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Aerial Technology for Precision Agriculture: Panacea for Agrochemical Spray in Nigeria

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Abstract
The potential of the space agency in Nigeria and aerial surveillance for constantly monitoring agricultural activities using satellites and other remote sensing technologies in precision agriculture for optimized production of food was highlighted. With technology, agriculture is fast translating to a more and more information-based industry in the reaction to economic and environmental considerations to help meet the requirements for the observational data obtained with the use of the aircraft, Unmanned Aerial Vehicles (UAVs) and balloons for farm management. In Nigeria, the huge problem of misuse of agrochemicals and the associated stress can be averted by the adoption of the techniques of remote sensing processes through Airboard, the world's most powerful drone. It is designed for precision agriculture. Airboard is majorly concerned with two simple technologies: Geographical Information System (GIS) and Geographical Positioning System (GPS) technology utilising different kinds of sensors, displays, and controllers during operation. Comparison of the specifics of Airboard Agro with that of similar innovation was done. Airboard possesses Industrial-grade reliability, has custom controller design, in-house battery and partners with leading European Agriculture University. Among the benefits of Airboard Agro is an expansion of farming business with larger acre coverage, customisable capacity, spray nozzles and pressure for different crops. Airboard Agro is also found to save money on labour and transportation costs compared to multiple smaller drones. It has free employee drone training and after-sales support. It is environmentally friendly and partnered with experienced industrial technical staff with 10 years of drone manufacturing expertise.

Keywords: Precision agriculture,Technology, Airboard Agro, Drone, Agrochemical, Satellite, GIS, GPS

Introduction

The potential of the space agency in Nigeria, aerial surveillance for constantly monitoring agricultural activities using satellites and other remote sensing technologies has improved and made possible the adoption of precision agriculture for the optimized production of food (Valente *et al.*, 2011). The National Space Research and Development Agency in Nigeria, for example, has successfully launched five (5) satellites (NigeriaSat-1, Sat-2, Sat-X, NigComSat-1, NigComSat-IR) and are planning to launch more (Nasrda, 2008).
Technology Application to agricultural development is fast increasing and broadly practised in several parts of the world where agriculture is a major source of income and livelihood (Diouf *et al.*, 2002). For example, `NigeriaSat-1 helps to detect and control desertification in the northern part of Nigeria, while NigComSat-1 provides rural internet access which aid farmers' linkage with relevant information. These applications to the agricultural sector help to eliminate the stress and hectic manual intensive labour involved in agriculture. It also tends to optimize yield and aids proper management of farm input resources translating into output (Wei and Balasubramanyam, 2015). In Nigeria, food security is at the heart of economic and social

development priorities, which will lead to political and economic stability in the country by making more food available, improving its quality and making it readily accessible to more people. This will serve to bridge the very wide gap between the rich and poor. The technological development in agriculture serves to lessen the human labour involved in farming. Technology is very important in both production and marketing of the agricultural sector. It is only with large production being aided by the available recent technology and exhaustive market that the farmer exploits both the local market and the global market to its full extent (Product, 2008).With technology, agriculture or farming is fast translating to a more and more information-based industry in the reaction to economic and environmental considerations to help meet the requirements for the observational data obtained with the use of the aircraft, unmanned aerial vehicles (UAVs), balloons and satellite through remote sensing which is playing a long-drawn-out role in farm management through precision agriculture (Deere, 2007).

In Nigeria, there is a huge problem of misuse of agrochemicals that can be averted by adoption of the techniques of remote sensing processes through Airboard agro, the world's most powerful drone.Airboardagro is UAV built for precision agriculture and environmentally responsible farming. It is designed for precision agriculture. Precision Agriculture is an integrated information- and production-based farming system that is designed to increase long term, site-specific and whole farm production efficiency, productivity and profitability while minimizing unintended impacts on wildlife and the environment. Precision farming is a technology that influences the whole production process from extension services to managerial functions on the farm. It is largely a data technology based farm management framework, and it includes a process of data/image collection, data and information mapping, data analysis and location-specific treatment (Abdullahi, Mahieddine, and Sheriff, 2015). Precision agriculture provides information about the nutrient content and soil quality available across a particular field or plantation. Precision farming technology which also includes farm product mapping, and the variable rate of nutrient application, can significantly increase the effectiveness of the required farm operations. Precision agriculture (PA) is majorly concerned with two simple technologies: GIS and GPS technology utilising different kinds of sensors, displays, and controllers for guiding farm's equipment during operation (Cox, 2002).

Airboard agro is built for pesticide and liquid fertilizer application with a capacity of up to 100 litres. It is 50 times faster than manual application at 6 hectares per hour. It has no soil compression and using smart GPS routing which provides optimised precision and workers' safety. Airboard agro is up to 5 times more precise than a helicopter and cut the operational expenditure by 80% compared to an helicopter. It is designed for both organic and chemical liquid substances; Fungicides for fungi which are commonly practiced in grapevines to prevent powdery mildew, insecticides for rodents (rats and mice), Bactericides for bacteria, Larvacides for larvae

Disadvantages of other Aerial Vehicles: Other aerial vehicles that are in use such as Helicopter, YAMAHA R-MAX and DJI MG1-Pare:

- Noising during operation;
- No guarantee on workers' safety ;
- Low flexibility on flight schedule;
- Not cost effective; distance from airports and expensive pilot licenses can step-up expenditure;
- Low precision- (1) resulting in lower yield and (2) regulatory limitations to treatment with airplanes due to environmental and public hazard.

Designed for Multi-Crop Use: Airboard agro offers customisable spray nozzles for pesticides and fertiliser overlay for vineyards, palms, cranberries, sugarcane, kiwifruit, avocado, rice, corn, agave and other produce. In cereal crops and wheat ear drizzle fungicides, where there is often only a tiny weather window, a finer air incorporation scatters directly down is efficient in achieving weeds and stem bases. Additionally, tilt dusting with finer air integration particles is efficient for spray coverage on all sides of soil clods and ridges.

Ease of Use: Airboard comes with a factory installed software for automatic flight planning practicing GPS routing (geofencing employing a satellite map). It gives the farmer data on travel history and operating speed, battery life, route course and more to better measure yield results and track performance. Airboad agro operation is fully autonomous and support multiple radar sensors and cameras for obstacle avoidance and maintaining a constant height above crops. The frame is designed of aircraft grade 6061 aluminium alloy and carbon fiber composite structure even for the most extreme flight conditions. The frame is also foldable and fits inside a pickup truck or a minibus for portable transportation.

Industrial Battery: One of the most important parts of any electric vehicle is its power unit. With airboard agro, the task of designing is taking to the next level. The machine comes with a 180Ah industrial Lithium battery pack that is divided into two separate swappable modules for installation and transportation. The module has two main positive and negative connectors for redundancy. It has integrated battery management system (BMS) with low voltage protection circuit module (PCM) with precharge. Deep discharge under 2.8V/cell power-on protection.

Safety and Reliability: The airboard agro is designed with aerospace level safety standards, highest quality components and redundancy systems in place to support a safe user operation. The agriculture drone is able to fly even if one electrical motor, controller or battery has stopped working. The flight controller is equipped with two GPS units for redundancy and breakthrough precision and can be customised for dual transmitter system. The controller has a dual power management unit (PMU) and dual power line.

Airboard Agro and Organic Agriculture: Biological growers (organic farmers) apply environmentally friendly programs to prevent diseases, like powdery mildew for grape agriculturists which is the largest problem with wine grapes. For instance, orange peel tea can be used as an alternative to fungicide use. Since biological methods are less resistant to rain, they require constant spraying (15-25 instances per year compared to 8-12per year using chemical substitutes). This, in turn, leads to inflated costs by 200%. Therefore, most bio-growers do not use helicopters for spraying but apply it manually themselves which leads to increased price of the end product. Given the reduction of airboard agro spraying cost, it provides a lower market entry barrier for organic agriculturists worldwide (and other farming industries) still service chemical substances and governments have put in place regulations to trim this amount.

Airboard Agro versus Tractor or Caterpillar: Generally, aerial treatment is more time efficient and provides lower fuel charge per acre than a tractor, due to upsurge coverage pace. However, multiple reasons make ground tractors or caterpillar a preferred mode.

Advantages of Airboard Agro

1. Airboard agro is the fastest means of getting the necessary protection products to the affected crop for now
2. It leaves no tracks in valuable produce and are the only option during wet spells (for example for growing corn, which is planted in wet soil)
3. More environmentally friendly as it lessens soil erosion by as much as 90% by assisting no-till or minimum till operations. It preserves the integrity of the soil.
4. Airbord agro reduce cost on human labour
5. It increases application efficiency with the 100 litres liquid tank.
6. It is 50 times faster than traditional tools
7. High performance application even after rain in wet soil
8. Lower impact on the environment: airboard agro is powered 100% by electricity, can save up to 90% water and 35% pesticides
9. It increases yield; small droplet diameter make the chemical more well distributed and improve the effect

Prior to an agriculturist starting the process of precision farming, a smart idea and comprehension of the soil types, hydrology, microclimates and aerial photography of the farm sites are required (Mulla, 2013), and also an understanding of the constantly changing factors in the fields that affects the yield map. The yield map is a confirmation of data of what is available to the farmers, by simply taking aerial images of the farm in consideration. New systems for measuring or inferring soil and crop parameters on a more continuous basis continue to be developed using both proximal (i.e. on ground-based platforms) and remote (i.e. aerial and satellite) platforms. Examples of these are soil Electrical Conductivity (ECa)measuring instruments, crop reflectance imaging and crop quality sensors. Remote sensing used in realizing the technology have platforms with satellites, aircraft, balloons and helicopters, with a variety of sensors like the optical, near-infrared sensors and RADAR (Radio Detection and Ranging) fitted on these platforms for its uses. Analytical information obtained from the images downloaded from these on-board sensors, like the biomass, Leaf Area Index (LAI), disease, water stress and lodging, can now effectively assist in crop management, yield prediction, safe/accurate application of agrochemicals and environmental protection and safety (Zhang and Kovacs, 2012). The cycle of obtaining high resolution images involves the use of a low-cost multi hi-resolution imagery sensor mounted on a mobile ground receiving station and analysis centre with internet based georeferencing and GIS processing. The electromagnetic (EM) scans are used in identifying the different soil types, and the layer of images or data obtained are used to create variable rate seed maps for improving crop production. Farm equipment like tractors use auto-steer systems with the information available.

Summary of Agriculture Drones Versus Manual Workforce/Machineries

- Given maximised precision and flexibility for unmanned aerial vehicle procedures, airboard agro offers a better value proposition than conventional treatment.
- Even more so, airboard agro activity is most efficient in fields that are often surrounded by obstacles such as trees, telephone lines, farm buildings, mountainous, steep fields, fruitage that are grown in swamps (e.g. Cranberries), fruits trees and palms.
- Adopting crop analysis tools from airborne imagery allows to further scale down the substance dosing, increases harvest and result in a higher output per acre and lower financial investment.
- Compared to manual treatment, airboard agro is 50 times faster than hand labour, and dramatically reducing the cost of operations.

Conclusion and recommendation

Airboard agro is no doubt state-of-the-art world class agricultural technology useful for farmers of all scale. The large scale farmers could singlehandedly hire or purchase it. While the small scale farmers could form themselves into farmers' association or cooperative group and collectively employ the service of Airboard agro. Government in collaboration with relevant stakeholders should liaise with Airboard agro manufacturers and subsidise the price to make it affordable for resource poor farmers. This paper recognizes the importance of subsistence farmers to keep people busy eliminating social vices, insecurity and ensures food security. To carry out import substitution policy, the next level in Agriculture is aerial technology for precision agriculture : panacae for agrochemical spray in Nigeria.

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Plate 1 :Airboard agro
Source: Elviss, 2018

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Design, Fabrication and Testing of a Groundnut Stripping Machine

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Abstract
This research work focused on the design, fabrication and performance evaluation of a groundnut stripping machine which is powered by a petrol engine of 3hp. The research work was aimed at reducing cost, drudgery and time wastage involved in the stripping of groundnut pods. The machine consists of hopper, crushing unit, the blower unit, serve and petrol engine. The machine was fabricated from locally sourced materials, which makes it cheap and easily affordable and also easy and cheaper to maintain. All major parts were made of mild steel. The Test results showed that the machine has a capacity of stripping 328.6 kg of groundnut per hour with a stripping efficiency of 95.1 % and material recovery efficiency of 98.8 % using speed of 200 rpm and concave clearance of 3.5 cm. The stripping efficiency and machine capacity increases with increased in speed to a ultimate speed of 200 rpm and then decreases with further increase in speed to 500 rpm. While the recovery efficiency decreases with increase in speed. The developed machine would reduce time wastage and labour involve in manual stripping of groundnut, thus increasing production and utilization.

Keywords: Design, Clearance, Concave Fabricate, Groundnut, Stripper

introduction

Groundnut, also known as peanut is taxonomically classified as *Arachishypogaea* and typically, among the crop plants. It consists of a pod that develops underground and it is grown mainly for its edible seed (Karthik *et al.,* 2018). Its seeds contain high quality edible oil, easily digestible protein and carbohydrates (FAO, 2016). It is a major crop and is mainly grown in the northern part of Nigeria especially in the arid and semi-arid zone of Nigeria. It is either grown for its nut, oil or its vegetative residue (haulms) (Wijnands *et al.,* 2009).
According to Tarekegn, *et al.* (2007), groundnut are used in various forms, which include groundnut oil, roasted, and salted groundnut, boiled or raw groundnut or as paste popularly known as groundnut (or peanut) butter. The tender leaves are used in certain parts of West Africa as a vegetable in soups. Odoemelam (2005), reported that groundnut oil is the most important product of the crop, which is used for both domestic and industrial purposes. The oil obtained from groundnut is the cheapest and most extensively used vegetable oil in Nigeria. It is used mainly for cooking, for margarine and vegetable ghee, salads, for deep-frying, for shortening in pastries and bread, for pharmaceutical and cosmetic products, as a lubricant and emulsion for insecticides and as a fuel for diesel engines. The groundnut like other agricultural product it most under goes various unit operations before it can be consumed. Some of these operations include; harvesting, stripping, drying, shelling, roasting among others. Stripping of groundnut is one of the basic operations that determine the quantity and quality of the final product. Basically, it is carried out using manual or mechanical means.
The traditional method of stripping groundnut pods is by removing by fingers or hitting bunches of nuts with rods. This method causes injuries to the fingers of the workers and product damage might be high during the process. Due to the improvement in agricultural mechanization and vast increase in the demand for groundnut arising from population increase, there is urgent need for machines that could ease the labour put

in making cultivation, harvest and processing of such crops and their likes. Several machines have been designed for stripping groundnut some of which include the design and fabrication of groundnut pods and shell stripper, a groundnut separator machine which runs with a robotic arm, a pedal operated groundnut stripper designed, drum type strippers, comb type strippers, pedal operated threshers (Karthik*et al.,* 2018). Most of these machines are imported which makes their spare parts not much available and are also expensive. For mechanization of agriculture in Nigeria to succeed, it must be based on indigenous designs, development and manufacture of most needed machines and equipment to ensure their sustainability to the crops as well as to the farmers' technical and financial capabilities'.It is therefore, important to encourage the use of strippers by utilizing the mechanized locally fabricated equipment to overcome the difficulties of handling large scale processing with manual methods. In this view, design of a machine that is capable of admitting the groundnut plants with the unstripped pods (not hand helded), having a high stripping efficiency, low percentage damage, low cost of production, high capacity and can be used on the farm (an on farm machine) is required. This will reduce labour efforts put in by farmers to process their harvest thereby increasing profit for the farmers since cost of transportation increases with increase in load.

Materials and methods

Materials selection: Mild steel (gauge 1.3 mm) materials were used for construction of component parts of the machine. A 50 x 50 mm angular iron was used for the construction of the machine frame in order to give a rigid support and ensure stability of the machine when in operation (Gana *et al*., 2017).

Machine description: The Machine was made up of the following components;

i. **Feeding chute or Hopper;** this is where the harvested groundnut is fed into the machine. It is like an inclined tray inclined at angle 30^{o} as shown in Plate 1. It was constructed using a mild steel sheet.

ii. **Shaft; t**he machine consists of stripping drum and blower shafts as shown in Figure 1. The former has a diameter of 3cm and it holds the stripping drum in place connected at both edges to the bearing while the later has a diameter of 2cm and holds the blower fans in place. It is connected to two bearings at the edges.

iii. Machine frame; this houses the whole machine and provide support, rigidity to the machine. An angle Iron of 50 x 50 mm dimension and mild steel were used in construction of the frame. It is shown in Figure 1 and Plate 1.

iv. Belt and pulley system; this is the machine part that transmits torque from the petrol engine to both the stripping and blower shafts by means of belt attached to both the petrol engine pulley and the shafts pulley.

v. **Stripping drum; t**his is made of flat mild steel bars and act as stripping mechanism to detach the groundnut pod from its plant and it is shown in Figure 1.

vi. Chaff parker; this draw out the chaff that has been separated **by the stripping drum. 70% of the major dirt attributed with stripping follows this chamber out of the machine.**

vii. **Sieve shaker;** this is a netted tray coupled with a cam shaft that vibrate as the cam rotates. The vibration action of the cam shakes and sieved out small sized dirt that follows the pod onto the tray it is shown in Figure 1..

viii. **Stripping drum casing;** this houses the stripping drum and also holds the stripped groundnut and feed chute in place.

ix. **Blower; the** blower rotates in a clockwise direction and blows out the dirt that falls along the blower path. It removes the lighter materials that the chaff parker left behind and it is shown in Figure 1..

x. **Concave sieve;** this consist of semicircular shaped rods linked together by flat bars with space between in order to allow the free passage of the pod and it is shown in Figure 1.

Working mode of the machine

The groundnut is fed to the machine stripping chamber through the hopper. It then moves to the stripping chamber where the groundnut pods were detached from the plant and stalk. This was achieved by rotational motion of the stripping drum. The separated stalk and other leaves materials moves to the end of the stripping drum case and the chaff parker, packed and discharge them out of the machine. The detached groundnut pod passed through the concave sieve and falls unto the sieve shaker. As the ground pod and some leaves materials falls, the blower produced vast of air which blow away the lighter leaves while the pod which are heavier falls unto the sieve shaker. In the sieve shaker the where remaining dirt and foreign materials are sieved out while the cleaned groundnut pod are discharged out of the machine.

Design analysis of machine components; Basic design analysis and calculations were carried out in order to determine and select materials of appropriate strength and sizes for the machine component parts.

