS9-5

The interplay of amylose and amylopectin in starch gels for in vitro digestion studies

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The interaction between amylose (AM) standard from potato starch and amylopectin (AP) standard from corn starch was studied for producing starch gels with critical phase overlap concentration for in vitro digestion studies. AM and AP were combined in five ratios (100:0, 75:25, 50:50, 25:75 and 0:100) on w/w basis respectively. The combined ratios were made into starch solutions in water with five concentration labels for each ratio viz., 1, 3, 5, 7 and 10 %. All samples were fully gelatinised in a circulating water bath at 95 °C for 20 min and temperature was normalised to 37 °C at the rate of ~1 °C/min. Rheological studies were performed by applying continuous shear rate sweep from 1 to 200 s^{-1} at 37 °C and double logarithmic plot of the series of concentrations against specific viscosity at 60 s-1 shear rate (ηsp60) was plotted. The data showed that AM diminished the gelling properties of AP, while also lowering the viscosity of solutions in 100:0, 75:25, 50:50, 25:75 ratios. Critical concentration for transition from dilute to semi-dilute regime were absent for 100:0 and 75:25 ratios at all five concentrations; for 50:50, 25:75 and 0:100 ratios, this concentration was found above 3, 5 and 7% respectively. The entanglement and overlap thus formed between AM and AP and hence, the increase in viscosities therein may limit enzyme contact during digestion and impede diffusion of glucose. Next phase in vitro studies are required to confirm such considerations.

Keywords: Amylose Amylopectin Starch gel Critical concentration Interaction Starch digestion

PS9-6

Isolation and characterization of bacterial γ-PGA (gamma poly-glutamic acid) and its application

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Background: Poly-γ- glutamic acid (PGA) is a water soluble, anionic, biodegradable and non-toxic homo-polyamino acid. γ-PGA and its derivatives find its applications in various industries such as food, cosmetics, medicine and water treatments. The gamma glutamyl linkage between the α-amino and γ-carboxyl chains makes it a poly amino acid that cannot be degraded easily by naturally occurring proteases. Microbially produced PGA has promising applications in food industry. γ-PGA is majorly biosynthesized by the Bacillus sp. in a wide range of molecular weight (100-1000 kDa).

Materials and methods: PGA producing bacteria were screened on a nutrient medium containing methylene blue dye. Further PGA was purified and quantified by UV-vis spectroscopy. The strains producing high quantity were selected and further taken for characterization studies. γ-PGA was used as a cryoprotectant for probiotic bacteria.

Results: A total of 103 bacterial strains were isolated which producing PGA between 14-38 mg/L. One of the strains, M-4 produced 38 mg/L. FT-IR results showed the presence of a carbonyl group; two amide stretches, N-H bending and C=O symmetric stretching band. ^{1}H and ^{13}C NMR showed the chemical shifts for the α-CH proton, β-CH_2 proton and γ-CH_2 proton. The γ-PGA exhibited thermal degradation considerable temperature stability as demonstrated by DLS. Amino acid analysis showed the presence of only D-glutamic acid residues. PGA showed strong cryoprotectant activity with 5-10% PGA with least reduction in cell viability. *L. fermentum* and *L. rhamnosus* were used as probiotic strains.

Conclusion: Strong γ-PGA producing strain was isolated from fermented food with a strong cryoprotectant activity.

Keywords: Poly-γ-glutamic acid (γ-PGA); biosynthesis; screening; characterization

PS9-7

Sustainable methods for utilizing the Vannamei shell waste for carotenoprotein recovery using biotechnological interventions

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Shrimp shell waste is a rich source of bioactive compounds like proteins and carotenoids which are underutilized. Nearly 3 lakh MT per annum of shrimp waste is generated from processing industries in India. The effect of plant based proteolytic enzyme on the recovery and characterization of carotenoprotein from white leg shrimp (*Penaeus vannamei*) was studied. Extraction conditions for the production of carotenoproteins were optimized by Response surface methodology (RSM). A box Behnken design was used in order to predict optimum conditions for hydrolysis. The maximum predicted deproteinization was found to be higher in head wastewhile compared to shell waste under optimum conditions. Spray protein powder containe75-80%protein content.The obtained powders had all essential amino acids, good microstructural properties and good antioxidant activities hence it can be regarded as good source of protein and it may be useful in feed formulations as flavouring agent. The results of this study show that the optimum conditions required for enzymatic deproteinization of shell waste and also emphasizes structural characterization of spray dried carotenoprotein hydrolysate. In the present study the proteins can be effectively extracted with enzymatic method for sustainable utilization. Therefore, the environmental pollution due to excess use of alkali can be reduced.