Theoretical capacity of the machine: The theoretical capacity of the machine was determined to estimate the system capacity. This was done using the formular reported by Karthik et al. (2018), and is given as

$Q = A \times \rho \times V$. (1)

Where, Q is the capacity of the machine, A is area of the stripping drum (m^2), ρ is bulk density of groundnut (kg/m^3) and V is rate of travel of groundnut (m/s)

Determination of power required by the machine: The power required by the machine is a sum of power required to strip the groundnut and power required to drive the blower. It was computed from the equation given by Khurmi and Gupta (2005)

$$P_T = P_{SM} + P_B \quad (2)$$
$$P_{SM} = 2 \times \pi \times N_{SM} \times \tau_{SM}/60 \quad (3)$$
$$\tau_{SM} = F_{SM} \times r_{SM} \quad (4)$$
$$F_{SM} = M_{SM} \times r_{SM} \times \omega_{SM}^2 \quad (5)$$
$$\omega_{SM} = 2 \times \pi \times N_{SM}/60 \quad (6)$$
$$M_{SM} = (M_M + M_G + M_S + M_P) \quad (7)$$
$$P_B = 2 \times \pi \times N_B \times \tau_B/60 \quad (8)$$
$$\tau_B = F_B \times r_B \quad (9)$$
$$F_B = M_B \times r_B \times \omega_B^2 \quad (10)$$
$$\omega_B = 2 \times \pi \times N_B/60 \quad (11)$$
$$M_B = (M_{BB} + M_{BS} + M_{BP}) \quad (12)$$

where, P_T is total power required by the machine (watts), P_{SM} js the power required by the stripping mechanism (watts), P_B js the power required by the blower (watts), $F_{SM}$is the total force on stripping mechanism (N), $F_B$is the total force on blower (N), $\tau_{SM}$is the torque generated by the stripping mechanism (Nm), $\tau_B$is the torque generated by the blower (Nm), $M_{SM}$is total mass of the stripping mechanism, groundnut, shafts and the pulley (kg), $M_B$is total mass of the blower blades, blower shaft and the pulley (kg), $\omega_{SM}$is angular speed of the stripping mechanism (rpm), $\omega_B$is angular speed of the blower blades (rpm) M_M is the mass of the stripping mechanism (kg), M_G is mass of groundnut (kg), M_S is mass of shaft (kg), M_P is mass of the pulley (kg), M_{BB} is mass of the blower blades (kg), M_{BS} is mass of blower shaft (kg), M_{BP} is mass of the blower pulley (kg),g is acceleration due to gravity (9.81m/s^2), π is constant, r_{sm} radius of the stripping mechanism (m), r_B is radius of the blower (m), N = revolution per minute

Determination of length of belt

The length of the belt was calculated to be able to select the appropriate belt for the machine to function efficiently. This was obtained as reported by Khurmi and Gupta (2005)

$$L_b = \frac{\pi}{2}(D_1 + D_2) + 2x + \frac{D_1 - D_2}{4x} \quad (13)$$

Where, L_b is the belt length (m), D_1 is diameter of driving (motor) pulley (m), D_2 is diameter of driven (machine) pulley (m) and X center distance between pulleys (m)

Design of the central shaft

The diameter of the central shaft was computed using the equation reported by Khurmi and Gupta (2005)

$$d^3 = 16/\pi S_s \sqrt{(K_b M_b)^2 + (K_t M_t)^2} \quad (14)$$

Where, d is the expected diameter of the shaft (m), M_t *is* belt torque moment (Nm), M_b *is* bending moment (Nm), K_b *is* shock and fatigue factor applied to bending moment, K_t *is* shock and fatigue factor applied to torsional moment, S_S *is* permissible shear stress of the shaft

Torsional deflection of the shaft

Torsional deflection of the shaft is essential to know the angle of deviation of the shaft in degrees and to make sure this angle of deviation is at its minimum. It was determined as reported by Khurmi and Gupta (2005) and is given as

$\alpha = \frac{584\tau L}{D^4 G}$ (15)

where, α is angular shaft deflection (Degree), L is length of the shaft (m), G = modulus of elasticity of steel

Determination of Maximum Working Stress of the Shaft

This is done in order to know the strength of the shaft and it behavior under working condition. It is determined as reported by Khurmi and Gupta (2005) and is given as

$\sigma = \frac{16Ts}{\pi d^3}$ (16)

Where, is maximum permissible working stress, d is shaft diameter (m), Ts is torque of the shaft

Determination of groundnut Terminal Velocity

The terminal velocity was determined to be able to determine the possibility of separating the materials from each other in an air stream. To determine the terminal velocity of ground nut, the diameter of particle i.e. mass of chaff and mass of the particle must be known. The terminal velocity of the groundnut was determined as reported by Karamanev (1996)

$V_t = \left(\frac{2Mg}{C_d \rho_a A}\right)^{1/2}$ (17)

Where V_t is terminal velocity of particle (m/s), M is mass of particle (kg), g is gravitational acceleration (m/s) C_d is the drag coefficient of particle, ρ is the density of the air (kg/m^3), A is the projected area of the groundnut object (m^2)

Testing of the machine

The performance of the groundnut stripping machine was evaluated in accordance with procedures reported by Gana et al. (2017). The groundnut plant (Samnut 21) was purchased from farmer's farm at Garatu village the samples were cleaned and sorted to remove unwanted materials before weighing 240 kg to be used in the experiment. A set of experiments was carried out to investigate the effects of concave clearances and stripping speed on the stripping efficiency and mechanical damage of the machine. The values of speed used are speed of 150 rpm, 200 rpm, 350 rpm and 500 rpm while the values of concave sieve used are concave with clearances of 2cm, 3.5cm and 5cm. The experiment was carried out at the Department of Agricultural and Bioresources Engineering, Federal University of Technology Minna, Nigeria.

Design of experiments: The experiment was designed by varying the stripping speed at four levels of 150 rpm, 200 rpm, 350 rpm, and 500 rpm using a constant concave clearance. The concave clearance was also varied at three levels of 2 cm, 3.5 cm and 5 cm. Each of the experiment was reaped three times and the average values where used in the machine performance evaluation.

Determination of machine performance: The machine performance was determined based on stripping efficiency, damage and capacity.

3.2.1 Stripping efficiency: this was determined to know how effectively the machine strips the groundnut pod from the groundnut plant. It was calculated as reported by Karthik et al.(2018), and is given as

$E_S = \frac{M_S}{M_T} \times 100$ (18)

Where, E_S is the stripping efficiency (%),M_S is mass of the stripped groundnut (kg), M_T is the total mass of the groundnut on the plant (kg).

Material efficiency: this is the ratio of mass undamaged stripped groundnut to the total mass of stripped groundnut. It was determined as reported by Karthik et al. (2018), and is given as

$E_M = \frac{M_U}{M_U + M_D} \times 100$ (19)

Where, E_M is the material efficiency (%),M_U is mass of undamaged stripped groundnut (kg), M_D is the mass of the damaged groundnut (kg)

Results and Discussion

Stripping efficiency: The machine stripping efficiency ranged from 95.1 % to 22.2 %. The highest stripping efficiency of 95.1% was obtained at a speed of 200 rpm, using a concave clearance 3.5 cm and the lowest stripping efficiency of 22.2% was obtained at 500 rpm with concave clearance of 2.0cm. The highest efficiency

of 95.1% attained may be due to the enough clearance between the stripping drum and its housing, which is more than maximum thickness of groundnut pods (ranged from 2 to 3cm) used for the study.
From Figure 2, the stripping efficiency generally increases from speed of 150 rpm to 200 rpm and then decreased with further increase in speed up to speed of 500 rpm for all the concave clearance used. The initial increased could be as result more impact action of the drum on the plant stalk. This conforms to result of an earlier study on design, fabrication and testing of millet thresher by Gbabo *et al.* (2013) where high speed of rotation of the threshing drum resulted in more impact of beaters on the millet stalks. The further decreased in stripping efficiency with increase in speed from 200 rpm to 500 rpm could be as result of rapture of the pod due to the high impact force associated with the higher speed. Vejasit and Salokhe (2004), also reported that high rotor speed resulted to higher threshing efficiency but also results grain damage and loss due to its rapid and violent nature. However, this increased in rotor speeds reduced loss from the threshing system owing to the centrifugal force that released the grain from the pods through the mesh. Higher rotor speeds increase greater threshing efficiency since threshing violence results in better scouring.
Material Efficiency: The material (recovery) efficiency ranged from 99.6 % to 73.2 %. The highest material efficiency of 99.6 % was obtained at a speed of 150 rpm, using a concave clearance 5 cm and the lowest efficiency of 73.2% was obtained at 500 rpm with concave clearance of 2.0cm. The highest efficiency of 99.6 % attained may be due to the enough clearance between the stripping drum and its housing, which is more than maximum thickness of groundnut pods (ranged from 2 to 3cm) used for the study. Also could be as result of lower impact force associated with the low speed of 150 rpm.From Figure 3, the material recovery efficiency generally decreases with increase in speed of stripping from 150 rpm to 500 rpm. With concave clearance of 5 cm, the efficiency decreases from 99.6 % to 94 %, from 99.5 to 93 % and 90 to 73 %, respectively, for concave clearances of 3.5 cm and 2 cm. It was obvious that there is no any significant difference between concave clearance of 3.5 cm and 5 cm with respect to material recovery. This could be as result of enough space with the clearances that permit the groundnut put to pass without much resistance.The decrease in material recovery efficiency with increase in speed could be as result of breakage and rapture of the pod due to the high impact force associated with the higher speed. Similar trend was reported by Alwan-Alsharifi (2018), where increased in speed of threshing cylinder led to increase the cracked maize grains percentage. Askari and Abbaspour-Gilandeh (2008), reported that during threshing of paddy using a head-feeding type thresher unit, percentage of damaged grains increased with increasing threshing drum speed.
Machine Capacity: The machine capacity ranged from 124.3 kg/hr to 328.6 kg/hr. The highest capacity of 328.6 kg/hr was obtained at a speed of 200 rpm, using a concave clearance 3.5 cm and the lowest capacity of 124.3 kg/hr was obtained at 150 rpm with concave clearance of 2.0cm. The highest capacity of 328.6 kg/hr attained may be due to the moderate impact associated with the speed of 200 rpm and also enough space for the stripped groundnut pod to pass without obstruction.
As presented in Figure 4, the machine capacity in general increases with increase in speed of stripping from 150 rpm to 200 rpm and then decreased with further increase in speed to 500 rpm. With concave clearance of 5 cm, the capacity increases from 124.3 kg/hr to 240.9 kg/hr and then decrease 209.6 kg/hr with further increase in speed. Then for concave clearance of 3.5 it increases from 255.8 kg/hr with speed of 150 rpm to 328.6 kg/hr with speed of 200 rpm and then decreased to 304.5 kg/hr with further increase in speed to 500 rpm. The trend is similar with concave clearance of 5 cm, the capacity increases from 165.2 kg/hr with speed of 150 rpm to 266.7 kg/hr with speed of 200 rpm and then decreased to 241.4 kg/hr with further increase in speed to 500 rpm. Biaou Olaye *et al.* (2016), reported that the threshing capacity of a thresher increased by increasing the cylinder speed and decreased by decreasing the concave clearance of the threshing chamber

Conclusions

The speeds of stripping and concave clearance were found to have significant effects on stripping efficiency and material recovery. The recovery efficiency decreases with increase in speed and reduction in concave clearance while the stripping efficiency and machine capacity both increases with increase in speed and concave clearance proportionate to the size of the groundnut pod. Speed of 200 rpm and concave clearance of 3.5 cm produced the best stripping efficiency and material recovery of 95.1 % and 98.8 % respectively. The development of this machine would increase production and utilization.

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Plate 1: The Developed Groundnut Stripping Machine

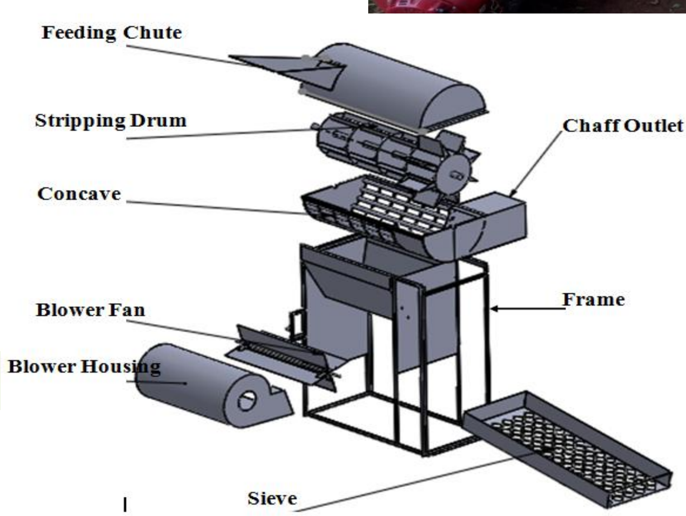

Figure 1: The Exploded View of the Machine

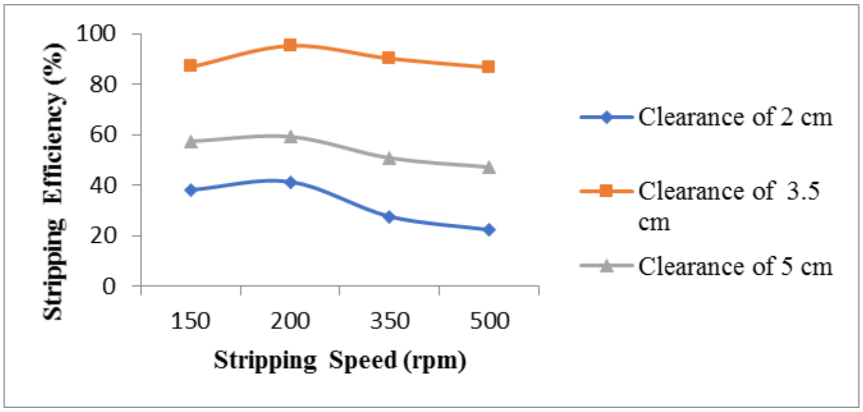

Figure 2: Effects of Stripping Speed and Concave Clearance on Stripping Efficiency of the Machine

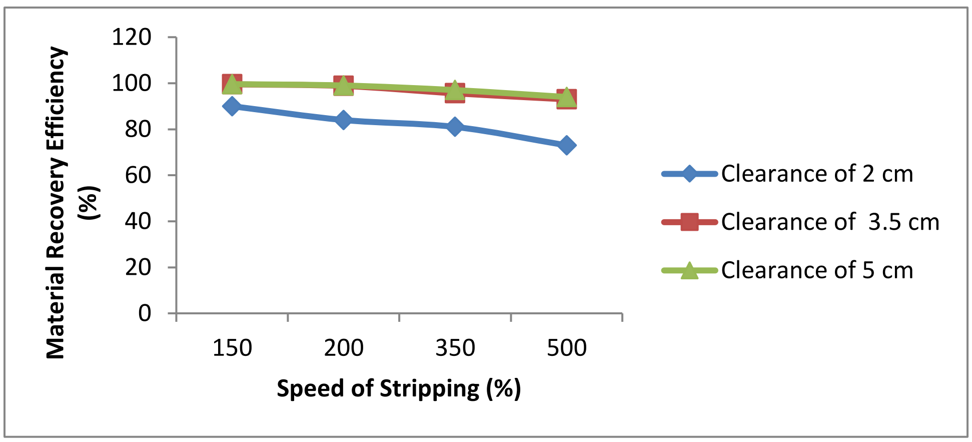

Figure 3: Effects of Stripping Speed and Concave Clearance on Material Recovery Efficiency of the Machine

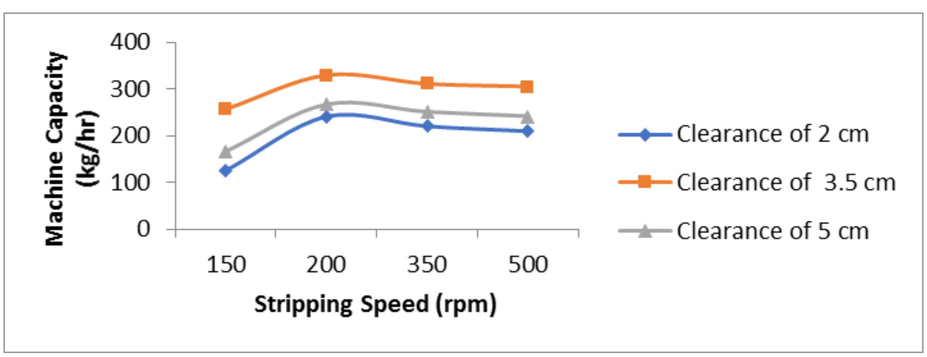

Figure 4: Effects of Stripping Speed and Concave Clearance on Machine Capacity

ASN 53rd Annual Conference Proceedings (Sub-Theme: Agricultural Engineering, Processing & Value Addition)

Determination and Control of pH and ammonia levels in concrete tank used for rearing of black tiger shrimp (*penaeus monodon*)

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Abstract
Determination of pH and ammonia levels and measures of control of Black Tiger shrimp (*Pannaeus monodon*) reared in concrete tank were carried out. Extruded floating feed containing 42% crude protein was used to feed the shrimp. The results obtained indicate pH ranged from 7.00 – 7.86 for five months study period while ammonia ranged from 0 – 3.00mg/L. pH levels were within the normal range while ammonia were high. Regular flushing of the tank, washing of feeding tray and introduction of treated filtered seawater reduced the ammonia level.

Keywords: ammonia, pH, control, black tiger shrimp, culture, concrete tank

INTRODUCTION

Water quality directly affects the health and growth of cultured aquatic organisms. Good water quality is very important and must meet the essential environmental needs of the organism to be cultured. Regular monitoring of water quality variables are very essential, for successful aquaculture, because poor water quality leads to stress, disease and death of the organism that is being cultured (Boyd, 1989.).
Black Tiger shrimp (*Penaeus. monodon*) is the most popular shrimp species in Southeast Asian countries. It is the most widely cultured shrimp accounting for 58% of global shrimp production (Chen, 1990, Rosenberry, 1998). Ayinla*et al*, (2009) reported *P. monodon* was not the native of West African region. But accidentally introduced into the Gulf of Guinea and has become well established in the coastal waters of Nigeria as result berried females catched by fishing trawlers and local fishermen all year round. Shrimps constitute the leading priced seafood on the global menu (Zabbey, 2007). The rate of consumption of shrimp is increasing in the developed world especially in US, Europe and Japan, and correlates positively with economic growth (Zabbey, 2008).

Ammonia is a major byproduct of protein metabolism, excreted through the gills of the shrimp. The feed ingested by the shrimp is proteineous which was assimilated and metabolized into waste products as ammonia-

Ammonia levels in the culture tank must be carefully managed because ammonia can be highly toxic to the shrimp. Ammonia exists in two different forms in the water as unionized ammonia

(NH_3) and as ionized ammonium ions (NH_4^+) simultaneously in the water and are transformed from one formed to another in equilibrium reaction. . $NH_3 + H_20 \leftrightarrow NH4^+ \; + \; 0H$

Unionised form of ammonia is toxic to the shrimp. The toxicity of ammonia is partly a function of shrimp age. Post larvae and small juveniles are less tolerant of high concentrations of unionized ammonia levels than larger juveniles and adult (Chen and Lei, 1990).

pH is the measure of the hydrogen ion (H^+) concentration. It is the degree to which water is either basic or acidic. Low (< 5) and high levels (> 10) of pH is harmful to shrimp and growth rate will be suppressed. The pH of water is strongly influenced by both respiration and photosynthesis. As a result of respiration carbon dioxide is released into the water. Dissolved carbon dioxide combines with water to form carbonic acid. During the day photosynthesis consumes carbon dioxide causing the pH to rise. During the night respiration releases carbon dioxide into the water causing the pH to fall. The desirable range of pH for shrimp culture is 7.0 – 9.0 (Peter and John, 2003).

This study was designed to determine the levels of pH and ammonia in concrete tank used for the culture of Black Tiger shrimp (*Penaeus monodon*) and the measures undertaken.

Materials and methods

Preparation of concrete tank: The study was carried out in concrete tank measuring 5.3x2.5x1.15m dimension belonging to the Nigerian Institute for Oceanography and Marine Research (NIOMR), Victoria Island, Lagos. The tank was washed and painted with epoxy paint to provide smooth interior surface. Rows of PVC perforated pipes were laid on the tank bottom to serve as water air-lift aeration system and then covered with layer granite followed by a layer of marine sharp sand. Hydrated lime was used to treat the sand in order to kill unwanted organisms. Sea water were treated and filtered into the tank with constant aeration. Mosquito nets were constructed with PVC pipe as shelters and installed inside the tanks to provide hiding areas for molted shrimps. Three feeding trays were also installed inside the tanks for monitoring shrimp feeding behavior.

Stocking and feeding: Post larvae of *P. monodon* reared in the concrete tank were collected from NIOMR shrimp hatchery. A total of 264 post larvae at size PL_{30} were stocked in the concrete tank at a density of 26 post larvae (PL_{30}) /m^2 for table shrimp production. The mean body weight at stocking was 1.763±0.647g while the total length was 5.8±1.0cm. The shrimp larvae were fed with 0.8-1.2mm imported extruded COPPENS feed twice daily at 3% body weight. The amount of feed given was adjusted every two weeks.

Water quality monitoring: Water quality of the tanks was monitored everyday during the culture period from May to September. The pH was monitored with the use of portable temperature/pH-009 (111) ATC meter while ammonia was monitored using LaMotte water test kit.

Results and discussions

The values of ammonia and pH obtained from the rearing tanks for five months are presented in Table1. The measures undertaken to control these water quality parameters are also indicated. For May pH ranged from 7.18 to 7.69 while ammonia ranged from 0.10 to 0.80mg/L. In June pH ranged from 7.18 to 7.47 while ammonia ranged from 0.2 to 1.0mg/L. In July pH ranged from 7.02 to 7.40 while ammonia ranged from 0 to 0.8mg/L. pH ranged from 7.00 to 7.55 while ammonia ranged from 0 to 3.0 in August. pH ranged from 7.05 to 7.86 while ammonia ranged from 0.2 to 3.0mg/L and in September pH levels were within the normal range while ammonia levels were high and fluctuated greatly. The results are presented in Table 1.

There is increase in the culture of shrimp due to its taste, market demand both national and the international market Pushparajan and Soundarapandian, (2010). The maintenance of good water quality is essential for optimal growth and survival of shrimps. In many countries where shrimps are farmed, intensive control of the levels of pH and ammonia concentration is essential for quality shrimp production Konghen, (1997).

Hence, critical water quality parameters are to be monitored carefully as it can have adverse effect on the growing of shrimps (Ramanathan*et al*, (2005). Ramakrisnareddy, (2000) recommended pH of 7.5 to 8.5 for *P. monodon* culture. Also Boyd, (2001) recommended acceptable range from 7.0 to 9.0 for shrimp culture. In the present study pH was ranged from 7.00 – 7.86 and was within the recommended range. pH of pond water is influenced by many factors, including source of waters, acidity of bottom soil, shrimp culture inputs and biological activity. The most common cause of low water pH is acidic bottom soil. Liming can be used to reduce soil acidity. The most common cause of high pH is high rate of photosynthesis by dense phytoplankton blooms. When pH is high, water exchange will be of better measure and control (Boyd, 2001). The purpose of water exchange is to maintain water quality and also to stimulate molting of the shrimp resulting in accelerated growth and production (Soundarapandian and Gunalam, 2008).

Ammonia levels in the culture tank must be carefully managed because ammonia can be highly toxic to the shrimp. The 96-hr LC50 concentration of unionized ammonia is about 0.2mg/L for post larvae (Chen and Chin, 1988) and about 0.95mg/L for 4.87 gram for juveniles (Chen and Lei, 1990). Ammonia obtained in this study was higher than the values (0.002 to 0.250mg/L) by Das *et al*, (1996) in rearing tank. Jayasankar and Muthu (1983) suggested a safe level of 1.2mg/L for ammonia. Ammonia increases in rearing tank due to decay of organic matter resulting from and removal of an amino group excreted by aquatic animals (Spotte, 1979).

Conclusion

A major control of ammonia and pH levels in this study was weekly flushing of tank and replenished with treated filtered seawater which lowered ammonia levels below 0.1mg/L in July contrary to higher of 0.2 – 3.0mg/L obtained for September. High levels of ammonia occurred in the tank usually when there is algae bloom and molting of the shrimp observed. Constant flushing and refreshing of the tank with treated filtered seawater kept the ammonia low which is an important tool for control of water quality in the concrete tank for faster growth of the shrimp.

Acknowledgement

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Table 1: pH and ammonia levels in the concrete tank

Month	pH		Ammonia (mg/L)		Measure taken to control water quality
	Mean ±SD	Range	Mean ±SD	Range	
May	7.40±0.14	7.18-7.69	0.21±0.31	0.1-0.8	Water was drained and tank walls washed. Tank refilled with filtered seawater.
June	7.30±0.07	7.18-7.47	0.30±0.67	0.2-1.0	Partial flushing of tank for 3 days. Gradual refreshing with filtered seawater.
July	7.18±0.08	7.02-7.40	0.24±0.23	0-0.8	Draining of water from the tank. Removal of feeding tray from the tank. Removal of shelter provided for hiding of molted shrimps was washed, rinse with saline salt and rinse with seawater. The tank was refilled with filtered seawater.
August	7.17±0.10	7.00-7.55	0.26±0.99	0-3.0	Water was drained. Tank wall was washed and replenished with filtered seawater.
September	7.38±0.19	7.05-7.86	0.27±0.91	0.2-3.0	Continuous flushing of tank and replenished with filtered seawater.

ASN 53rd Annual Conference Proceedings (Sub-Theme: Agricultural Engineering, Processing & Value Addition)

Determination of Aflatoxin B1 content of Maize, Millet and Sorghum collected from Bida and Lavun Local Government Areas of Niger State, Nigeria.

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Abstract
In this study Samples of maize, millet and sorghum were collected from Bida and Lavun local government areas (LGAs) of Niger state. In the laboratory the samples were pulverized and, AflatoxinB1 was extracted using a solvent/solvent separation and column chromatography for purification. Thin layer chromatographic method was used to estimate the aflatoxinB1 by fluorescence intensity of standard spot using UV chromatoview cabinet at 360nm. From samples collected from Bida Local Government Area, Aflatoxin B1 was detected at the concentration of 13.50µg/kg, 6.80µg/kg and 13.50µg/kg, for Maize, Millet and Sorghum respectively. Whereas, in that of Lavun Local Government Area, Aflatoxin B1 was detected in the samples collected at the concentration of 67.50µg/kg, 6.80µg/kg and 13.50µg/kg, for Maize, Millet and Sorghum respectively. From the results of this study it can be deduced that the concentration of aflatoxin B1 is present at low concentration in all samples from both Bida and Lavun except that its presence in maize from lavun is very high. Therefore, the products except maize from Lavun LGA are safe for consumption by human beings, livestock and international market

Keywords: aflatoxin, fungi, cereals, Chromatographic methods

Introduction

Most mycotoxins in feed and food are produced by three genera of fungi: *Aspergillus*, *Penicillium* and *Fusarium* (CAST, 2003). Aflatoxins (AFs) B1, B2, G1 and G2 are natural substituted coumarone produced by *Aspergillusflavus*, *Aspergillus nomius* and *Aspergillus parasiticus*, which can be found onfoodstuffs supporting fungal growth, such ascereals, dried fruits, oil seeds, spices, andpulses (Leitao, 1988). Aflatoxins have immunotoxic,mutagenic and carcinogenic effects,and they were classified as group1 carcinogenesby the International Agency for researchof Cancer (IARC, 1993). Aflatoxin B1 is the most frequently encounteredof the group and the most toxic (Ghali *et al.*,2008). The best protection against aflatoxins is monitoring their presence in feeds and foods. Since aflatoxins can cause serious problems with human health like Liver diseases (hepatotoxic, hepatocarcinogenic), carcinogenic and teratogenic effects, haemorrhages (kidneys), immune suppression and so on, therefore the maximum tolerated levels of aflatoxins in food products have been established in many countries.

Materials and Methods

Samples were collected from the major markets in Lavun Local Government area, which are kutigi and batati town markets. In the case of Bida LGA samples were collected from usman zaki (old) and umaru majigi (small) markets. Small quantities about 300gm from five sellers were purchased and pulled together to make about 2kg and was taken to the laboratory.

Extraction: The samples were milled, 50g of ground samples were weighed, 25ml of 0.1MH_3PO_4 was added followed by 250ml of CH_2Cl_2 and were shake for 30mins at speed of 300m/s using wrist action shaker. After shaking, the samples were then filtered through fast filter paper. The filtrates were finally transferred to a 250ml round bottom flask each and covered using flask cork cover. 50ml of each of the filtrate were used for aflatoxin B1 analysis.

AflatoxinB1 analysis: A column with glass wool and beaker were set up on retort stand. 120ml of methylene chloride (CH_2Cl_2) was poured into the column, which was then empty half (½) way of the column, three(3) spatula of anhydrous sodium sulphate (Na2SO4)was added to the column with which it was washed side way with methylene chloride (CH_2Cl_2).Half (½)of the remaining methylene chloride (CH_2Cl_2) was drained. Silica gel was added to the column followed by 80ml of methylene chloride (CH_2Cl_2) which was allowed to settle and emptied half (½)way. Three (3) spatula of anhydrous sodium sulphate (Na2SO4) was added to the column, and the remaining (CH_2Cl_2) was drained to the top of the column. 50ml of the filtrate sample was added to the column, which was drained to the top of the column, followed by 100ml of hexane (C6H12) was added and drained. Subsequently, 100ml of ether was added and drained. New round bottom flask placed under the column with which 100ml of ether /methanol /H_2O (96:3:1) was added and collected from the column. The collected filtrate from the column was evaporated to near dryness in rotatory evaporator at temperature of 45^0c. 100 micro liter of CH_2Cl_2 was pipetted into the remaining evaporated solution in the round bottom flask and pipetted into glass vial; this was then placed on the hot plate and dried. The dried extract was stored in deep freezer refrigerator. The deep freezer refrigerated aflatoxin extract in vials was diluted in 200µl benzene/acetonitrile (98:2). 5µl of each extract along with 3µl + 3µl of standard were spotted on TLC glass coated plate, also 2-10µl of standard (10µg/100ml) were spotted on TLC plate and the plate was developed in ether/methanol /water (96:3:1) solution for about 30 minutes. This was removed and placed on working bench for air drying, after drying it was inserted in TLC machine in order to compare the color of sample spotted with the standard. Finally, it was viewed under UV light at 375nm wavelength and results were recorded.

Results and Discussion

In this present research study, 3 samples (maize, millet and sorghum) of cereal products from Usman Zaki (Old) and Umaru Magiji (Small) market of Bida LGA, and that of Kutigi and Batati town markets of Lavun LGA, were analyzed and the concentration and occurrence level of AFB1 are represented in table 6 below. The screened aflatoxin B1 was evaluated using Thin Layer Chromatography (TLC) and viewed with chromatoview under UV light at 375nm wavelength.

Conclusion

Aflatoxins are not only a big problem at crop production level, but also it has become a global health issue because of the consequences that the consumption of this toxin generates in animals and human beings. Efforts to reduce aflatoxin exposure require the commitment of sufficient resources and the collaboration between the agriculture and public health communities as well as local, regional, national, and international governments.

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Table 6: Shows the result of aflatoxin B1 concentration in maize, millet and sorghum from Bida and Lavun LGA's.

Local Government	Maize (µg/kg)	Millet (µg/kg)	Sorghum (µg/kg)
Bida	13.50	6.80	13.50
Lavun	67.50	6.80	13.50

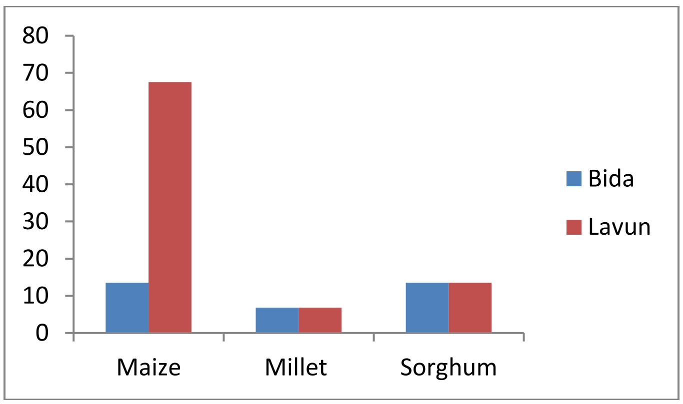

Fig 1: **Shows the comparative prevalence of aflatoxin B1 concentration between Bida and Lavun LGA's**

ASN 53rd Annual Conference Proceedings (Sub-Theme: Agricultural Engineering, Processing & Value Addition)

Development of a Manual Weeder

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Abstract
Weeding and hoeing is generally done 15 to 20 days after sowing. The weed should be controlled and eliminated at their early stage. Depending upon the weed density, 20 to 30 percent loss in grain yield is quite usual which might increase up to 80 per cent if adequate crop management practice is not observed. the primary objective of row crop cultivation is to enhance the use of farm machinery for eliminating weeds from the crop land. The effect of this method is to promote plant growth and better-quality crops. However, in Nigeria the use of such machine is not common and the availability of a mechanical weeder is scarce. In order to complete weeding operation within available period of time, farmers have to engage more labour and hence it leads to labour scarcity and increased cost. Mechanical weeding keeps the soil surface loose, which results in better aeration and moisture conservation. hence mechanical weeder is necessary to reduce the labour force. Environmental degradation and pollution caused by chemical is reduced by the use of Mechanical weeder.It is on this background that a manually operated weeder was designed, fabricated and evaluated for its performance, the results show that the average traveling speed, field capacity, average weeding efficiency, were found to be 0.3m/sec, 0.02 ha/h, 90.14 % respectively

Keywords: Manual, Weeder, Design, Speed, field, Capacity

Introduction

Weed control is one of the most expensive field operations in crop production. Indeed, the detrimental effects of weeds in agriculture in developing countries far exceed those of all crop pests. Njoku (1996) and Satish*et al*. (2017) reported that uncontrolled weeds growth reduces yield of the principal crops while untimely weeding reduces the returns from the overall investments in the production of crops. Timeliness rather than frequency of weeding is a major determinant of effective weed control (Igbeka, 1984). Yadav and pund(2007) also reported that biological control of weeds includes the use of cover crops and leguminous which are grown in association with the crops. The cover crops creep on the land to cover the soil, thereby preventing development of weeds by chocking them out. The use of mucuna mulch can be used as an effective supplement with mechanical weed control. The effectiveness of supplementing mucuna mulching weed control must be considered with appropriate hand-pulling of weed using a special V-shaped hoe and mowing weeds with about a 2-kW engine mower. Kepner *et al.,* (1978) claimed that mechanical method of weed control is the best with little or no limitation because of its effectiveness. According to Kepner *et al.,* (1978) and Buckingham (1976), the primary objective of row crop cultivation is to enhance the use of farm machinery for eliminating weeds from the crop land. The effect of this method is to promote plant growth and better-quality crops. However, in Nigeria the use of such machine is not common and the availability of a mechanical weeder is scarce. In order to complete weeding operation within available period of time, farmers have to engage more labour and hence it leads to labour scarcity and increased cost. Mechanical weeding keeps the soil surface loose, which results in better aeration and moisture conservation. Weeding with the use of tools like cutlass and hoe requires high labour force in a commercial farming system hence mechanical weeder is necessary to reduce the labour force. Environmental degradation and pollution caused by chemical is reduced by the use of Mechanical weeder. Low effective operation, low work effort and high time requirement for different types of hoe or cutlass, can be overcome with the use of mechanical weeder (Quadri, 2010). Delay and negligence in weeding operation affect the crop yield up to 30 to 60 per cent (Singh, 1988). To increase the productivity per unit area of small land holdings and considering the economic condition of rural farmers, it is quite necessary to have suitable agricultural implements which farmers can use and also allow them to use for hiring Although works had been done on tractor operated weeding implements but these implements are costly and for large fields. Moreover, the farmers have fragmented small farm lands scattered all over for agriculture which make it difficult to use tractor operated weeder. Therefore there was need for development of such type of weeding implement suitable for small fields. The objective of this research work was to design, fabricate and test the performance of a manually operated weeder.

Materials and methods

Machine Description: The major components of the manual weeder as shown on figures 1 and 2 were the Ground wheel, the weeding blade, the prongs/Rake and the headpiece/Handle.

The ground wheel: The ground wheel of the weeder was made of bicycle wheel mild steel of 350 mm diameter and it has a hub (16 mm Φ) made from mild steel placed at the cetre of the wheel the spokes were provided for attaching the hub in the center of the wheel.

The weeding blade: The weeding blades were made from 250 x 20 mm mild steel flats because it is strong enough to overcome weed and soil resistances as well as to carry the load of the implement. The blades were sharpened at the lower end so that it can penetrate into the soilat proper angle and at desired depth during weeding.

The prongs/Rake It is made of mild steel rod , with 20 cm long and 8 numbers of fingers are present. It is used to break up soil and separate the weed from the soil which prevents the weeds from regaminating.

The headpiece. Handle was fabricated from two mild steel pipe of 320 mm in length and 20 mm diameter having an angle of 1600 to each other. The height of handle at an angle of 370 with horizontal was 955 mm. The height and angle can be adjusted as per the need of the operator to suit his posture.

design requirements: Physical and operational characteristics Safety: It provides safety to users, Life in service: The product will last approximately long duration, Ergonomics: Easy to operate by everyone, of all physique conveniently, Weight: The product must less in weight, Materials: The material used is mild steel.

Design Analysis: Relevant theories and engineering principles were followed in designing the weeder, these include: ground wheel, cutting depth, blade width travel speed and draft, were considered to obtain appropriate draught.

Design calculation: The following design calculations were carried out during the process of design

Ground wheel:

Diameter of ground wheel = 350 mm

Radius of ground wheel = 175mm

Circumference of ground wheel = 2πr = 2×3.14×17.5 = 138.16 cm

Thickness of ground wheel spokes = 3 mm Distance between two spokes = 4.7 cm

Thickness ground wheel = 3 mm

Width of ground wheel = 32 mm

Blade: Length of the blade = 280 mm

Width of blade = 25 mm

Thickness of blade = 25mm

The field capacity

The field capacity of the weeder (ha/h) was calculated by using
the area of 3 (3m x 3 m).

Draft

The draft required by the weeder was calculated by using the equation 1

D = W x dw x Rs (1)

Where, D – Draft of a weeder, (kg)

W- Width of cut, (cm)
dw – Depth of cut, (cm)
Rs – Soil resistance, (kg/cm2)

Power Requirement

The power required to operate the machine was calculated using equation 2

Power (hp) = (D x S) / 75 (2)

Where, D = Draft, kg
S = Travelling speed, m/sec

Weeding Efficiency

This was calculated using equation.3

e = { (W1 – W2) / W1 } x 100 (3)

Where, e = Weeding efficiency, %
W1 = Count of weeds between two rows before weeding.
W2 = Count of weeds between two rows after weeding

% Plant Damage: The percentage plant damage during field operation was calculated from Equation.

% Plant Damage = { 1 - (q / p)} x 100 (4)

Where, q = Number of plants in a 10 m row length after weeding
p =+ Number of plants in a 3 m row length before weeding

Performance Index

The performance of the weeder was assessed through performance index with the help of equation suggested by Gupta (1981).

P.I. = (A x E x R) / P (5)

Where, PI = Performance Index
A = Field Capacity of weeder, ha/hr
E = Weeding efficiency, per cent
R = Plant damage, per cent
P = Power input, HP

Mode of Operation

The weeder is pushed by an operator between crops planted on flat land within minimum spacing of 25 cm. The operator produces the power for both driving the hoe and maneuvering the weeder by exerting his force on the handle. The consequent action of the force on the hoe causes earthlings-up, lifting and removal of the weeds.

Results and Discussion

Results: the results of performance evaluation of the weeder is presented in table 1

Discussion of results: The weeding test was performed on the sugar cane farm of National Cereals Research Institute, Badeggi. The test started 45 days after the previous weeding operation row-to-row spacing of 700 mm. The average moisture content of the soil was 10 % at the time of testing. The average plant population per square meter area was 4 and average height of plant was 40 cm.

Five readings of travel speed were taken and average travel speed was calculated and used in the study. The average traveling speed was found to be 0.3m/sec. During testing it was observed that the traveling speed also depends on the parameters such as weight of the operator, height of the operator and physical condition of the operator. Therefore, to avoid the error in result analysis the subjects of more or less equal weight and anthropometry were selected for the study. The developed weeder was found easy to operate at the speed of 0.3 m/s. The field capacity of the developed weeder was calculated by selecting three sample plots of size 3m x 3 m. The field capacity of the developed weeder was found out to be 0.02 ha/h, which was higher than the already available manual weeders. The probable reason behind this may be the 28 cm width of weeder, which was not so with the available manuall weeders. It was also observed that if the effective cutting width is reduced, the field capacity is also reduced. The average weeding efficiency for the developed weeder was found to be 90.14 %, which shows that the weeder is efficient. It was observed that the weeding efficiency depends on the root zone depth of weeds, shape of blades, moisture content of the soil at testing site and cutting depth of the weeder blade. Draft is an important parameter in the development of weeder and it must be within the physical limits of the operator. The average draft required for weeding was found to be 35.00kg.

However, maximum pushing force for average man agricultural work ranges from 25 to 30 kg (Gite and Yadav, 1985). Though, the draft for developed weeder is higher but it was comfortable in operation because the operators selected for the study were tall and strong enough. However, it was observed that the draft depends on the type of soil, effective cutting width and depth of cut. In manually operated weeders the tool works in a shallow depth so the soil resistance has a little impact on the draft requirement of the tool.
The average power requirement for the weeder was estimated to be 0.17 hp, which is higher by 50 % because of the higher width of cut. Further, it was concluded that if one want to reduce the power requirement, reduction in effective width of cut is needed which subsequently reduces the field capacity of the weeder. The performance index for the developed weeder was found out to be 2468.7 (Table 1). It was observed that the developed weeder was not only suitable for groundnut crop but it could also be used for other crops as row spacing isgreater than 25 cm. The angle of penetration of blades can be changed as per the requirement.