Keywords: Carotenoproten; Deproteinisation; feed formulation; Papain enzyme; Spray drying;

PS9-8

Conventional and non-conventional methods for animal based protein extraction

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Protein is an essential macronutrient and the building block of our body. People are being more health conscious which has increased the demand of protein in the last few years. Animal protein is generally considered as a perfect source of protein due to its well-balanced amino acid profile and good digestibility. Terrestrial and aquatic animals and their by-products are nowadays being center of attraction for researchers as they are good source of protein and can be utilized to meet the protein requirement of growing population and also can be used as functional ingredient in various products. The aim of this paper is to study the influence of various conventional as well as novel techniques to extract protein from different terrestrial and aquatic animals as well as their byproducts. Different extraction techniques have different impact on the production yield and physicochemical properties of the extracted proteins. It was found in various studies that incorporation of novel techniques such as ultrasound, microwave, ohmic heating, thermal Hydrolysis etc., along with traditional methods not only improves the extraction yield but also modifies the physicochemical properties of the extracted product. However, more research is required in this field to effectively use the conventional and novel technologies as well as their combination at industrial level.

Keywords: Protein, novel techniques, animal, extraction

PS9-9

MEGA ULTRASOUND TECHNOLOGY FOR OIL EXTRACTION: A REVIEW

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Changes in consumer's desires in the recent past, have led to the requirement for more convenient foods having supreme qualities, minimally processed and nutritionally healthier. Hence, many novel non thermal technologies like high pressure processing, pulsed light, pulsed electric field, ultrasound, irradiation, etc. find application in food materials. The application of ultrasound in food processing has been popular technology in non-thermal approaches, which exploits the preservative effect of the high intensity sound waves i.e. greater than 20 kHz. The high frequency ultrasound standing waves are referred as "Mega Ultrasound". An important distinction between ultrasound and mega ultrasound methods is that the mega ultrasound frequencies do not cause the violent cavitation effects found with ultrasonic frequencies. Extraction is a major unit operation used for the effective separation and production of various oils, bioactive compounds and molecules from their matrices. Soxhlet extraction, heat reflux, and maceration are the commonly used conventional techniques for extraction, which require large amounts of solvent. labor, energy and cost-intensive. Mega Ultrasound extraction is an effective alternative that overcomes the drawbacks of traditional technologies with enhanced yields. Ultrasonic implosion and cavitation rupture the cell walls, enhancing the mass transfer from solid to liquid phase. Also, within the tissues, microchannels are created on an ultrasound application which enhances the solvent penetration into the solid matrix which increases mass transfer. Thus, Ultrasound aided extraction contributes to efficient recovery of compounds in lesser time, energy, solvent requirements and an advantage of low-temperature extraction, for temperature-sensitive food products.

Keywords: Oil extraction, ultrasound applications, Extraction methods, Megasonics

PS9-10

Exploration of Red Yeast Rice Powder as Food Colorant in Buttermilk and Lemon RTS

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The present study was carried out to justify acceptability of Red Yeast Rice Powder (RYRP) as food colorant. Addition of 1.0 percent red yeast rice powder to lemon juice and buttermilk was scored highest in terms of color, texture and appearance parameters. The prepared red yeast rice powder was stable at room temperature for 90 days when properly packed in suitable packaging material. On the basis of findings, it was concluded that the products prepared by using red yeast rice powder as food colorant could be considered as the best from both nutritional and sensory point of view. It is also economically feasible than synthetic colorants which are being sold in market.

Keywords: Bio-colorant, *Monascus purpureus*, Red yeast rice, Lemon juice, Buttermilk, RTS

PS9-11

Cell Surface Properties of *Lactobacillus fermentum* Isolated from Vechur Cow Milk

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Cell surface properties of bacteria, which are crucial in deciding the adhesion potential decides its colonization potential in the intestinal ecosystem, an important prerequisite for probiotics. The present work attempted to evaluate the cell surface properties of *Lactobacillus fermentum* isolated from Vechur cow milk, by assessing hydrophobicity (CSH), auto aggregation and coaggregation potential. Black colonies in Congo red agar indicated its ability to produce exopolysaccharide (EPS). Capsule staining and ethanol precipitation method confirmed its EPS production potential. The CSH value of 76.16 % with xylene at 6h suggested the hydrophobic nature of cell surface. Autoaggregation, measured in terms of sedimentation rate was found to be 63.7 % indicating that the isolate possessed a strong auto aggregating phenotype. The coaggregation potential enables the probiotics to evade pathogen adhesion onto the epithelial cells .Coaggregation value of *L. fermentum* was found to be 30 percent against the *E. coli* and 28 percent against *S.aureus*. The inhibitory activity of the isolate against *S.aureus* was confirmed by well assay. The observation of this acid and bile tolerant isolate as non-haemolytic and negative for gelatin liquefaction suggests the possible absence of virulence factors. Antibiogram revealed that the isolate was sensitive to all the antibiotics except Vancomicin. The observations indicate not only its probiotic attributes but also its potential to be used as a protective culture in food industry.