Conclusion
The weeding efficiency of the developed weeder was found to be satisfactory and it is easy to operate. The developed weeder could work up to 3.00 cm depth with field efficiency of 0.02 ha/hr and higher weeding efficiency was obtained upto 90.14 %.

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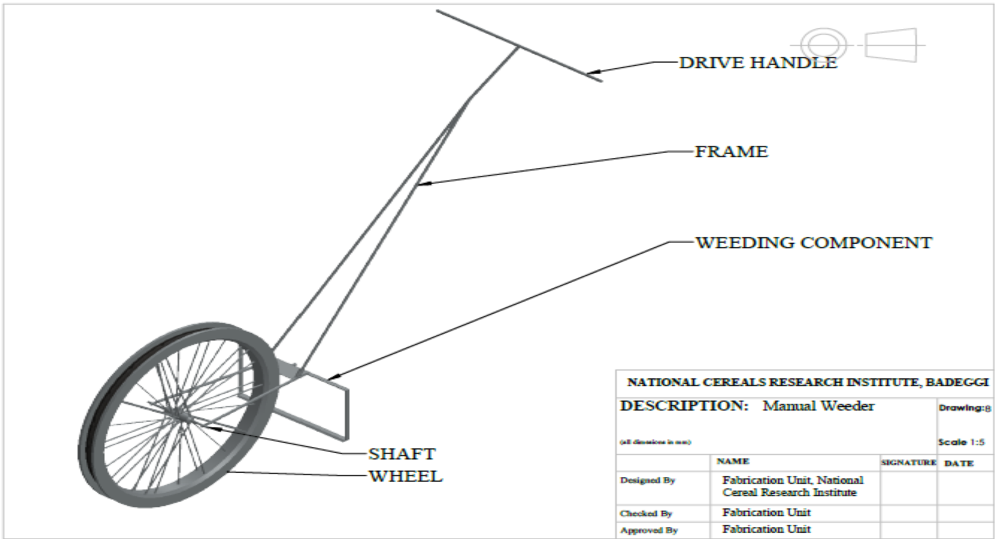

Fig 1: isometric view of manual weeder

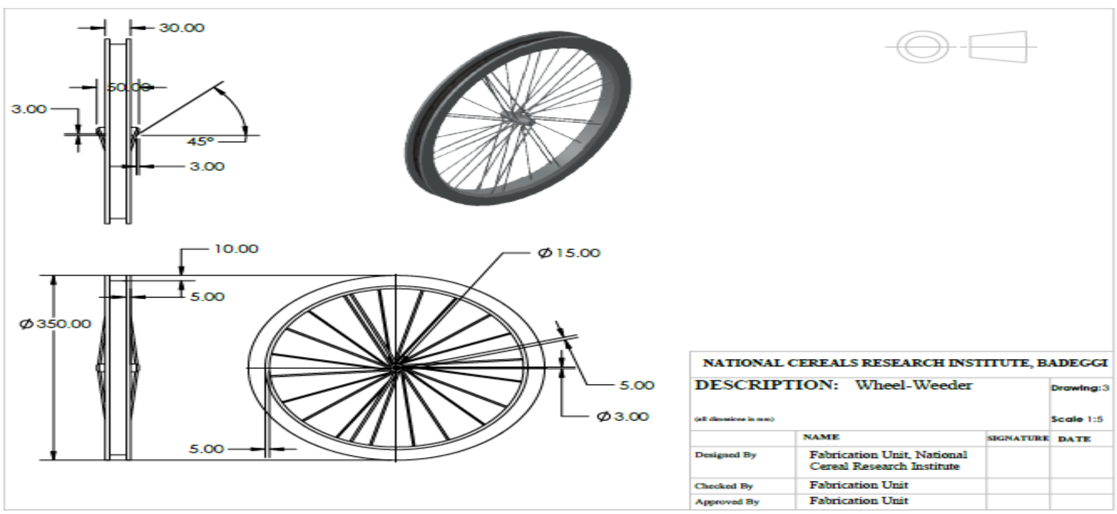

Fig2: Component part of maual weeder

Table 1:results of the performance evaluation of the weeder

s/no	Parameter	Designed value	Actual value
1	Width of cut	28 cm	28.5cm
2	Depth of weeding	2.5 cm	2.5 cm
3	Draft	30.50 kg	35.00 kg
4	Power requirement	0.12 hp	0.15 hp
5	% Plant damage	-	-
6	Performance Index	2468.7	2468.7
7	Travelling speed	03m/s	03m/s

Effects of some processing methods on Chemical properties of Groundnut (*Arachis hypogea*) Oil Extract

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Abstract
The effect of some processing methods on physicochemical properties of oil Extract of Groundnut (*Arachis hypogea*) was investigated. Before expression of the oil, the groundnut was subjected to five different treatments ranging from Boiling, Soaking, Roasting, Boiling/Roasting, Soaking/Roasting and using the raw groundnut as control. The different processing method had significant (p<0.05) effect on all parameters measured. Roasted samples (roasted, soaked/roasted boiled/roasted) had the highest acid value (6.59.mg/KOH/g, 6.9577mg/KOH/g and 6.70 77mg/KOH/g). While Soaked and Boiled samples had higher respective saponification values (203.37mg/KOH/g and 204.77mg/KOH/g), peroxide had low values of (2.40meq/g, 2.50meq/g) for boiled /roasted and Raw/ roasted samples respectively. All of these have implications in the degree of saturation of the oil.

Introduction
Nigeria is blessed with many oil bearing seeds from which variety of vegetable oils, fat and other related products can be produced. Groundnut is one of the most important of these seed from which groundnut oil is produced. Groundnut (*Arachis hypogea*) is regarded as one of the most important legumes, protein rich and it occupies the fifth position as oil seed crop globally after soybean, cotton seed rapeseed, and sunflower seed (El-sayed *et al*., 2001) Vegetable *oils are* widely consumed domestically in Nigeria. It is used primarily as a cooking and salad oil. According to codex (2005) edible vegetable oils are, "food stuffs which are composed primarily of glycerides of fatty acids being obtained from vegetable sources.Fats and oil whether the source is animal, vegetable or marine in origin represent the highest source of energy per unit weight that man can consume. Apart from being source of reserved energy, fats deposit insulate the body against loss of heat (Dawodu, 2009) .They are important food source for man and are also extensively used for nutritional, cosmetic and industrial purposes.

Materials and Methods
Source of raw material: The groundnut seed (kampala spp) used in the study were purchased from Kure ultra-modern market Minna, Niger state.
Preparation of the groundnut flour: The groundnut seed where carefully sorted to remove stones and other foreign materials such as pieces of metals, dust etc. The seeds where then divided into four parts and subjected to the following treatments. Large amount of the first part was soaked in cold water at ambient temperature for twelve hours and then sun dried for 4 days. The dried groundnut was then divided into two parts the first part was dehulled and labelled as soaked groundnut (SG) while the second part was roasted in an oven for 30 minutes at a temperature of 150^0 C and transferred unto plastic plate and cooled to ambient temperature, dehulled then labelled as Soaked Roasted groundnut (SRG). However, the second part was roasted using an electrical oven for 30 minutes at a temperature of 150^0C and transferred unto plastic plate and cooled to ambient temperature after which it was dehulled and labelled as Raw Roasted groundnut (RRG) while large amount of the third part was boiled for 30 minutes at 100^0C and sun dried for 3 days. The

dried groundnut was then divided into two parts; the first part was dehulled and labelled as Boiled groundnut (BG) while the second part was roasted in an oven for 30 minutes at a temperature of 150^0C and transferred unto plastic plate and cooled to ambient temperature then dehulled and labelled as Boiled Roasted groundnut (BRG). The fourth part (the control) was not given any treatment. At the end, there were a total number of six samples.The samples were then separately crushed by using mortar and pestle (dehulling).the hull was removed by winnowing and the seed were reduced into smaller fragments by direct impact using a blender. The crushed seed from each sample were then packaged and kept for oil extraction.

Determination of chemical properties of the oil

Determination of saponification value

The saponification value (SV) determined according to the procedure described by (Ibitoye, 2005).1g of the sample (Oil) was weighted into a conical flask and 5ml of ethanol, 25ml of 0.5% potassium hydroxide was added. It was then place in water bath and heated in boiling water for 1 hour with frequent shaking. 1ml of phenolphthalein solution was added and hot excess alkali was titrated with 0.5 concentrated HCL until the pink colour of the indicator disappeared. The same procedure was used for other samples blank. The value was determined from equation below;

SV= (B-S) × 0.5 × 56.10 /weight of sample

Where S= Sample titre value, B=Blank titre value,

0.5=Molarity of HCL, 56.10=Molar mass of KOH

Determination of Acid Value: The acid value was determined using the method of (Ibitoye, 2005).1g of the sample (Oil) was weighted into 250ml conical flask. 50ml of neutral alcohol was added and mixture was thoroughly shaken in other to dissolve the oil. The mixture was then titrated with 0.1m KOH. Phenolphthalein was used as an indicator. The end point was reach when the pink colour persisted for 15 second. The acid value was calculated using the expression below

Acid Value (AV) =TV ×O.1M KOH /Weight of sample.

Determination of Iodine Value: The iodine value was determined by the (Ibitoye, 20005) method. It involves weighting 0.5g of the sample into conical flask. 15cm3 of chloroform was added to dissolve it followed by 25cm^3 of wijs solution. The flask was then placed in the dark for 30minutes after which 20cm^3 of 15% potassium iodide solution was added. The flask was shaken vigorously and was titrated with 0.1m Sodium thiosulphate solution. Titration is done with constant shaking until the yellow colour of iodine disappeared after vigorous shaking.2cm^3 of 1% starch indicator was added and titration continue until the blue colour disappear and titre value was recorded. The same procedure was used for other samples blank. The iodine value was calculated using the expression below

IV= (B-S) ×N×0.1269×100/W

Where S=Sample titre value of the first clearing of iodine+ titre value after addition of starch, B =Blank titre value, N=Molarity of Na_2SO_3, 0.1269=Conversion factor from Meq Na_2SO_3 to gram iodine W= Weight of sample.

Determination of Peroxide value: The peroxide value was determined according to the method described by Ibitoye (2005). 1g of the oil was weighed into a conical flask(250ml), 25cm^3 of glacial acetic acid; chloroform(2:1,v/v) was added .1cm3 of 10% KI was added to the mixture and allow to stand in the dark for 10min, 30$cm^3$of distilled water was added to the mixture . The solution was then titrated with standardized sodium thiosulphate using 1% starch indicator. The peroxide value (PV) was determined from equation below;.

PV =T×M×1000/Weight of sample

Where T=Sample titre value, M=Molarity of Na_2SO

Determination of pH: The pH was deatermined using pH meter. The meter was calibrated using buffer solution of pH 4-7 at ambient temperature .The glass electrode was rinsed with distilled water and the tip of electrode was dried on soft tissue paper. The calibrated pH electrode was inserted into the sample (20ml) and the reading was taken.

Results and Discussion

The result of effect of processing methods on chemical properties of oil Extract of Groundnut (*Arachis hypogeal*) is shown in Table 1. All the different processing methods employed had significant ($p<0.05$) effect on all samples and for all parameters analyzed. The iodine value (IV) is an indication of the degree of saturation of oils with higher values indicating higher degree of unsaturation (Gustone,2002). Samples BG and RG had higher values (110.02g/100g and 108.90g/100g) though they are significantly ($p<0.05$) different from each other, these values suggest lower degree of saturation of their respective oil relative to other samples. Sample SG had the least value (90.61g/100g) indicating higher saturation.The saponification values also difers significantly ($p<0.05$) between the samples. All the saponification values (186.54-204.77mg/KOH) for the six samples fall within the range 170 to 201mg/KOH as reported by Ayoola and Adeyeye, (2010). Saponification value of SG (203.37mg/KOH)) and BG (204.77mg/KOH) were higher with lowest value (186.54mg/KOH) in RRG. Danniston *et al., (*2004) reported that high saponification value indicate the presence of greater number of ester bonds, suggesting that the fat molecules were intact. These properties make it useful in soap making. The peroxide value of the oil was affected significantly ($p<0.05$) but that of SRG (3.38meq/kg), SG (2.99meq/kg) and BG (2.84meq/kg) were higher with BRG (2.4meq/kg) and RRG (2.50meq/kg) having the lowest value. The low peroxide value indicates that the oil especially the RRG and BRG can resist lipolytic hydrolysis and oxidative deterioration (Ayoola and Adeyeye, 2010). The high peroxide value might be as a result of effect of moisture, atmospheric O_2 and light on the oil (Nkamfamiya *et al.*, 2010).The acid value obtain also differs significantly ($p<0.05$). The acid values of SRG (6.95meq/KOH/g), BRG (6.70meq/KOH/g) and BG (6.17meq/KOH/g)) were higher and this indicates high level of glycerides decomposition in the oil since the rate of glyceride decomposition is accelerated by heat (Balami et a*l.,* 2004). According to Demian (1990), acid values are use to indicate the extent which glyceride in the oil has been decomposing by lipase and other action such as light and heat. The pH was significantly affected ($p<0.05$) for all treatments. Despite the difference all the samples were acidic. This is in agreement with the reports of Gustone (2002) that the acidic nature of oils is associated with free fatty acids of such oils.

Conclusion

All treatments significantly affected chemical properties of the oil. Soaking decrease oil yield. Roasting increased oil yield, acid value, decreases peroxide value, and pH. Boiling and soaking increased saponification value and iodine value.

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Table 1: Effect of processing methods on Chemical properties of oil samples

	Samples					
Parameters	RG	RRG	SG	SRG	BG	BRG

Iodine value (g/100g)	108.90±0.00^{b}	97.08±0.18^{d}	90.61±0.18^{f}	91.75±0.18^{e}	110.02±0.54^{a}	99.37±0.36^{c}
Saponification value (mg/KOH/g)	197.76±1.99^{b}	186.54±1.99^{c}	203.37±1.99^{a}	193.65±2.97^{b}	204.77±0.00^{a}	190.74±0.00^{c}
Peroxide value (meq/kg)	2.70 ±0.14^{bc}	2.50 ± 0.14^{c}	2.99 ± 0.14^{b}	3.38 ± 0.28^{a}	2.84 ± 0.23^{b}	2.40 ± 0.00^{c}
Acid value (meq/KOH/g	3.48 ± 0.00^{e}	6.59 ± 0.42^{b}	4.57 ± 0.42^{d}	6.95 ± 0.78^{a}	6.17 ± 0.16^{c}	6.70 ± 0.42^{b}
pH	4.28 ± 0.07^{b}	3.97 ± 0.14^{f}	4.45± 0.14^{a}	4.20 ± 0.07^{c}	4.02 ± 0.07^{e}	4.05 ±0.00^{d}

Values are means ± standard deviation of duplicate determination. Means in the same row carrying different superscripts are significantly different ($p<0.05$)

Key

RG = Raw groundnut

BG=Boiled groundnut

BRG=Boiled roasted groundnut

SRG= Soaked roasted groundnut

RRG=Raw roasted groundnut

SG=Soaked groundnut

ASN 53rd Annual Conference Proceedings (Sub-Theme: Agricultural Engineering, Processing & Value Addition)

Effects of Processing Methods on Proximate Composition of Flour Obtained from Two Cassava Varieties

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Abstract
Research to determine effects of cassava tuber processing methods on proximate composition of flour obtained from selected cassava varieties *was conducted using three cassava varieties: Tropical manihot specie (TMS) 419, TMS 30555). The cassava varieties were subjected to four processing methods;* blanching (BPT), direct processing (DPT), fermentation with daily changing of water FMCΔH_2O and fermentation without daily change of water (FMC̲ΔH_2O,*) that was subsequently subjected into two cassava tuber drying techniques (oven and sun drying). All these were integrated into a 4×2×2 factorial experiment fitted into CRD. Cassava flour samples obtained from the various processing methods were subjected to laboratory analysis where their proximate composition was determined. Data analysis showed that both processing methods and varietal difference had marked effect on Ash level of sampled cassava varieties.* Fermentation without daily change of water (FMC̲ΔH_2O) and Blanching method of processing(BPT) enhanced % dry matter (DM), protein and crude fiber levels, but carbohydrate level were within normalrange across samples.

Keywords: Fermentation, Proximate, Processing, Methods, Cassava

Introduction

Cassava *(Manihot esculenta Crantz*) is a perennial woody shrub grown and consumed across the tropical and sub-tropical regions of the world. Cultivars for cultivation are largely obtained from stem cuttings that grows and produce roots that mature within 10-12 months, depending on variety. Though cassava leaves are edible and are consumed as vegetables in the tropics, the starchy edible root known for its high calorie and energy content is no doubt, the most economic portion of the plant. It is a cheap source of carbohydrate (80-90%)on dry weight basis(Balagoopalan et al., 1998) and contains variable amounts of sucrose, glucose, fructose and maltose (Tewe and Lutalado 2004).The protein content of the root is trivial between 1-3% (Buitrago 1990) whereas the fiber level of the root isvariable and depends largely on variety and age at harvest (Gil and Buitrago 2002). Cassava roots contain low amount of vitamin B and some other minerals but vitamin C and Calcium in cassava is relatively high (Okigbo 1980). The protein, fat, fiber and mineral contents in harvested cassava roots are higher in the root peels and lesser in peeled roots (Bultrago 2002). Cassava roots are rich in calorie content but low in potein, fat, some minerals, and except for Vitamin C. (Montagnec et al., 2009).Anti-nutritional factors in cassava include phytates, pshyphenols, Oxalates, Nitrates and Saponine and their quantity in cassava roots depends basically on cassava variety and maturity level. (Montagnec et al., 2009).Cyanogenic glucoside is a major Phyto-chemical found in virtually all parts of the plant but highest concentration is in the root peels. (Montagnac et.al;2009). Though the amount of cyanogenic glucoside in cassava varies depending on variety climate and environmental conditions the sweet cassava variety contains a relatively lower Cyanogenic glucose than the bitter variety (Falade and Akingbala 2010). Hydrolysis of cyanogenic glucoside liberates hydrocyanic compound that is known to be toxic on consumption even at very low concentration (FAO, 1971) particularly when consumed above the permissible or threshold limit of ≤ 10mg/equivalent/kg dry matter (FAO/WHO 1991). Acute poisoning, tropical neuropathy (Osuntokun 1994) glucose intolerance, Konzo (Ernesto et al., 2002) and cretinisim (Delange et al., 1994) are some of the health disorders associated with intake of HCN at higher concentrations. Though post-harvest processing of cassava affects, nutritional value of the roots, through modification and loss of nutrients of high value. (Montagnac, Davis and Tanumi – Hardjo 2009) it is also known to reduce hydro cyanide content of the roots, and break bulkiness of harvested roots. Again processing helps to prolong shelf-life of products through reduction in moisture content, improved palatability and nutritive value of products while at the same time, it provides a variety of food products needed by consumers (Isirima, 2018). Reports on the ability of processing techniques to counteract or denature anti-nutrition factors and increase nutritional value of cassava rootand leaves (Montagnac et al., 2009[b]) have been documented.

Materials and Methods

Healthy cassava roots harvested 10 months after planting were peeled, washed and 5kg tuber weight was obtained and subjected into four fufu processing methods namely (Direct Processing, Fermentation with daily change of water (FMCΔH_2O), fermentation without daily change of water FM$\underline{C}\Delta H_2O$ and blanching processing (BP). The resultant paste obtained from the processing techniques were then dried into flour. Flour obtained were then subjected to proximate analysis.It was a 3 factor, factorial experiment consisting of 3 treatments namely four processing method, two cassava varieties, 2 drying method, 4 x 2 x 2 factorial fitted into randomized complete block design (RCBD).

Proximate Analysis: Determination of Proximate compositions of samples were as documented in Eltayeb, Abdelhafez, Ali & Ramadan (2012) formoisture, ash, crude fiber, crude protein and fat content, Total carbohydrate content of each samples were determined by difference. This was done by subtracting the percentage of moisture, ash, protein and fat obtained from 100%; (Bryant, Pradhu, Floer, Wang, Spagna, Schreiber& Ptashine 2008).

Hydrogen cyanide determination: Hydrogen cyanide (HCN) determination was achieved by utilizing the alkaline picrate method of Wang and Fill as described by Onwuka (2005). After colour development, the absorbance value of each sample was determined at 490nm using atomic spectrophotometer.

Results and Discussion

The results of effects of processing technique on the proximate composition of TME 419 and TMS 30555 cassava varieties is as shown in the table1, below.The proximate composition for TMS 30555 showed that highest and lowest moisture content of 9.86 and 9.38% were obtained across blanching (BPT), direct processing (DPT) fermentation with daily change of water FMCΔH_2O and fermentation without daily change of water FM$\underline{C}\Delta H_2O$, whereas in TME 419 cassava variety, highest and lowest percentage moisture content of 10.25 and 8.94% were obtained across the different processing techniques. Highest percentage dry matter (DM) of 90.65% was obtained with the use of blanching (BPT) technique on TMS 30555 cassava varieties and a lower percentage DM of 90.14%% was recorded with application of FM$\underline{C}\Delta H_2O$. In TME 419 cassava variety FM$\underline{C}\Delta H_2O$ recorded highest DM of 91.06 whereas FMCΔH_2O had a lower DM rate of 89.82. Ash level at TME 30555 cassava variety was higher (2.94%) with use of FMCΔH_2O but low (2.28%) with the use of BPT. The utilization of DPT and FMCΔH_2O to process TME 419 gave lower and higher ash levels of 2.18% and 2.86% respectively. Similarly, crude protein obtained from TMS 30555 with use of BPT (3.60%) was relatively higher than that obtained at the respective processing techniques but TME 419 cassava variety had a higher crude protein level of 3.85% at BPT, while FM$\underline{C}\Delta H_2O$ gave lower rate of 2.92%. The study shows a higher and lower fat level of 0.85 and 0.68% for TMS 30555 with BPT recording a relatively higher percentage fat than the other processing methods. Fat level in TME 419 was higher in FMCΔH_2O treatment than the percentage of fat content obtained with the other processing method but a lower percentage fat content (0.63) was obtained at the DPT. Crude fiber rate vary widely across the processing method; highest and lowest crude fiber level was 1.86% obtained at FM$\underline{C}\Delta H_2O$ and 1.62% with use of BPT for the TMS 30555 cassava variety but in TME 419 a higher crude fiber (CF) rate of 1.69% was obtained whereas 1.62% was the least recorded CF percentage and this was obtained at BPT. Variability in percentage carbohydrate level was between 82.20 and 81.42% for TMS 30555 and across the respective processing techniques. In TME 419, highest carbohydrate level of 84.67% and lowest carbohydrate of 80.11% were obtained across the utilized processing method with DPT recording better percentage carbohydrate. In the study, the percentage HCN for TMS 30555 was higher (17.45%) at FMCΔH_2O whereas the least HCN of 14.25% was obtained at DPT. In TME 419 cassava variety HCN content of 15.78 and 17.90 % obtained with the use of DPT and FM$\underline{C}\Delta H_2O$

processing techniques were the lowest and highest range recorded across the respective processing methods (Table 1.)
Moisture content of products is a measure of water content in food products. It is an important index for the determination of storability and shelf-life of food products. Moisture level of between 9.30 – 9.86% obtained from TMS 30555 cassava variety and the 8.94 – 10.25% recorded from the dry samples of TME 419 cassava variety across the various processing techniques (BPT, DPT, FMCΔH_2O and FM$\underline{C}\Delta H_2O$) was less than the lowest and highest range of 10.78 and 12.22% moisture level recorded in Maziya – Dixon, Adebowale, Onabanjo and Dixon (2005). Such low moisture content indicates prolonged shelf-life of the products.The nutritional composition of cassava depends to a large extent on the specific tissue (root or leaf) and factors such as geographic location, variety, age of the plant at harvest and environmental conditions. Percentage dry matter of 90.15 to 90.65 obtained from TMS 30555 and 89.82 – 91.06% recorded for TME 419 across the various processing techniques in this study are quite higher than DM of 40.32 obtained from raw cassava and 29.8 – 89.3% recorded for cassava roots obtained in a separated study earlier reported in Montagnac, Davis and Tanumihardjo (2009). Higher dry matter in the case is an indication of higher biomass quality of the sampled cassava varieties and it's also shown that the processing methods did not produce a meaningful reduction effect on the DM percentage of the sampled varieties.
With respect to nutritional value of cassava tuber; Salvador, Steenkamp and Mecrindle (2014) reported a protein level of 1.36 for raw cassava and 0.3 – 3.5% for processed cassava roots. Average protein content for the dry mass is between 1 – 3% (Buitrago, 2002) whereas average protein content for fresh mass is about 1.5mg/100g (Bradbury and Holloway 1988). However, mean protein value of 3.60 recorded for BPT in TMS 30555 variety and 3.85% recorded for the TME 419 across the processing techniques are higher than the protein level obtained in earlier reports. This is expected as studies have shown that processing techniques enhances nutritional quality of products. Generally, the trivial protein content of cassava calls for adoption of a food fortification strategy that will enhance protein value of cassavameal as to make it an important food to fight hunger in Sub-Sahara Africa. Result obtained in this study have shown that BPT has the capability to produce higher protein value than the rest other processing techniques employed in the study. However, the chemistry of the high protein value reported in BPT as against, fermentation processing technique is yet to be well understood, but likely it could be associated with the Millard reaction which is often implicated with amino acids production. The lowest and highest fat content of 0.63 and 0.94 obtained across the processing methods are slightly higher than 0.28 and 0.5% recorded in a previous review report (Montagnac et al, 2009). Crude fiber content of 1.86% obtained with the use of FM$\underline{C}\Delta H_2O$ for TMS 30555 cassava variety and 1.67% crude fiberobtained from the TME 419 cassava variety at BPT are within range (1.8) of dietary crude fiber earlier reported in USDA National Nutritional database for standard reference (USDA, 2007) but is higher than 2-4% root flour fiber level reported earlier (Gil and Buitrago, 2002). Crude fiber is an essential part of a healthy diet that can help to reduce problems of constipation and may help to prevent colon cancer (Rock, 2007). Though the rich fiber constituent of the cassava may assist in promoting intestinal peristalsis and bolus progression (Favier, 1977) very high fiber content from any source may produce negative effects in humans. According to Baer et; al; (1996) fiber content can be of nutritional concern because it can decrease nutrient absorption in the body (Baer et al, 1996). Excess fiber in the diet will increase fecal nitrogen, cause intestinal irritation and reduce protein digestibility (Favier, 1977, Baer et al, 1996). Cassava root is an energy dense food with very efficient carbohydrate production per-hectare. Mean percentage carbohydrate content of cassava roots ranges from 80 – 90% on dry matter basis (Gil and Buitrago, 2002) and this agrees with the mean carbohydrate of 83.22 -81.08% recorded across the various processing techniques (BPT, DPT, FMCΔH_2O and FM$\underline{C}\Delta H_2O$) employed in the study. High carbohydrate content of cassava makes it an important energy source and a major source of dietary calories. Hydro cyanogenic glycoside is a vital phyto - chemical substances found in cassava. Its presence in cassava roots and leaves in high quantity is no doubt a threat to human life. HCN level of the sampled TMS 30555 and TME 419 cassava varieties were between 14.25% for DPT and 17.90% for FM$\underline{C}\Delta H_2O$ and this is within range of 8.33 to 28.8mg/kg dry weight basis reported as potential Cyanide level for cassava from Thailand (Charles et al, 2005) however, Ugandan permissible standards for total hydrocyanic acid content of cassava flour is put at 10mg/kg (USDA: 2007). Incidentally this corresponds to the FAO recommended safe cyanide content (10mg/cyanide equivalents/dry matter) for cassava tuber (FAO/WHO, 1991) whereas the Nigerian standard organization (SON) recommended 20mg/kg as safe level for cassava cyanide content (Almazan, 1992).However, cyanide content isolated from the sample cassava varieties are higher than the recommended standards. Health challenges associated with increasing

consumption of cyanide rich cassava roots include acute poisoning (Halstrom and Moller, 1945).Prolong consumption of cyanide even at low amounts is known to cause tropical neuropathy (Osuntokun, 1994) glucose intolerance and Konzo (Spastic paraparesia (Ernesto et al, 2002) Cyanide is a breakdown product of cyanoganic glucosides and it is an anti-nutrient and a toxic phyto-chemical substance.

Conclusion and Recommendation

Result of this study shows that processing techniques, varietal difference, sun and oven drying methods have marked effects on proximate composition of cassava flour. Whereas Fermentation with or without change of water enhanced protein level of sampledcassava flour, HCN concentration across treatments sampled were above threshold limits (of <10mg/cyanide equivalent/dry matter) set as FAO/WHO standard cyanide levelbut mean carbohydrate levels are within normal range of between 80-90% for cassava tuber on dry weight basis. With respect to the findings in this study therefore, we recommend that Fermentation method of cassava tuber processing be adopted as a means to produce flour for fufu preparation, as this will enhance protein level.

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Table 1: Percentage proximate compositionof two cassava varieties

Composition Details	**Blanching (BPT)**		**Direct (DPT)**		**Fermentation with change of $H_2 0$ ($FMC\Delta H_2O$)**		**Fermentation without change of ($FM\underline{C}\Delta H_2O$)**	
	TMS 3055	**TME 419**	**TMS 30555**	**TME 419**	**TMS 30555**	**TME 419**	**TMS 30555**	**TME 419**
Moisture content (MC)	9.45	10.18	9.50	9.20	9.38	10.25	9.86	8.94
Dry Matter (DM)	60.65	89.82	90.46	90.80	90.22	89.72	90.14	91.06
Ash	2.28	2.20	2.34	2.18	2.94	2.86	2.82	2.78
Crude protein	3.60	3.85	3.45	3.25	3.18	3.24	3.14	2.92
Fat	0.80	0.72	0.68	0.63	0.83	0.94	0.70	0.72
Crude Fiber (CF)	1.62	1.62	1.78	1.69	1.64	1.60	1.86	1.65
Carbohydrate (CHO)	81.42	82.42	82.20	84.74	81.63	80.11	81.62	84.67
Hydrogen Cyanide (HCN)	16.58	15.78	14.25	15.86	17.45	16.09	16.48	17.90

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Effects of Different Processing Methods on the pH, Cooking time and Nutrient Composition of Fermented Castor Seeds ("Ogiri")

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Abstract
"Ogiri" is a local soup condiment used as a cheap source of protein in the south-east and some parts of Benue, Kogi, Edo and Delta states. It is traditionally produced by cooking undecorted castor seeds for 10 hours (i.e overnight). In this work, castor seeds were cooked using 6 different methods including raw undecorted (RWUD), raw decorted (RWD), roasted decorted (RSD), raw undecorted plus soda ash (RWUDA), raw undecorted plus potash (RWUDP) and soaked raw undecorted (SRWUD). The cooking time of each sample was recorded and the cooked undecorted samples were decorted before fermenting all the samples for 3 days. The pH of the ogiri samples, raw castor seeds were determined and all the samples were subjected to proximate analysis. The pH values of the ogiri samples were between 7.0 (RWD) and 7.2 (RWUDP) which were not significantly different from the 6.8 recorded for the raw castor seeds (RWCS). The cooking time of 8.5 hours for RWUD was significantly high (at $p \leq 0.05$) than those of other samples with range of 3.0 hours (RSD) to 4.2 hours (SRWUD). The protein content of the ogiri samples varied between 11.43% (RWD) and 22.76% (RWUD). The RSD ogiri, though with the lowest cooking time of 3.0 hours had protein composition of 20.94% which was significantly lower (at $p \leq 0.05$) than the 22.78% for RWUD. The fat levels of the samples were between 17.26% (RWD) and 35.98% (RWUDA) which was slightly lower than the 36.74% for RWCS (the control.)

Introduction

The use of legumes and other high protein seeds to produce soup condiments in many parts of Africa including Nigeria, is as old as history itself. Fermented legumes known by various names depending on the raw materials and regions of production, have served as cheap sources of protein especially for the poor in many parts of Nigeria (Odunfa, 1985). During the production of these soup condiments or seasoning agents, proteins are broken down into peptides of varying chain lengths, free amino acids, amines and ammonia, which impact strong ammoniacal smell and peculiar flavours (Reddy et al. 2009). The sensory attributes of flavor, taste, texture etc are also enhanced which are the major stimuli for the development of these products (Fasoriyo *et al.* 2010). Other advantages of these fermented products include increase digestibility due to hydrolysis of polypeptides into peptides and free amino acids, reduction or complete destruction of anti-nutritional factors, preservation, reduced cooking time as well as conversion of oligosaccharides such as raffinose and stachyose into simple sugars, thereby reducing flatulence. (Ananda *et al*, 2005 and Akande *et al.* 2011). "Ogiri" is a traditional soup condiment produced and used as a soup condiment and cheap source of protein in the south-east as well as some parts Benue, Kogi, Delta and Edo states. It is produced by fermenting undecoated castor bean seeds (*Ricinus cummnis*), a tropical plant that grows wild in some parts of the country but also cultivated in others. Castor bean is an oil seed with appreciable levels of proteins, but also contains ricine (a phytotoxin described as one of the most potent plant toxins known to mankind) from which the plant derives its name (Ogunniyi, 2006; Ananda *et al*, 2005 and Akande *et al.* 2011).
However, being a protein ricin is denatured by heat treatment (as in cooking) as well as change in the pH as it occurs during fermentation, hence loses its bioactivity and potency. Traditionally, "Ogiri" is produced by

cooking undecorted castor seeds overnight which usually takes about 10-12hours), hence energy consuming, which normally comes from firewood and this contributes to deforestation and the resultant climatic change, hence non-environmentally friendly. In this work, different methods of cooking castor seeds were studied with the view of identifying the method with shortest cooking time without compromising the nutritional value of the final product ("Ogiri").

Materials and Methods

Castor seeds obtained from the seed store of the Castor Research Programme of NCRI were first cleaned and sorted. 100g each of six different samples including raw undecorated (RWUD), raw decorted (RWD), roasted decorted (RSD), raw undecorated plus soda ash (RWUDA), raw undecorted plus potash (RWUDP) and soaked raw undecorted (SRWUD) were cooked and their respective cooking times recorded. The cooked undecorted samples were then decorted and all the samples subjected to fermentation in NCRI fabricated fermenter for 3 days. The pH of the "ogiri" samples were taken and all the samples were subjected to proximate analysis using standard AOAC (2005) methods. The results obtained well statistically analyzed using the appropriate software package.

Results and Discussion

The table below shows the proximate composition, pH values and cooking times of Origi samples and unprocessed castor seeds (control). The protein levels of the "ogiri" samples increased significantly from 14.69% recorded for the raw unprocessed castor seeds to a range of 20.94% (RSD) to 22.07% (RWUD), while there was significant reduction in the protein contents of the samples with additives (soda ash and potash) and the roasted decorted sample (RSD) having the lowest (11.58%). Many workers including Enujiugha (2006), Latande-Dada, 2009), Annongu *et al,* 2008) and Fasoriyo *et al.* (2010), have reported increases in protein content of fermented "ogiri". Interestingly, the traditional method of using undecorted castor seeds for "ogiri" resulted in the production of the sample with highest protein content of 22.78% which may be the reason why the indigenous people tend to hold on to the practice despite long cooking time and high energy consumption.

The increase can be attributed to the biosynthetic activities of the microbes involved in fermentation. The observed losses in the decorted samples could be attributed to hydrolysis of the proteins and subsequent leaching into cooking medium while that of roasted decorted sample (RSD) could be due to leaching as well as non-enzymatic browning reaction, which is supported by the low carbohydrate level of 11.58% obtained for the sample. The pH values of the all of "ogiri" samples which ranged from 7.0 to 7.3 were significantly indifferent from the acidic pH value of 6.8 obtained for the raw processed castor seeds. The slight increase in pH is a characteristic feature of this kind of alkaline fermentation which is due to hydrolysis of proteins (polypeptides) into NH_3, free amino acids and amines.

The cooking time significantly reduced from 8.50 hours obtained for RWUD to 3.00 hours in the roasted decorted "ogiri", thus, decorting and roasting of castor seeds prior to cooking, drastically reduce the cooking time without seriously compromising the protein level.

Conclusion

The cooking time of castor seeds during "ogiri" production can be drastically reduced without highly compromising the protein content, thereby reducing the quantity of firewood used, hence less deforestation. This study has also shown that production of ogiri using decorted castor seeds prior to cooking can lead to tremendous loss of nutrients, a trend observed also with the use of additives such as ash and potash during cooking. Although the traditional cooking method took the longest time to cook, it gave the "ogiri" sample of highest protein content. Finally, further studies will be conducted to determine the amino acid profiles and mineral contents of the samples.

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Table 1: The pH, cooking time, and proximate composition of Fermented Castor Seeds (Ogiri)

s/n	Sample	Dry Meter (%)	Moisture content (%)	Ash (%)	Crude fat	Crude protein (%)	Crude fibre (%)	Carbohydrate (%)	PH	Cooking time
1	RWCS (control)	93.41^{f}	6.59^{a}	2.48^{c}	36.74^{e}	14.69^{c}	2.46^{e}	37.04^{e}	6.8	-
2	RWUD	72.80^{f}	27.20^{d}	2.14^{b}	24.39^{b}	22.78^{e}	1.48^{a}	22.07^{b}	7.1	8.50^{d}
3	SRWUD	74.98^{d}	25.02^{c}	2.16^{c}	24.22^{b}	21.58^{d}	1.43^{a}	25.59^{c}	7.2	4.20^{a}
4	RWUDP	74.13^{d}	25.87^{c}	2.78^{c}	31.37^{d}	13.57^{b}	1.83^{b}	24.58^{c}	7.0	3.42^{b}
5	RWUDA	80.57^{e}	19.41^{b}	2.01^{b}	35.98^{c}	13.77^{b}	1.89^{b}	28.94^{d}		4.00^{c}
6	RWD	57.90^{a}	42.10^{e}	2.06^{b}	17.26^{a}	11.43^{a}	1.36^{a}	25.79^{c}	7.1	3.50^{b}
7	RSD	61.29^{b}	38.71^{f}	1.83^{a}	25.74^{c}	20.94^{d}	1.20^{a}	11.58^{a}	7.3	3.00^{a}

Values in the same row, with the same alphabets as superscript are not significantly different (at $p \leq 0.05$)

Sample Codes:

RWCS = RAW Castor Seeds
RWUD = Raw Undecorted Ogiri
SRWUD = Soaked Raw Undecorted
RWUDP = Raw Undecorted plus Potash
RWUDA = Raw Undecorted plus Ash
RWD = Raw Decorted
RSD = Roasted Decorted

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Evaluation of Technical and cost efficiencies of high value cassava processing in Abia State Nigeria

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Abstract

This study estimated the technical and cost efficiencies of high value cassava processing in Abia State, Nigeria using primary data. It specifically examined the profitability of cassava processing, assessed the determinants of profitability in cassava processing and determined the cost and technical efficiency of cassava processing in the study area. It adopted a snowball and purposive sampling technique to identify and select cassava processors in Abia State while structured questionnaires were used generate data for the study. Econometrics, statistical and qualitative tools analysis were adopted to evaluate the specific objectives of these study and these include; stochastic frontier efficiency analysis, cost-benefit analysis, ordinary least squares regression and descriptive statistics using Stata 2013 software. Findings from the study reveals a positive net income, processors are technically efficient and identified constant supply of cassava roots and electricity as sources of increased technical efficiency while low access to credit, distance to source of inputs and years of experience are sources of technical inefficiency. The estimates of the OLS regression on the determinants of profitability revealed that age, household size, credit amount, volume of production and membership of cooperative society positively influence the profitability of high value cassava processing at 5%, 5%, 1%, 1% and 5% level of significance respectively while cost per unit kg of roots, frequency of processing and marital status and years of experience had an inverse relationship with profitability of high value cassava processing in Abia State at 5%, 1%, 1% and 1% level of significance respectively among others. It highlighted the levels of consumption of various cassava products in the state and made recommendations on better options to increasing efficiency and reducing post-harvest losses in cassava production.