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PS9-12

Process Standardization of Fibre Rich Probiotic *Basundi*

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The present investigation is aimed towards utilization of encapsulated lactic acid bacterial culture *(Lactobacillus acidophilus* and *Lactobacillus bulgaricus)* and modified psyllium husk for the preparation of probiotic *basundi*. Probiotic *basundi* was prepared from 1000 ml of milk, 90 gm sugar, 02-03 pieces of cardamom, saffron and encapsulated LAB culture having (10^7, 10^8 and 10^9 cfu/gm containing equal proportions of *Lactobacillus acidophilus* and *Lactobacillus bulgaricus* with 0.65 percent hydrochloric acid modified psyllium husk. The probiotic *basundi* was then stored at refrigerated conditions at 4^0C for 08 hours. The prepared probiotic *basundi* was analyzed for physicochemical, microbial and organoleptic quality parameters. The organoleptic evaluation of probiotic *basundi* was carried out with 9-point hedonic scale. *Basundi* prepared with encapsulated 10 percent probiotic culture (10^9 cfu/gm) and 0.65 percent hydrochloric acid modified psyllium husk had shown maximum consumer acceptability (8.3) among all samples.

Keywords: Probiotic *basundi*, *Lactobacillus acidophilus*, *Lactobacillus bulgaricus,* Psyllium husk, Lactic acid bacteria, Encapsulation

PS9-13

Development of functional whey based health drink fermented with *Saccharomyces cerevisiae and Lactobacillus plantarum* isolated from Traditional fermented foods of Meghalaya

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Whey is the liquid protein of milk after manufacturing of casein as paneer or channa. This is the major by-product of dairy industries and a huge wastage as it contains all the nutrients and minerals possessed by milk. Utilization of whey to readily palatable drink incorporated with probiotic strains would serves as refreshing and economically viable drink. The aim of the present study was to develop functional whey based health drink using *Saccharomyces cerevisiae* WTS1A (NCBI GenBank Accession no.MG183699) and *Lactobacillus plantarum* KGL3A (NCBI GenBank Accession no.MG722814) isolated from Traditional fermented foods of Meghalaya. The functional whey based health drink was formulated with 1:1 cell biomass of *S. cerevisiae* WTS1A and *L. plantarum* KGL3A as starter culture with inoculum concentration of T_0 (control), T_1 (1%), T_2 (1.5%) andT_3 (2%). The product was fermented for 6, 12, 18 hours of incubation stored at 32, 35, 37°C for optimization of the functional whey based-health drink. Optimization of the best inoculum concentration, incubation hours and temperature for the preparation of functional whey based health drink estimated by examining physico-chemical analysis and organoleptic evaluation of the product.

Keywords: Whey drink, Saccharomyces cerevisiae and Lactobacillus plantarum, optimization and sensory analysis

PS9-14

Metal chelating bioenhancer protein hydrolysate from fermented milk of *Citrullus lanatus* seed, as functional food

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A nutraceutical is a food or part of a food that provides medicinal and health benefits. This study aims to develop a fermented milk of *Citrullus lanatus* seed using probiotic gram positive lactic acid bacteria *Lactococcus lactis* which is rich in bioenhancer protein hydrolysates. Metal chelating protein hydrolysate (MPH) of 9.86 kDa was isolated and purified using preparative rpHPLC followed by HiTrap immobilized chelating column charged with copper ion. The purified MPH exhibited high copper chelating ability of 86.81±0.29% followed by 61.04±0.41% & 24.32±0.27% of calcium and iron chelating property respectively with added 78.03±0.48 antioxidant property. Structure-function relationships of MPH were further characterized through Ultraviolet and fluorescence spectroscopic analysis. It was observed that the chromophore groups (-C=O, -COOH) and auxochrome groups (-OH, $-NH_2$) of the amino acids of MPH generates polarizing changes when the ligand binds with copper ions in the chelating process. Further the presence of aromatic amino acid having indigenous fluorescence at 285nm and 345nm which is quenched by the binding of metal ions to the MPH. MS/MS ESI *tof* data analysis of MPH confirmed the presence of aromatic amino acids (F,W,Y-5.89%) and also presence of acidic (D,E-15.3%), basic (K,H,R-15.29%) and hydrophobic (G,V,L,I,P,M-31.76%) amino acids that enhances the metal binding ability of MPH. The MPH was stable at gastro-intestinal conditions and also retained its copper chelating ability which is critical to their relevance as bioenhancer peptides which can increase the bioavailability of metals in human nutrition and enhance health as a potential functional food.