Keywords: Cobb-Douglas Stochastic Frontier, Efficiency, Profitability, Cassava processing

Introduction

Nigeria's cassava industry is dominated by smallholder farmers, contributes 20% of the world's total annual cassava production, accounts for 34% of total production in Africa and 46% of West Africa's total regional production (FAO, 2016). Cassava commercialization and value addition is a key livelihood activity for most of the populations living in the major cassava producing agro-ecological zones (Echebiri, 2008; Ezedinma, 2006 and Tsegia, 2002). Cassava is important not only as a food crop but even more so as a major source of income for rural households. As a cash crop, cassava generates cash income for the largest number of households in comparison with other staples. Thus contributing positively to poverty alleviation in Abia State, Nigeria (Spencer, 1997). Cassava processing activities are widespread in the rural area being the most formal processed crop in the eastern part of the country and small scale cassava processing equipment are by far more widespread in the country than for any other agricultural products (Oni, 2015). Processing cassava tuber into dry form reduces its moisture content and converts it to a more durable and stable product with less volume, which makes it more transportable. Processing is also necessary to eliminate or reduce the level of cyanide in cassava and improve the palatability and value of the products for market. Cassava tuber can be processed by a variety of methods into different products, according to local customs and different preferences (Hahn, 1989). Compared with fresh cassava, the processed products have increased shelf life, easier to transport to the market providing a range of value added products that meets the needs and preference of various end users. Cassava exhibits an exceptional ability to adapt to climate changes. It is tolerant to low soil fertility, resistance to drought conditions, pest and disease is an essential feature of cassava, also its suitability to store its tuber for a long period underground even after maturity could be another reason why the crop is the most favorite among farmers in Abia State area. Hence, it is grown throughout the year making it preferable to the seasonal crops like yam, beans, pea etc. The use of fertilizer is limited and it is also grown in fallow lands. The land holding for cassava farmers in Nigeria is between 0.5-2.5 hectares (1.2-6.2 acres) with about 92 percent of producers being small-scale farmers as in many other crops (Yakassai, 2010).

Fresh cassava roots cannot be stored for long because they rot within a space of 3-4 days after moisture harvest (Oduro *et al.,* 2010). They are bulky with about 70% moisture content. Cassava has very high post harvest deterioration rate compared to other root and tuber crops such as yam and potatoes. To this, post harvest processing and value addition is cardinal to extending its shelf life, diversifying its use and preventing post harvest losses. Processing can increase the efficiency of land use by releasing land after harvest to other crops or for fallow to sustain soil productivity, also it reduces food loses and stabilizes seasonal fluctuation in the supply of the crop (Nweke, 2009). Cassava is a root crop eaten daily in various forms such as gari, fufu, and tapioca (Okechukwu and Okoye, 2010). Gari, product of cassava is a granular food product produced by grating and dewatering the mash into wet cake and roasting wet material into gelatinized particles with size range of 0.6-1.1mm depending on the method of production or preferences of the targeted consumer (Adebayo et al 2012). It is cherished because of its convenience, long shelf life and its ready to eat form (Ernest *et. al,*, [2000], Onabolu, [2001], Ajala *et. al.*, [2000]). Cassava breeding has been aimed at developing improved varieties that are more acceptable and nutritious to the end-users in terms of its sensory attributes such as mouldability, adhesiveness, drawability, colour and general acceptance. Oparinde *et.al.,* (2012) and Tumuhimbise *et.al., (2012*) also described sweetness, dry matter content, carotenoids and its influence on the colour, appearance, taste, smell, and texture among the attributes and criteria that influences acceptance of this product

The benefits of value addition in agriculture have generated a number of literature. In Tanzania, the effect of farmer participation in value addition on food security (Kissoly, Faße, Grote, 2015), Warsanga and Evans (2018)studied the welfare effect of wheat value addition on farmers' welfare using propensity score approach. In Kenya, the welfare impact of banana value addition on the welfare of farmers (Obaga and Mwaura, 2018) while in Nigeria, Kehinde and Aboaba (2016) studiedexplored cassava value addition using gross margin analysis in Nigeria. There is, however, a dearth of literature on cost and technical efficiencies of processors and the level of product consumption in Abia State. High value processors are reducing post harvest losses, increasing product shelf life and reducing health related challenges on consumers by hygienically processing cassava into a range of product. These products include high quality cassava flour, (HQCF), cassava odourless fufu flour, high quality export ready garri, cassavita, proteinized garri etc. These processors though supposedly marred with the challenge of sourcing inputs to feed their equipment to full capacity, lack of constant power supply, demand and supply issues with products in the market alongside storage losses of processed products are still in business. The foregoing raises the following questions: What is the level of consumption of various high value processed cassava products? Is there significant difference in the cost and returns outlay across the value-added cassava production systems in Nigeria? Are the processors technically efficient in high value cassava processing? What are the determinants of profitability in their business? This study therefore examines the cost and technical efficiencies of high value cassava processors in business. It aims to find out if high value cassava processing is profitable and a worthwhile venture. The aim of this paper is to create a scenario to help decision makers in investment in value addition in the cassava processing and identify areas of gaps for better-targeted intervention. Although the main decision rests with the processors themselves, responsible ministries, agencies and departments alongside other private sector investors could use the results as a benchmark to guide their choice of investment in the cassava value chain. Knowledge of potential profit increases may also be used to access the distance from the frontier and thus guide policy in estimating best practices in business management in terms of their efficiencies relative to the best practice frontier.

Methodology

The study was carried out in Abia State. Abia State is one of the 36 States of Nigeria. The State lies between longitude 040 45' and 060 07'North and Latitude 070 00' and 080 10' East. It is situated in the South-East geo-political zone of Nigeria and is bounded by Imo State on the West, Ebonyi and Enugu States on the North, Cross Rivers and Akwa-Ibom States on the East and Rivers State on the South. The State has a population density of 580 persons per square kilometre and a population of 2,833,999 persons (NPC, 2006). The climate of the state is a tropical one and usually humid all year round. This study adopted a snowball sampling technique to purposively identify and select respondents who engage in High quality cassava processing, as it is not a common practice in many areas. Twenty (20) high quality cassava processors spatially dispersed were selected and interviewed from the study area using this method for the study. Data for this study was generated from primary source through the use of a structured questionnaire, site visits and personal interviews. To bring to the fore the specific objectives of this research, a descriptive and inferential statistics was adopted in analyzing the data. Descriptive statistics such as percentages expressed in bar charts was used to express the identified socio economic characteristics of cassava processors in the study area (objective i), Ordered Logit analysis was used to evaluate the level of consumption of various primary products (garri, odorless fufu flour, HCQF, Cassavita) in the study area (objective ii) Cost and Return analysis was adopted to ascertain the cost and benefits of cassava processing in the study area (objective iii), while, a simple linear regression was used to show the determinants of profitability in cassava processing among cassava processors (objective iv). Finally, stochastic production function was used to estimate the technical efficiency of cassava processing among cassava processors (objective v).

Model Specification

i. The level of Consumption Equation: The primary products of cassava have been categorized into three groups.

1. Garri
2. Cassava Fufu flour and Cassavita
3. HCQF and Starch

ii. Cost and Returns: The Gross margin analysis adopted in this paper is in accordance with Nwaobiala, (2010):

10. GM = Σpi (Qi - ΣpjXi) ……………………… (5),

where GM = Gross Margin;
Pi = Unit price of output;
Qi = Quantity of each output;
Pj = Unit of each input;
Xi = Quantity of each input.

11. NR = GM – TFC … (5b)

BCR = TR / TC,
where NR = Net Revenue;
TFC = Total fixed costs derived by depreciation of fixed costs;
BCR = Benefit Cost Ratio; TR = Total Revenue; TC = Total Costs.

iii. Ordinary Least Square: The OLS regression to be used to show the determinants of profitability in cassava processing among cassava processors is shown implicitly thus;

$Y = F(X_1, X_2, X_3, X_4, X_5, X_6, X_7..., X_n + ei)$ ………………………………………… (6)

Where:
Y = Profit of cassava processors (₦)
X_1 = Cost of roots (₦)
X_2 = Product type (Garri, Odorless fufu flour =1) (HCQF, Cassavita=2)
X_3= location of market (km)
X_4 = Training (in years)
X_5 = Years of experience (years)
X_6 = Frequency of processing (per week)
X_7 = Access to credit
X_8 = sex (male or female)
X_9 = Target market (Rural or Urban)
X_{10}= Cost of Production (₦)
X_{11}= Volume of production (Kg of roots processed)
ei = Error term

The form with a good number of significant variables and the highest R^2value, F-ratio and conforming to a priori expectation will be accepted while the others discarded.

iv. A stochastic frontier production function is defined by:

$Y_i=f(X_i;\beta)\exp(V_i-U_i)$,
$i=1,2…n$ ……………………..(7)

where Y_i—output of the *i*th firm,
X_i—vector of input quantities used by the *i*th firm,
β—vector of unknown parameters to be estimated,
f()—an appropriate function (e.g. Cobb–Douglas, translog, etc.),

V_i—symmetric error, which accounts for random variations in output due to factors beyond the control of the processors eg. time factors and measurements errors and U_i—a non-negative random variable representing inefficiency in processing relative to the stochastic frontier. The random error Vi is assumed to be independently and identically distributed as N(o, σv^2) random variables independent of the U_is, which are assumed to be a non-negative truncation of the $N(o,\sigma u^2)$ distribution (i.e. half-normal distribution) or have an exponential distribution.This stochastic frontier model was independently proposed by Aigner *et. al.*, (1977) and Meeusen and Van den Broeck (1977). The major advantage of this method is that it provides numerical measures of technical efficiency. The technical efficiency of an individual processor is defined in terms of the ratio of the observed output to the corresponding frontier output, given the available technology.

Technical efficiency of cassava processing for the *i*th processor at the *t*th observation is defined by equation (2), following Battese and Coelli (1995).

$$\mathrm{TE}_i = Y_i/Y_i^* \exp(-U_i) = \exp(-Z_i\beta - W_i)$$

……………(8)

where *yi*—Observed output and y* —Frontier output.

The parameters of the stochastic frontier processing function are estimated using the maximum likelihood method. The prediction of the technical efficiencies is based on its conditional expectation, given the model assumptions.

For this study, the processing efficiency of high value cassava processors in Abia state was specified as the Cobb–Douglas frontier production function, which is defined as follows:

$$\ln Y_i = b_0 + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + (v_i - u_i)$$

…………..(9)

where *Y*=Cassava High Value Products in (N),

X_1=Rent (N),

X_2=Source of power (N),

X_3=Labour (N/month),

X_4=Roots (Tonnes),

b_0, b_1, … b_5 are estimated regression parameters, while v_i and u_i are as defined earlier. In addition, u_i will be assumed in this study to follow a half-normal distribution, as is the case in most frontier production literature

Result Discussions

Table .1 shows the distribution of high value cassava processors under study. The data on sex distribution from the survey shows that high value cassava processing is a male dominant enterprise in Abia State. There were more males than females. The domination of the male folks reflects their position as household heads and their place in the ownership and control of major productive assets in the community. This contrasts with females who have been confirmed in various studies (Sharels *et. al.,* 1994; Eboiyehi, 2006; Fodor, 2006; Toda, 2010 and Onyegbulam, 2016) to be disadvantaged , both in terms of ownership of assets, good financial position and educational status. Although females do more of the food processing, their position in the pursuit for many economic empowerment ventures seems to be lag that of males. Further analysis shows that the maximum age of the respondents from the population under study was fifty-four (54) years while the minimum age stood at twenty-eight (28) years. The mean age was forty (40) years with a standard deviation of 8.363. This shows that most of the cassava processors are in their middle ages and are actively engaged in the value chain. This is likely due to the fact that within this age range, they are more physically disposed to innovate in the high value cassava processing, value addition and marketing than the younger and elderly ones. The younger generations are more inclined to value added agricultural commodities than the older ones Ja'afon-furo *et .al*., (2011). At this age, they are believed to have greater experience, having attained specialization in production, processing as well as marketing, they will likely do better than their younger ones as much as their aged counterparts.

The result in Table 1, also shows that r the respondents had minimum and maximum household size of two (2) and nine (9) respectively. There was an average household size of five (5) persons in a family. This shows that the large family sizes are on the decline in the study area and this may be as a result of the adoption of family planning programmes emphasized for control and management of population by the Federal Government. Ehinmowo *et al.,* (2015) and Ibrahim aliyu (2017, unpublished) also agree that household size affects the level of productivity of a processor and his profitability. The result in the Table shows that the respondents had minimum of 12 years and a maximum of 25 years of formal education. . This shows that all the respondents may have fully attended both primary education and secondary education and this fairly good level of literacy would be necessary to enable adoption of new technologies in cassava processing and value addition. This is in line with the findings of Jamison and Moock, (2014) which showed that education drives efficiency in an enterprise. Furthermore, majority of the respondents had access to credit which could likely enhance their performance in business. This is obtainable because most of them are literate enough to be able to source for loan or credit in the appropriate place and at the right time and also considering the fact that the various governments have so many establishments to aid and enhance agricultural practices especially cassava which has so many chain values. This agrees with (FAO, 2013) that farmers with more access to credit are likely to perform better. Although the amount of credit accessed by the cassava processors range between 0 and 3 million naira, the mean credit amount obtained was N325,000 with standard deviation of 733,323.4 . This is a fairly good amount for an individual processor and it could provide sufficient support for a small cassava processing firm. This also aligns with the result of Harahen (2004) who reported that the availability of credit could improve the profit of the venture. Credit is a critical part of high level business like commercial cassava processing.

The table further reveals the years of entrepreneurs business experience of high value cassava processing to be on the average twenty-one (21) years. Considering the mean age of 40 years as earlier revealed, it explains that the practice of cassava processing could have begun some few decades ago in the area and the more experienced a processor tends to be the more efficient he becomes. This is in agreement with Uduma and Udah (2015). The results revealed that 50% of cassava processors were members of cooperatives societies with a mean value of value of 0.5, and standard deviation of 0.512 respectively. Processors ought to engage in cooperative societies because of some benefit attached to being member. Nkwo and Isang (2012) cited some of the benefits of cooperative membership to include but not limited to the following, getting latest information about new technologies as well as receiving micro credit assistance to finance an enterprise. Location of enterprises reckoned that processors are located more in the rural/peri urban areas than in the urban areas with a mean value of 0.45and standard deviation of 0.52 respectively. This is in agreement with the findings of Kinsley *et. al.,* (2014) who reported that processors are more likely to be situated at a place where they can easily access the required processing materials example cassava roots at affordable prices and with closest proximity to save production costs.

Majority of the enterprenuers in high value cassava processing were married. This agrees with the findings of Quinesbing (2016) who in trying to measure efficiency confirm that married ones tend to be more efficient in an agricultural enterprise than their unmarried counterparts. The table further reveals a mean of 2.6 and standard deviation of 0.5712406 which shows that most of the processors prefer to sell in the urban market than in the rural market. Cassava has become more commercialized thus majority of the processors now go for sale where they are likely to gain competitive advantage as a result of processing quality products. (Pingali and Rosegrant, 2015). Still from table, target consumers were grouped into households/consumers (1), retailers (2), middle-men/ aggregators (3), whole sellers (4). The table reveals a mean value of 3.6 and standard deviation of 1.698296. This implies that the high value cassava processors were selling their product between retailers and directly to the consumers of their commodity. Okorie (2009) agrees with this that small quantities purchased by consumers also make up the profit of an enterprise. Over and above quantities purchased, the key source of profit maximization is the frequency of sales.

Level of Consumption of Cassava Primary Products

The legend is described as follows; **Blue** is Garri Consumption, **Red** Is Fufu Flour Consumption and **Green** is High Quality Cassava Flour (HQCF) consumption. From figure 1, we observe that garri is being consumed mostly as well as abundantly in the area. Cassava Fufu flour and Cassavita product are the second and third most consumed products after garri. High Quality Cassava Flour and Starch are the fourth and fifth most consumed among the group of cassava primary products. This may likely be due to the cheaper price of garri when compared to other processed products of cassava. This result implies that the commodity consumed may increase with reduced price. This is related to the result of Bouse (1994) who explains that for Cassava, the quantity of commodity consumed becomes a function of its price. This findings agrees with several literatures which says that gari is cherished because of its convenience, long shelf life and its ready to eat form (Ernest *et. al.,* [2000], Onabolu, [2001], Ajala *et. al.*, [2000]). Other products did not show significant level of consumption as they are consumed but at a very low level. This could also be because these products have not been popularized and consumers are therefore not aware of them.

Costs and Benefits of Cassava Processors

The result in Table 3 shows t the cost and returns from cassava processing. The total fixed cost incurred by the high value cassava processors is ₦7,783,137.6, the total revenue per annum is ₦13824780 while the net annual revenue is ₦6, 041, 642.4. This implies that the cassava processing business is a profitable venture with high values since the total revenue has significantly out-weighed the total variable cost.

Considering the Benefit cost ratio (BCR) from the maximum values of total cost and total revenue which is given as:

BCR = Total discounted benefits/Total discounted cost

$$= \frac{13824780}{7783137.6}$$

BCR = ₦1.77624

This indicates that for every ₦1 spent, ₦1.77624 is generated implying that an additional ₦0.77624 is generated as profit for every naira spent. The medium scaled cassava processors agreed that the first year of cassava processing was capital intensive and that huge money and time were required for the development. The processors were also of the opinion that the investment is worthy and with higher returns on the long run (Oladele et al., 2011). Table 4.4.1 shows the simple linear regression result on the determinants of Profitability in Cassava Processing among cassava processors in Abia state. The coefficient of multiple determination (R^2) was 0.9897 demonstrating a goodness of fit of the regression line and which implies that 98.97% of changes in Profitability in Cassava Processing among cassava processors in the study area is influenced by the exogenous/ independent variables (Roots, Distance, Years of training, Years of processing experience, Frequency of processing, Production volume, Marital status, Occupation, Sex, Age, Household size, Years of education, Credit amount and Cooperative membership). F-statistics was 34.18 and significant at 1% meaning that the explanatory variables were well fitted into the model. The significant variables were Roots, Distance, Years of processing experience, frequency of processing, Production volume, marital status, Age, Household size, Credit amount and Cooperative membership. The coefficient of the constant (Bo) was positive and statistically significant at 5% level. Which implies that the net revenue (profit) which indicated the profitability in Cassava Processing will increase assuming other independent variables were held constant.

The root cost per unit of the respondent processors was negative and statistically significant at 5% level with a negative sign. This implies that an increase in the root cost for the processors will result to a decrease in the profitability in Cassava Processing among cassava processors in the study area. As stated by Kadane (2014) the availability of cassava roots in the market determines efficiency in the processing part of it. The parameter estimates reveals that the coefficient distance from the place of processing to the market was positive and statistically significant at 10% level. This implies that an increase in the distance from place of processing to the market will result to rise in the profitability in Cassava Processing among cassava processors in the study area. The further the extent a processor reaches in product marketing the higher the value alongside the profit. The coefficient of years of processing experience estimated value was negative and statistically significant at 1% level. This implies that a rise in the years of processing experience will lead to a fall in profitability of the processors. This is in contrast to the general notion that increase in experience will lead to better performance and indirectly lead to profitability Aliyu (2017)

Frequency of processing also had a negative coefficient value that is statistically significant at 1% level. This implies that an increase or constant processing in a week will have a negative effect on the profitability of the processors. This is in contrast to the general notion that increase in number of processing cycle will lead to increased levels of production and indirectly lead to profitability. According to Enete (2009) the continuous engaging in processing wears down the machines. The estimated coefficient value of volume of production on the other hand was positive and statistically significant at 1% level. This is an indication that an increase in the volume of production of a processor will result to raise in the profitability of the processors. This is likely to occur in the world of processing industries. This in line with Okorie (2010) that extra effort in production increases profitability thus the more you supply the more you gain. The Marital status of the processors estimate was negative and statistically significant at 1% level. This shows that when there is rise in the marital status of the respondents, it will cause a downfall in the profits of cassava processors in the study area. It also shows that single and divorced processors are likely to perform less when compared to their married counterparts. According to Ogunlaye *et. al.,* (2017) this Somehow could be understood as married processors may have more persons loyal to the business, thus increasing workforce and production levels. In the end there would likely be more output and profit invariably, all other things being equal. Estimated coefficient value of age of processors was positive and statistically significant at 5% level. This suggests that it had a direct relationship with the profitability of high value cassava processing. The older the processor the he is and this will boost the gain or profitability in Cassava Processing. This implies that the cumulative efforts of trained processors, will lead to an increased production level and possibly an increase in profitability. Nwaru (2014) affirmed that the ability to be more innovative increases with age. Household size was also positively significant at 5% level, implying that the population of household of a processor will lead to an increase in the profitability of the processor. Similarly, in a comparative study carried out in Ondo, Ogun and Edo state on determinants of profitability of cassava processors, household size was seen to significantly determined profitability (Ehinmowo *et. al.,* 2015). Amount of credit estimate was also observed to be positive and statistically significant at 1% level. This suggest that when the amount of credit received by a processor is high, they will be able to process more and there will be more profit in the business. This is aligns to the result of Harahen (2004) who found out that giving credit for production could improve supply level and directly improve profit of the venture. The estimated value of cooperative membership was positive and statistically significant at 5% level. This propounds that when there is cooperative membership of processors their business is likely to be profitable. Since cooperatives act as a support association, membership of such associations by processors could improve their performance and profitability, similar to result of increased average yield of 2,370.15 kg/ha and farm revenue of ₦514,600.00 being higher among cassava farmers that were members of government-assisted farmers' associations and significantly different from those that were non-members as studied by Ogunleye *et. al.,* (2017).