Keywords: Fermented milk, *Citrullus lanatus*, Protein hydrolysate, Metal chelation, antioxidant

PS9-15

Growth Studies of Potentially Probiotic Lactic Acid Bacteria (*L.acidophilus*, *L.plantarum*, *L.rhamnosus*) in Buransh (*Rhododendron arboreum*) concentrate

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Development of non-dairy probiotic drinks including those based on vegetables, cereals and fruits are gaining importance owing to the increasing vegetarianism and lactose intolerance. Utilisation of edible blossoms to develop functional foods is also on the rise in global food and pharma industry because of their nutritional and phytochemical profiles. *Rhododendron arboreum* (Buransh) an edible flower exhibits anti-diabetic, anti-inflammatory, anti-oxidant, anti-cancer and anti-microbial activities. Therefore, its juice can serve as a good substrate for fermentation by lactic acid bacteria. The present study evaluates the use of Buransh concentrate as a vehicle for the growth and viability of three potentially probiotic strains viz *Lactobacillus acidophilus*, *Lactobacillus plantarum*, *Lactobacillus rhamnosus* over 72 hr of fermentation and 3 weeks of refrigerated storage at 4 °C. pH, titratable acidity, reducing sugars and viable cell counts (log CFU/ml) were analysed at 24 hr intervals for the fermented juice samples upto 72 hr of fermentation. Total phenolic content, Total flavonoid content & DPPH radical scavenging activity were recorded before and after the fermentation. The study concluded that Buransh concentrate could serve as a favorable substrate for the development of a non-dairy probiotic beverage which could deliver health benefits to the consumers owing to the extra ordinary nutraceutical properties of *Rhododendron arboreum* and benefit both lactose intolerant and vegan population.

Keywords: Non-dairy probiotic drinks, *Rhododendron arboretum,* lactic acid bacteria, lactic fermentation.

PS9-16

Unstructured kinetic modelling of growth and lactic acid production by lactic acid bacteria during fermentation of *Aegle marmelos*

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The fruit, leaf, and bark of the *Aegle marmelos* tree have historically been used to treat asthma, liver toxicity, fungal infection, microbial infection, inflammation, and pyrexia.Bael contains phenolic compounds and flavonoids. Fermentation increases the bioavailability of these polyphenols and increases the antioxidant capacity.The present research examines the growth and lactic acid production by four strains of lactic acid bacteria during fermentation of *Aegle marmelos*. Unstructured models have proved to reliably characterize lactic acid fermentation. The *Aegle marmelos*samples were inoculated with cultures of *Lactobacillus plantarum*MTCC 2941, *Bacillus coagulans* MTCC 2302, *Pediococcuspentosaceus* MTCC 3817 and *Lactobacillus acidophilus* NCDC 11 ($<10^5$CFU/mL) and incubated for 72 h at 37°C. Chemical and microbiological examination of inoculated samples of *Aegle marmelos* (Bael) juice were done at 2 h intervals. Acidity and viable cell counts (CFU/mL) were determined. Four differential equations with parameters which were calculated using linear and non-linear regression analysis were used in the kinetic model suggested by E.L. Piret and R. Luedeking. We found that during both the growth phase and the stationary phase, substantial lactic acid production occurred.The growth-related and non-growth-related coefficients were calculated for the lactic acid development rate. The model for batch development of lactic acid bacteria in *Aegle marmelos* juices has been shown in this research.

Keywords: Unstructured, kinetic modelling, lactic acid, lactic acid bacteria, fermentation, Aegle marmelos

PS9-17

Addressing the Challenges in Probiotication of Phenols and Anthocyanin Rich Grape Juice by Using Natural Prebiotics

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Apart from well-known customary functional ingredients, probiotics are emerging out as a promising active ingredients. Dairy products being considered conventionally best carriers for probiotics; but, nowadays, up to 70% of the world population is affected by lactose-intolerance. Grape juice could combine nutritional effects with the added value of health benefits from a probiotic. Antioxidant rich Manjari Medika grape (MMG) juice is found to be highly effective against colon cancer owing to its unique matrix of anthocyanins. Although Manjari Medika juice rich inantioxidants, but probiotic culture viability is suppressed by presence of phenolic compounds and acidity of the fruit juice. Efforts are being made to develop a probiotic beverage with minimum loss to natural nutrient profile of Manjari Medika juice through surface response methodology. Through series of experiments it was found that diluting the MMG juice to 15 °B recorded maximum growth of *Lactobacillus acidophilus* ($20x10^2$ CFU/mL) over juice with 20 °B($30x10^1$ CFU/mL) and control (25 °B, $20x10^1$ CFU/mL). Use of skim milk powder (SMP) as a source of lactose at the rate of 5% in MMG juice with 15 °BTSS resulted improved probiotic culture growth i.e. ($60x10^2$ CFU/mL) over 2.5% SMP ($20x10^2$ CFU/mL). Addition of 7.5% oat meal in the MMG juice at 15 °B TSS shown maximum growth of probiotic culture ($20x10^3$ CFU/mL) over oat meal (2.5%) added to MMG juice ($50x10^2$ CFU/mL). The aforesaid findings will certainly help in further development of quality probiotic beverage from MMG juice with maximum growth and viability of promising probiotic cultures (IPR protected).

Keywords: Fruit juice probiotication, Challenges, Non-Dairy probitic foods, Lactose intolerance, Prebiotic, Manjari Medika

PS9-18

Suitability of Olive (*Elaeocarpus serratus*) pickle as a delivery matrix for probiotic bacteria *Lactobacillus sakei* ATCC 15521

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Olive (*Elaeocarpus serratus)* fruit is a commonly used to prepare traditional pickle in the North-East region of India. In the current work, Olive pickle of probiotic nature was standardised by inoculating with *Lactobacillus sakei* ATCC 15521. The changes in physicochemical and bioactive properties were studied till 30 days of storage at different temperatures viz. 37 ºC, 27 ºC and 4^{o}C. The Olive (*Elaeocarpus serratus)* pickle was made with traditional procedure. Microbial, physicochemical and bioactive properties were studied and compared during the storage period with standardised non-probiotic pickle. Parameters viz. pH, titratable acidity (TTA), free fatty acid (FFA), total carbohydrate content, total reducing sugars along with total polyphenolic content (TPC) and DDPH radical scavenging antioxidant activity were evaluated on storage. It was observed the inoculated pickle retained a viability of 1.1×10^{8} CFU/g at the end of 30 days when stored 4^{o}C, thus retaining the probiotic nature till 30 days. While at other temperatures the complete cell viability was lost at the end of 1st week of study. The storage comparison revealed that in all samples general pH, carbohydrates, reducing sugars, TPC and DPPH decreased invariably. While an increase in TTA, FFA and soluble protein content was observed in all samples However, the decrease in values was similar to the control samples. Thus, suggesting no major implication on probiotic addition. Thus, this standardized probiotic pickle prove to be a suitable non-dairy matrix for probiotic delivery opening further research avenues and practical applications.

Keywords: Olive fruit, probiotic pickle, physicochemical properties, bioactive properties, non-dairy probiotic matrix, pickles

PS9-19

Characterization and evaluation of bacteriocin produced by bacterial isolates from fermented foods

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Food spoilage and preservation is one the most demanding aspects to be researched upon. When we talk about fermented food items there is a fortunate possibility of secretion of some antimicrobial components by food bacteria against the food spoilage bacteria or food borne pathogens. Thus, microorganisms producing such active principles can be used as a weapon for food safety. One of such substances is bacteriocin, which inhibits the growth of closely related bacteria. This approach could be enhanced and modified according to our system. The study here proves the inhibitory action of fermented food bacteria against standard pathogenic strains. Upon interpreting the present results, it is speculated that the presence of test pathogen induces the production of bacteriocin against it due to survival competence. Some such food borne pathogens are *S. typhi*, *P. aeruginosa*, *L. monocytogenes*, *Y. enterocolitica*, *E. coli* etc. The growth of pathogens was inhibited in the range of 80% and above. Antibacterial activity was demonstrated against *Salmonella enterica typhi* extensively with agar overlay assays, as well as broth micro dilution assays. Next, to obtain the desired bioactive component, precipitation was done using Ammonium Sulphate method; checked the activity against *S. typhi* after dialysis too. Protein precipitation had an approach for optimization to get maximum inhibition of S. typhi by the extract. Maximum inhibition percentage of around 80-95% was found to be at 40-45% of the salt. The results show consistent inhibition of *S. typhi* by the crude protein extract obtained out of the bacteriocinogenic isolates. Future perspectives of the work include purification of active component in large scale using appropriate chromatographic methods; in furtherance, incorporation of bacteriocin in food systems as a preservative of natural origin to increase shelf life.

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