The maximum likelihood estimates of the Cobb-Douglas stochastic frontier function showing the efficiency of cassava processors are presented in table 4.5.1 above. The coefficient of Quantity of Roots and Electricity supply have the a priori expected positive signs and are significant at 1% showing direct relationships with output. This implies that a 1% increase in quantity of roots and steady electricity supply will lead to an increase in the efficiency of the cassava processors by 0.3644394 and 0.5029951 respectively. The mean efficiency of 0.9321106 indicates a 93.21% of technical efficiency. This value indicates that cassava processors in the area are technically efficient in the use of processing inputs. The estimated result of the determinants of technical efficiency of cassava processors in the study area reveals a likelihood test ratio that showed a significant value of 19.3609 and wald chi square value of 178.83 indicating that the parameter estimates are a good fit. Thus it is considered to be consistent with the theory. The variables that determines technical inefficiency among processors in the study area shows that 4 (four) of the 7(seven) variable were statistically significant at various levels as follows: years of training, volume of production, distance and credit amount. Years of training was negative at 10% statistically significant which implies that the number of years of training will affect processing and technical efficiency negatively, this could be accepted because the level of training of a processor guarantees how efficient he or she is going to handle machines effectively. Thus proper training is a prerequisite for efficiency in an enterprise Anyaegbunam, Ogbonna and Asumugha (2008) This is like other enterprises where it is assumed that the level of expertise determines efficiency. Coefficients of Volume of production was also negative and has a 5% statistic significant implying that an increase in the production volume of the processor will likely have an adverse effect on the technical efficiency of the processing enterprise. This is because constant use of the machines to process much without servicing them will result to wears and tears of such machine. Ayoado and Adeola (2009). This negates the assumption that increase in the level of production leads to a correspondent increase in profit the higher the supply the higher the profit. The estimate value of distance was statistically significant at 5% level implying that the distance of processing to the market has negative impact on the technical efficiency of a cassava processor. This is possible in Nigeria where there is bad transportation system so when a processor tries to convey the processed products to there are needed he is likely to encounter many constraints like cost of fuel, high transportation cost and other tariffs which will downsize his morale for the processing work thereby rendering him technically inefficient. Umannah, (2005).

Estimate value of the amount of credit was negative and significant statistically at 1% level, this is an indication that the amount of credit receivable by a processor can impact negatively on his technical efficiency. This is true because cassava processing requires credit or loan in order to purchase some of the equipment necessary for efficient processing when setting up, even the daily improvement in the processing industry. Also credit has been identified as a major criteria in the development of agricultural sector in Nigeria but the high rate of interest rate tends to be a major barrier credit access. This relates to the work by Oladeebo (2012) Ekwueme, Adrika and Umeabali (2013) and Aliyu *et al.,* (2017) unpublished.

Conclusion and Recommendations

The cassava business is a male dominated enterprise this could be as a result of intense energy required and time-consuming activities associated with processing cassava. Household size is on average in the study area due to the fact that there is reproductive awareness, virtually all sampled processors had a good level of literacy. Furthermore, the most consumed commodities driving the demand for cassava root are garri, cassava fufu flour, HCQF, and starch with garri leading the pack as the most consumed product followed by cassava fufu flour. Thus the cost and return analysis of cassava processing shows an appreciable profit in processing.

Profitability of cassava processing venture is determined by cost of root, years of processing experience, frequency of processing and marital status which have an inverse relationship with profit while distance, production volume, age, household size, credit amount and cooperative membership have a direct relationship with profitability.

1. Government should devise ways to ease the scarcity of cassava roots thereby making it accessible to processors.
2. Processors should always make plans for alternative source of power due to the shortage of electricity supply in the area.

3. The government should try every possible way to provide processing center close to the cassava farms and provide subsidized transportation from farms to processing locations in order to reduce the cost of transportation.
4. The government should also utilize adequate pricing mechanisms to help keep the profits of the processors' high, this will go a long way in keeping the net revenue as well as profitability level high and as well attract more vibrant personnel into the of business.
5. Adequate sensitization should be made to enlighten the populace on the other value chain associated with cassava processing other than garri. In doing so there will more demand for the other primary products which can in turn increase the processors profitability.

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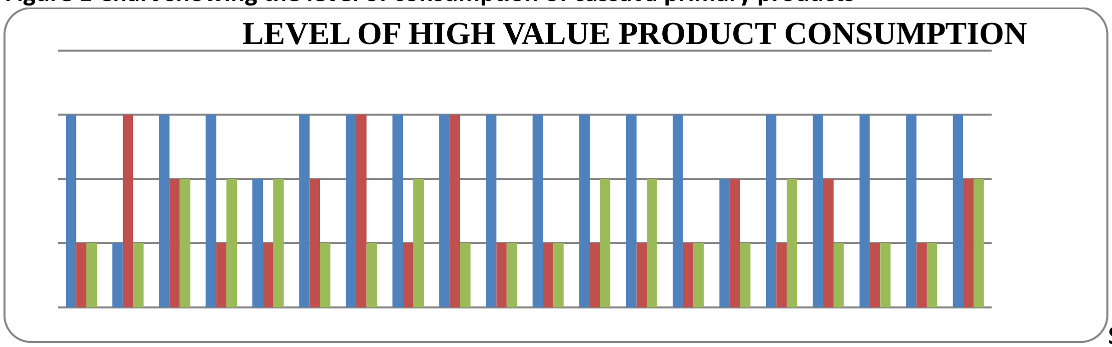
Table 1: Socioeconomic Characteristics of High Value Cassava

Variable	Mean	Std. Dev.	Min	Max
Sex	0.65	0.4893605	0	1

Age	40.05	8.363297	28	54
House Hold size	5.85	1.694418	2	9
School Years	17.95	2.665076	12	25
Credit Access	0.3	0.471623	0	1
Credit Amount	325000	733323.4	0	3000000
Years of Business Experience	9.9	6.766014	2	21
Cooperative membership	0.5	0.5129892	0	1
Area	0.45	0.5104178	0	1
Marriage	1.7	0.4701623	1	2
Occupation	2.7	0.5712406	1	3
Target Market	2.6	0.680557	1	3
Target Consumer	3.6	1.698296	1	4

Source: Field Survey, 2018. **Number of Observations =20**

Figure 1 Chart showing the level of consumption of cassava primary products



Source: Field survey, 2018.

Table 2. Cost and Benefit Analysis

Items	Monthly value	Annual Value
Fixed cost		
Depreciation grater	-	35,960.12
Depreciation peeler	-	54,898.81
Depreciation presser	-	43,848.95
Depreciation Lister	-	82,505.95
Depreciation flash	-	373,989.30
Total Fixed Cost		591, 203.00
Variable cost		
Rent cost unit (month)	14841.25	178095
Labour cost per person/month	4175	50100
Root cost per unit (1tonne)	28950	347400
Electricity (per month)	9200	110400
Diesel (per month)	225.55	2706.6
Total Variable Cost	57391.8	688701.6
Revenue flows		
CA - Garri total value	207000	2484000
CD - Fufu total value	314185	3770220
CG - Cassavita total value	193650	2323800

CJ - HQCF total value	423030	5076360
CM - Peels total value	14200	170400
Total Cost	648594.8	7783137.6
REVENUE	1152065	**13824780**
NET REVENUE	503470.2	**6041642.4**

Source: Field Survey, 2018.

4: Table 3. Parameter estimates of the OLS regression on the determinants of profitability in high value cassava processing in Abia state.

Log Net Revenue	Coefficient	Standard error	t-values
Root cost per tonne	-0.0002215	0.0000645	-3.44**
Distance to market	0.0255057	0.010121	2.52*
Years of training	0.2151496	0.1305365	1.65
Years of processing experience	-0.1911502	0.0403192	-4.74***
Frequency of processing	-0.720176	0.1059019	-6.80***
Production volume	0.0001561	0.0000154	10.16***
Marital status	-1.14767	0.2818519	-4.07***
Occupation	-0.0851712	0.1937374	-0.44
Sex	0.4742506	0.2947374	1.61
Age	0.475363	0.0179341	2.65**
Household size	0.3371752	0.1311933	2.57**
Years of education	0.0614166	0.1298275	0.47
Credit amount	6.05e-07	1.01e-07	5.99***
Cooperative membership	0.4021037	0.1342093	3.00**
_ constant	18.57333	3.240131	5.73**
Number of respondents	**20**		
F-ratio	34.18***		
R-square	0.9897		
R-square (Adjusted)	0.9607		

Legend: ***, ** and * connotes 1%, 5% and 10% statistical significant respectively.

Source: Field Survey, 2018

Table 4.7: Maximum Likelihood Estimates (MLE) of the Cobb-Douglas stochastic frontier function showing the Technical efficiency of High value cassava processors

Number of Observations =20; Wald Chi^2 (4) =178.83 and Prob>Chi^2 =0.0000

Processing inputs	Coefficients	Standard Error	z-values
Rent	0.0946706	0.0773105	1.22
Roots	0.3644394	0.0662984	5.50***
Source of Power	0.5029951	0.1613947	3.12***
Labour	0.0937936	0.0720021	1.30
_constant	2.36232	1.450904	1.63**
Determinants of Technical Inefficiency			
Years of training	-4.914505	2.79944	-1.76*
Production volume	-0.0018816	0.0009325	-2.02**
Age	0.3037894	0.2542302	1.19
Distance	-1.047123	0.5412022	-1.93**
Years of schooling	-3.656498	2.456041	-1.49
Credit amount	-0.0001038	9.441241	-0.001***
Target market	6.556749	4.510741	1.45
_constant	62.21047	45.86577	1.36***
Vsigma			
Constant	-5.099063	0.3846319	-13.26***

Sigma *u*	0.2679635	0.0423697	6.32***
Lambda	2.040706	0.0624632	32.67***
Mean efficiency= 93.21%			
Standard deviation= 0.1205857			
Log likelihood= 19.3609***			

.**Source: Field Survey, 2018** Legend: ***, ** and * connotes 1%, 5% and 10% level significant respectively.

ASN 53rd Annual Conference Proceedings (Sub-Theme: Agricultural Engineering, Processing & Value Addition)

Influence of Tenderizer type, Concentration and Application Method on Chemical Properties of *banda* (Nigerian dried meat product)

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Abstract
The study was conducted to evaluate the effects of types of tenderizer, concentrations of tenderizer and tenderizer application methods on chemical properties of *banda*(Nigerian Dried Meat Product). Four hundred and sixteen (416) pieces of *Banda* samples were laid out in a factorial arrangement of four tenderizer types (Trona, Potash, Alum and Baking powder) at four concentrations (0g/l, 5g/l, 10g/l and 15g/l) and two application methods (Boiling and Soaking). The experiment followed a Completely Randomized Design (CRD) where samples were randomly allocated to 32 treatment combinations. Results of chemical components shows that tenderizer type and application method had significant effect ($P<0.05$) on all chemical components (moisture content, ash content, crude protein and ether extract). Concentration had effect ($P<0.05$) on all chemical components except ether extracts. It was concluded that, tenderization of banda with either baking powder or trona at the concentration of 5g/l by either boiling or soaking application method engenders greater level of chemical properties.

Key words: *Banda*, Baking powder, Trona, Moisture, Ether extract

Introduction

Chemically, meat is the muscle tissue of an animal containing about 65% water, 12.3% protein, 5% fat and carbohydrate, and about 17.7% vitamins and minerals which is regarded as food for human beings (FAO, 2009). It makes valuable contribution to the diets of developing countries due to its high nutritional and biological values as an excellent source of proteins and nutrients especially fats, A and B vitamins, iron and zinc. It has high contents of essential amino acids needed to build, maintain and repair body tissues (Fakolade, 2011). Dressed carcass and fresh meat can only remain fresh for a short time before spoilage sets in. Frederick (2011) pointed out that deteriorative changes in meat begin after rigor mortis that follows animal slaughter. Contamination by micro-organisms is the major cause of meat deterioration which can lead to spoilage. Spoilage in meat is undesirable due to change in colour, unpleasant odour, loss of eating quality and rejection by consumers. It is necessary to prevent spoilage by preserving the little meat available (Brigitte *et al*., 2004). *Banda* is tough and dried meat product that needs to be tenderized before cooking. The use of local tenderizers in traditional meat cooking is common however, some substances like trona ($Na_2CO_3.N_aHCO_3.2H_2O$), potash (K_2CO_3), alum ($KAL(SO_4)_2.12H_2O$) and baking powder ($NaHCO_3$) are traditionally used in tenderization (Ribah, 2012) but studies on the suitable type of tenderizer to be used and its related influence on chemical properties of *banda* are scanty. The aim of the study is to investigate the effect of type of tenderizer, tenderizer concentration and application method on chemical properties of *banda*. The objectives are to determine the influence of type of tenderizer, concentration and application method on the chemical properties and to identify the factor combination that will optimize chemical properties of *banda*.

Materials and Methods

Study Area: The study was conducted at the department of agricultural education, Adamu Augie College of Education Argungu, Kebbi State.

General Experimental Layout: Four hundred and sixteen (416) pieces of *banda* bought from meat market were used for the experiment. Samples were laid out in factorial arrangement of four tenderizer types (trona, potash, alum, JN and baking powder), four concentrations (0, 5, 10, 15g/l) and two application methods (boiling and soaking) replicated thirteen (13) times. The experiment followed Completely Randomized Design where the samples were randomly allocated to 32 treatment combinations.

Data Collection: Each 13 pieces batch of *banda* samples meant for the soaking application method were soaked in one litres of their respective tenderizers at each of the four concentrations for one hour, after which they were drained and boiled in plain water for 40 minutes. In the boiling application method, there was no draining of tenderizer solutions. The samples were boiled in the tenderizers for 40 minutes. Chemical Parameters measured were Moisture, Ash, Crude protein (CP) and Ether Extracts (EE). They were determined according to AOAC (1990) method.

Data Analysis: Tenderizer type, concentration and application method were compared for all the chemical parameters using General Linear Model (GLM) univariate procedure of SPSS (version 16). Significant means were separated using Tuckey test.

Results and Discussion

Table1. Chemical properties of *banda* according to type of tenderizer, concentration of tenderizer and application method.

Moisture content: Tenderization of *banda* samples with alum gives the highest moisture content (45.70) among tenderizers. The high moisture content could be attributed to the hydration of myofibrillar proteins due to the hygroscopic properties of alum in which it can absorb water from tenderizing solution (Karthikeyan *et al*., 2006). It could also be due to its lower pH of 3 (Martin, 2013) that can influence the meat matrix causing damage to meat proteins micro-structure leading to more water absorption (Elisabeth and Steven, 2005). Highest moisture content (46.56) in samples tenderized with concentration of 15g/l might be due to the use of higher concentration of salt from tenderizers that can increase water absorption. Meat myofibrillar proteins are salt soluble, in higher salt concentration they solubilize and form a sticky exudate on the surface of the meat pieces and the exudate forms a matrix of heat-coagulated protein which entraps free water and increase the moisture content of the product (Rhonda, 1998). This is similar to the report of Nesimi *et al*. (2003) where beef treated with highest salt concentration shows the highest moisture content. This may be explained by case hardening of coagulated proteins and their migration to meat surface preventing further moisture release due to an increase in salt concentration. Samples that are boiled had higher moisture (41.67) than those that were only soaked (41.16). This may be as a result of the combine effect of heat and tenderizer salts that increases the hydration and solubilization of meat proteins thereby improving the moisture content of samples that were boiled in tenderizer solution. It could also be the combine effects of heat and salts from tenderizing solution that constitute an increased softening force enhancing moisture inflow during cooking in which there was no much force to drive the water in to meat due to the absence of heat when samples were only soaked. This is similar to the report of Haluk and Ramazan (2011) who reported higher percentage of moisture from meat samples boiled in sodium chloride solution than those that were boiled without sodium chloride solution.

Ash content: Tenderization of *banda* samples with trona provides highest ash content (5.13) than tenderization with other tenderizer types. This could be due to its composition of clay and silica that might have added to the mineral content of the samples (Safaei *et al*., 2014). Presence of aluminium ion can lead to the decrease in ash content from samples tenderized with alum (Dejan *et al*., 2008). Samples tenderized in tenderizer concentration of 10g/l had higher ash content (3.76) which could be attributed to the use of optimum tenderizer concentration. High salt concentration induces muscle fibre shrinkage and reduction in the mineral content of meat (Offer and Knight, 1988). Samples that were boiled had higher ash content (3.19) than those that were only soaked in tenderizer solution (2.87). Increased in ash values observed from the boiled product could be due to aggregation of mineral nutrients as a result of the effect of heat on meat muscles (Fakolade and Omojola, 2010). It could also be due to the addition of mineral nutrients from the tenderizing solution as ash content was a reflection of the amount of additives used (Kembi and Olorunkoya, 1991). This is similar to the report of Haluk and Ramazan (2011) who observes high ash values from meat samples boiled in salt solution than those that were only soaked.

Crude protein: From the result, samples tenderized with trona and baking powder had the highest percentage of crude protein (44.17 and 44.01) which was attributed to their composition of bicarbonate ions and their alkaline nature that can enhance protein level. The efficacy of bicarbonates in increasing the level of proteins is attributed to their ability to partially solubilize myofibrillar proteins and enhance their electrostatic repulsion through raising the pH. This leads to transverse expansion of myofibrils and increases the protein surface. It was reported by Kembi and Olorunkoya (1991) that bicarbonates in the presence of sodium chloride are known to enhance dissociation of meat proteins actomyosin thus making it more soluble. This is in line with the report of Richardson and Jones (2007) which indicates an increase in protein content of meat due to an increase pH. Tenderization of samples with tenderizer concentration of 0g/l (control) recorded the highest percentage of crude protein (46.43) possibly due to the absence of salt to cause proteolysis of muscle proteins. A trend of "the higher the tenderizer concentration, the lower the crude protein content" was observed. This was probably due to the proteolytic degradation of muscle myofibrils by high salt concentration leading to reduced crude protein content. This does not agrees with the reports of Richardson and Jones (2007) and that of Brianna (2011) whose indicates an increase in percentage of crude protein by increasing salt concentration. Samples that were only soaked in tenderizer solution had higher crude protein content (43.37) than those that were boiled (42.06). This was due to the denaturation of protein through the application of heat during boiling that can lead to aggregation and clumping of protein molecules (coagulation), the presence of which indicates a loss in protein solidility. Hedrick *et al*. (1994) noticed that in well cooked meat, an increased rigidity typically occur, which is referred to as protein hardening. This was in line with the observation of Haluk and Ramazan (2011) who report a significant reduction in protein values of meat treatment groups boiled with salt solution than those treated without salt.

Ether extract: *Banda* samples tenderized with alum had the highest percentage of ether extract (12.42) than samples tenderized with potash (5.46) Alum, baking powder and trona report statistically similar effect. The higher percentage of ether extract from samples tenderized with baking powder and trona is attributed to their higher pH that can enhance fat level (Richardson and Jones, 2007) and the presence of clay and silica in trona can add to lipid content of the meat samples as observed by Safaei *et al*. (2014). No significant difference (P>0.05) was observed among the tenderizer concentrations on the composition of ether extract which may be as a result of the close similarities in the chemical composition of tenderizer substances. Samples that were only soaked had higher lipid content (11.46) than those that were boiled (5.44) in tenderizer solution. The lower lipid content of samples that were boiled with tenderizer could be due to heat generated during cooking that can lead to the loss of essential fatty acids mainly due to lipid oxidation (Bou *et al*., 2001). The result agree with the finding of Rodriguez *et al.* (1997) who observed a significant decrease in the lipid content of boiled meat compared to non-boiled.

Conclusion and Recommendation

It was concluded that, chemical properties were affected by the type and concentration of tenderizer and method of application.

Based on the findings of the study, it was recommended that *banda* should be tenderized with baking powder or trona at the concentration of 5g/l using either boiling or soaking application methods for better product performance in terms of chemical properties.

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Chemical Property Factor	Moisture (%)	Ash (%)	Crude Protein (%)	Ether Extract (%)
Overall mean	41.42	3.03	43.22	8.45
Tenderizer				
Alum	45.70^{a}	2.06^{d}	43.47^{b}	12.42^{a}
Baking powder	41.40^{c}	2.73^{b}	44.01^{a}	8.48^{ab}
Potash	42.00^{b}	2.20^{c}	41.23^{c}	5.46^{b}
Trona	36.56^{d}	5.13^{a}	44.17^{a}	7.44^{ab}
SE	0.07	0.03	0.06	1.81
Concentration				
0g/l	46.30^{b}	1.90^{d}	46.43^{a}	11.12
5g/l	41.46^{c}	3.46^{b}	44.74^{b}	5.76
10g/l	31.35^{d}	3.76^{a}	43.25^{c}	10.35
15g/l	46.56^{a}	3.00^{c}	38.44^{d}	6.57
SE	0.07	0.03	0.06	1.81
Application Method				
Boiling	41.67^{a}	3.19^{a}	43.06^{b}	5.44^{b}
Soaking	41.16^{b}	2.87^{b}	43.37^{a}	11.46^{a}
SE	0.05	0.02	0.04	1.28

abcd = means bearing different superscripts along the same column within a subset differ ($P<0.05$)

ASN 53rd Annual Conference Proceedings (Sub-Theme: Agricultural Engineering, Processing & Value Addition)

Modification and Performance Assessment of a Castor Shelling Machine

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Abstract

Castor is an indigenous plant of Southeastern Mediterranean Basin and Indian origin. Today, it is widespread throughout the tropical regions. Castor establishes itself easily as an apparently "native" plant and can often be found on wasteland. Shelling can be done both manually and mechanically. Manual method is a traditional means of shelling, it does not encourage higher productivity, requires high application of energy and time consuming. The existing castor shelling machine has deficiency in shelling and cleaning. The objective of this research work is to modify the existing castor shelling machine designed and fabricated by Agricultural Engineering Department of National Cereals Research Institute Badeggi, The parts modified were shelling cylinder, shelling clearance, and incorporation of blower and shaker mechanism. The modified castor shelling machine performs better than the existing machine with improved average shelling efficiency of 91.5 %, kernel recovery rate of 88.6.7 %, percentage losses of 14.5 %, percentage damage of 3.1375% and cleaning efficiency of 70.00%. The machine capacity was found to be 832 kg/ day. The shelling speed, shelling clearance and moisture contents were investigated and the maximum shelling efficiency was obtained at shelling speed of 445 rpm, shelling clearance of 82.5 mm and moisture content of 8 % to be 91.5 %. The modified machine would encourage potential castor farmers to go into mass production of castor seeds and its products since it is going to reduce drudgery, save time and increase productivity.

Keywords: Castor, Shelling, Machine, Modified and Efficiency

Introduction

Castor is indigenous to the Southeastern Mediterranean Basin and India. Today, it is widespread throughout tropical regions. Castor establishes itself easily as an apparently "native" plant and can often be found on wasteland. It is often seen along the road sides and on dump sites or heaps throughout the tropics and subtropics. The castor seed botanically referred to as *Ricinus communis* belongs to the *Euphorbiaceae* or *spurge* family. Castoris basically divided into two types, tall (giant) and short (dwarf) and its seed contain 40-60 % oil (Balami *et al*., 2012). The world production of castor seed was 1,209,756 metric. India is the largest producer of castor seed followed by China, Brazil, Ethiopia and Paraguay accounting for about 85% of the global production of the seed. The statistical data of castor production in Nigeria has not yet been made available because farmers in Nigeria are not growing castor in large quantities (Food and Agricultural Organisation, 2008).. Nigeria spends between four to six hundred million dollars ($ 600,000) annually importing castor oil despite the abundant land, ecological and climatic conditions which are favorable to castor production (Oyeyemi *et. al.,* 2007). Pradran *et al.* (2010) defined Shelling of seeds as the action of separating the shell/seed coat from the seed or kernel. Shelling may be achieved using one of several methods (mechanical): impact, rubbing, compression or a combination of any these three. In these three ways, the rubbing action would produce seed with minimal damage.Shelling cane be done both manually and mechanically (Oluwole and Adedeji, 2012). Manual method is a traditional means of shelling which involves the separation of seed from the spiny husk by prolonged sun drying in the open space until the casing splits or are beaten by stone or rubbed with wooden plank. The traditional methods of castor shelling have being found to be inefficient, laborious, time consuming and result in low output and energy sapping (Kenneth and Kochar, 2012).The existing castor shelling machine designed and fabricated by Gbabo *et al.* (2015) in Agricultural Engineering Department, National cereals Research Institute Badeggi, Niger State has low shelling and cleaning efficiencies, hence there is need to carry out this modification in order to improve on the performance of the machine

Materials and Method

Testing of the existing castor shelling machine

The materials required for testing of the machine include castor pods, weighing balance, moisture meter and stop watch. The existing castor shelling machine shown in figure 1 below was then tested to identify problems associated with its operation due to shortcomings in its design. The necessary procedures were carried out to eliminate the causes of the shortcomings observed vividly.

Problems identified with the existing castor shelling machine

- Losses from the hopper as a result of escaping of some pods from hopper during shelling.
- Low cleaning efficiency due to rapid free flow of materials
- Low shelling efficiency.

The proposed modification on the existing castor shelling machine

The improvement on the existing machine was carried out on the basis of the problems identified during the initial performance evaluation. The hopper was slightly moved to the side of the shelling cylinder cover and its opening, partially covered to reduce losses during shelling. Shaking mechanism was incorporated to reduce rapid free flow of materials in order to improve the cleaning efficiency. The spike tooth mechanism on the shelling cylinder was replaced with rubber covering the cylinder to improve on the shelling efficiency as well as to minimize percentage damage.

Design consideration of the improved castor shelling machine

Some factors were considered in the design modification of the castor shelling machine in order to make it effective and efficient. The factors considered in the machine modification include:Material availability, Versatility, Strength of material, Portability, Ease of operation and maintenance.

Design Analysis

Design analysis of the modified machine was carried out to determine necessary design parameters for the selection of constructional materials as well as various machine parts in order to avoid machine failure during its required working life.

Determination of machine capacity

The capacity of the improved machine is a paramount parameter required in the design of other components. It was estimated using standard formula for calculating the curved surface area of cylinder and then multiplied by the clearance between the shelling cylinder and concave, bulk density of biomaterial and shelling cylinder speed which is given as follows:

$$V_m = (2\pi\ rhc \times \rho)n \qquad 1$$

Where; V_m = capacity of the machine (kg/min.), r = radius of the shelling cylinder (m), h = length of the shelling cylinder (m), c = clearance between the shelling cylinder and the concave (m), π = constant (22/7), ρ = bulk density of castor pod (kg/m^3), n = speed of shelling cylinder (rpm)

Evaluation of the weight of the shelling cylinder

The weight of shelling cylinder was determined so as to estimate the amount of load exerted on the shaft by the shelling cylinder. Hence the weight of the shelling cylinder was calculated as reported by Gbabo *et. al*, 2016.

$$W = mg = \rho vg \qquad 2$$

Where W = Weight of the shelling cylinder (N), m = mass of the shelling cylinder (kg) ($m = \rho v$), g = acceleration due to gravity (m/s^2), ρ = density of the shelling cylinder (kg/m^3), v = volume of the shelling cylinder (m^3) $v=\pi r^2 h$

Power requirement

This is the sum of the various power required to drive the shelling cylinder, blower and shaker. The speed required to effectively set the shelling cylinder, blower and shaker in motion all depends on the speed of electric motor and pulley sizes. Both speed and pulley sizes were determined from the following relationship.

$$N_m D_m = N_s D_s,\ N_m D_m = N_B D_B,\ N_s D_s = N_{sh} D_{sh} \qquad 3$$

Where Nm = speed of electric motor (rpm), D_m = diameter of electric motor pulley (M), N_s = speed of shelling cylinder (rpm), D_s = diameter of shelling cylinder pulley (M), N_{sh} = speed of shaker shaft (rpm), D_{sh} = diameter of pulley driving the shaker shaft (M)

And power required is expressed as;

$$P_T = \tau_s\omega_s+\tau_b\omega_b+\tau_{sh}\omega_{sh} \quad 4$$

Where P_T = total power required (W), τ_s = torque of shelling cylinder (Nm), ω_s = speed of shelling cylinder (rad/s), τ_b = torque of blower shaft (Nm), ω_b = speed of blower shaft (rad/s),τ_{sh}= torque of shaker shaft (N_m), ω_{sh} = speed of shaker shaft (rad/s)

Determination of size of shafts

This was computed to ascertain the size of shaft that can withstand the applied load. For a solid shaft, the diameter of the shaft was determined using relationship reported by lukman (2017);

$$d^3 = \frac{16}{s_a\pi}\sqrt{(Kb\ Mb)^2 + (Kt\ Mt)^2} \quad 5$$

Where d = diameter of shaft (m), S_a= allowable shear stress (N/m^2), K_b = combined shock and fatigue factor applied to bending moment, M_b = maximum bending moment (Nm), K_t = combined shock and fatigue factor applied to twisting moment, M_t = twisting moment (Nm), π = constant (22/7)

Construction of the modified machine

The materials for construction of the machine were selected based on the obtained designed parameters and some standard components which were purchased directly based on the specification from design calculations. Various machine components were formed. The components were assembled as shown in Figure 2 below:

Operational Principle of the machine: The castor shelling machine was modified to shell castor pods. A 5hp electric motor provides power to the shelling cylinder shaft. The shaft rotates with the aid of bearings. It also provides power to the blower and shaking mechanism through belts and pulleys. As the castor pods are fed into the shelling cylinder through hopper, castor pods are then crushed between shelling cylinder and perforated concave where both castor seeds and crushed cover shell pass down to the shaking mechanism. On the screen of the shaker, the crushed cover shell are then blown out as chaff by the stream of air blast from the blower while seeds fall through a screen down to the base of cleaning unit and collected as clean castor seeds through the outlet.

Performance assessment of the modified machine: In order to determine the level of performance of the modified castor shelling machine, some parameters were measured and such parameters include:

Shelling efficiency: Shelling Efficiency is the capacity of the machine to effectively shell the castor pods. It was computed using equation 6.

$$\text{Shelling Efficiency (\%)} = 1-\frac{massof\ the\ un-shelled\ pods}{Total\ mass\ of\ the\ sample} \times 100 \quad 6$$

Cleaning efficiency: Cleaning involved the ability of the blower to efficiently separate the chaff from the kernels or seeds without leaving any chaff in the shelled seeds. The cleaning efficiency was calculated as given in equation 7 below.

$$\text{Cleaning efficiency (\%)} = 1 - \left(\frac{Total\ mass\ of\ impurities}{Total\ mass\ of\ clean\ seeds}\right) \times 100 \quad 7$$

$$\text{Seed loses at outlet (\%)} = \frac{mass\ of\ the\ kernel\ (whole+broken)with\ husk\ (kg)}{Total\ mass\ of\ the\ sample\ (kg)} \times 100 \quad 8$$

Percentage of un – shelled seeds (pods): During shelling, some of the pods go through the shelling chamber and pass through the screen opening without being shelled. This occurred when the diameter of the seed is smaller than the diameter of the screen opening. It was computed using equation 9 below;

$$\text{Un – shelled seeds (\%)} = \frac{mass\ of\ un-shelled\ seeds}{Total\ mass\ of\ seeds} \times 100 \quad 9$$

Results and Discussion

The study was undertaken to modify castor shelling machine. The result of the performance parameters of machine is given and discussed as follows.

Kernel recovery efficiency: The highest kernel recovery efficiency of the modified castor Sheller was 88.56% at 445rpm, 8% which is higher than the 81% of kernel recovery of previous castor Sheller under the same condition. This result for the modified Castor shelling machine is in line with kernel recovery efficiency of 99.6% reported by Balami *et., al.* (2012) for castor seed decorticator.

Cleaning efficiency: The cleaning efficiency of the modified castor Sheller was 70.0% at 445rpm, 8% which is higher than the 32.23% of the existing castor Sheller under the same condition. This result is in line with kernel recovery reported by Balami *et. al.* (2012) for castor seed decorticator.

Un-shelled pods: The average percentage of the Un- Shelled pods for the modified castor Sheller was 9.07% which was lower than the 32.0 average percentage un- shelled seeds of the existing castor shelling machine as shown in the figure 3 bellow. The smaller value of average un- shelled seed indicate a very good result as the value is negligible.

Blower losses: The average seed losses through blower in the modified castor Sheller was 14.5% which is minimal compared to 32% average blower loses of the existing machine at the same condition of shelling as shown in figure 3 bellow. It is also minimal compare to the total (1000g) weight of the castor seeds feed into the machine which therefore gives better result.

Percentage damage of seeds: The average percentage damage to seeds in the modified castor Sheller is 3.1% which is better than the 22.20% of the existing machine

Conclusion and Recommendations

The existing machine was successfully evaluated and modified. The modified castor shelling machine showed improved performance compared to the existing machine with improved average shelling efficiency of 91.5 %, kernel recovery rate of 88.6.7 %, percentage losses of 14.5 %, percentage damage of 3.1375% and cleaning efficiency of 70.00%. The machine capacity was found to be 832 kg/ day. The shelling speed, shelling clearance and moisture contents were investigated and the maximum shelling efficiency was obtained at shelling speed of 445 rpm, shelling clearance of 82.5 mm and moisture content of 8 % to be 98.02 %. The modified machine would encourage potential farmers to go into mass production of castor seeds and its products since it will reduce drudgery, save time and increase productivity.

1. The Castor pods should be shelled at lower (8%-10%) moisture content in other to reduce the seeds breakage and thereby increases the kernel recovery of the machine.
2. The modified machine is recommended for adoption and commercialisation to meet the needs of castor seeds processors at small, medium and large scale levels.

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Figure 1.The existing castor shelle.

Figure 2.Pictorial view of modified machine.

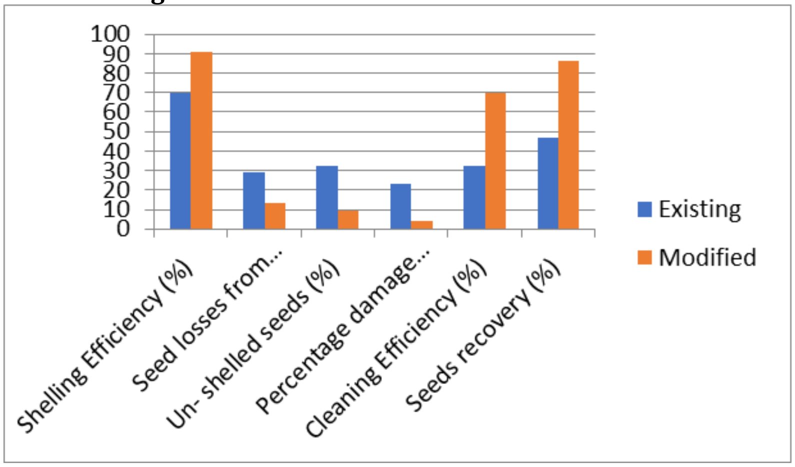

***Figure 3*: Comparison assessment of the existing and modified castor shelling machine**

ASN 53rd Annual Conference Proceedings (Sub-Theme: Agricultural Engineering, Processing & Value Addition)

Nutritional Contents of Two Leafy Indigenous Vegetables Consumed in South western Nigeria

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Abstract
The proximate and mineral composition of two indigenous vegetables in South Western Nigeria was evaluated. Data obtained were analysed in triplicates with analysis of variance and treatment means separated using Duncan Multiple Range Test. Both vegetables - Corchorus olitorus (24.69%) and Amaranthus cruentus (27.75%) had higher level of crude protein as well as carbohydrates with C. olitorus having 50.5% and A. cruentus having 29.60%. There was no significant difference in the level of micro-nutrients in both vegetables. Thus, indigenous vegetables are generally cheap sources of protein, minerals and vitamins which should be consumed for normal growth. This calls for the need to educate the populace about the available vegetables around them with their dietary and medicinal use to promote increased production and adequate consumption.

Introduction
The vegetation of the South Western Nigeria, being in the rain forest region is very rich in fruit and leafy vegetables (Awobajo, *et al*., 2010). Indigenous leafy vegetables are often gathered but are cultivated and have been improved by breeding and selection (Rice and Tindal, 1987). They include *Amaranthus spp., Celosia argentae* (Corkscomb), *Telferea occidentalis* (fluted pumpkin), *Vernonia amygydalina* (bitter leaf), *Corchorus olitorus* (Jute mallow), etc. They are generally cheap sources of vitamins, minerals and protein in Tropical Africa where starchy crops are the staple foods, as well as add flavour, variety, taste, colour and aesthetic appeal to diet (Mepba *et al*., 2002). Awobajo *et al*., (2010) observed that very few vegetables are routinely included in the diet compared to the abundance of vegetables in the South Western Nigeria and in many African countries. Vegetables are very abundant immediately after the rains but becomes scarce in late rainy season and more so in dry season (Adeleke and Abiodun, 2010). However, scarcity of vegetables in the diet is a major cause of Vitamin A deficiency, causing blindness and even death in young children particularly in arid and semi-arid regions of Africa, (Adeleke *et al*., 2010),Nigeria inclusive. This is the more reason why joint FAO and WHO (2004) report on a Global Strategy on Diet, Physical Activity and Health recommended a minimum daily intake of 400 grams of fruits and vegetables per person. In order to assess the contribution of vegetables, various elemental nutrients in these vegetables have to be determined before any valid recommendations could be made (Olusola, 1982) as the most important enterprise of the pre-urban system, important component of human diet and their easy cultivation on small area of land. Therefore, the objective of this work was to evaluate the nutritional contents of two leafy indigenous vegetables (*Corchorus olitorus* and *Amaranthus cruentus*) consumed in South Western Nigeria, so as to appreciate their nutritional values for the populace in order to include them in their diet and making some economic gains from their cultivation.

Materials and Methods
Samples of two commonly consumed leafy indigenous vegetables (*Corchorus olitorus* and *Amaranthus cruentus*) were harvested fresh from Teaching and Research Farm of Yaba College of Technology (YABATECH), Epe Campus 4 weeks after planting. They were carefully washed with distilled water to remove unwanted matters, air dried, grinded manually with porcelain mortar and pestle and milled to pass through 0.5mm sieve, stored in plastic

bottles and labelled appropriately, analysed in triplicates according to the methods of Association of Analytical Chemist (AOAC, 2012) as described by Rosulu *et al*, (2018) for their proximate and mineral composition.
Determination for proximate composition was done for moisture (using auto moisture analyser model ML-50), ash (using carbolite model), Protein (Kjeldahl digestion and steam distillation method with model KJELTEC 8200), fibre (using FIBRETEC hot/hydrolysis unit, model 1020) and fat (using Soxtec Extraction System, Soxtec model 2005). Protein content was obtained by multiplying the Nitrogen value by a factor of 6.25 (Kjaldahl Nitrogen) while available carbohydrate (Nitrogen free extract) was calculated using differenciation method. Determination of mineral composition of *Corchorus olitorus* and *Amaranthus cruentus* was done by digestion and wet oxidation methods (AOAC, 2012) using $HClO_3/HNO_3/H_2SO_4$ mixture. Sodium and Potassium was assayed by flame photometry (Model AAS 200A, Busch Scientific), Calcium and Magnesium was determined by Atomic Absorption Spectrophometry (AAS), while Phosphorus was determined by Colorimetric Spectrophotometer using Vanadomolybdate reagent. Nitrogen in the digestion was evaluated by using auto analyser.
Data Analysis: Data were analysed for significant differences in their means with Analysis of Variance at $p < 0.05$ and differences in the means were separated using Duncan Multiple Range Test (DMRT) as packaged by SPSS (2001).

Results and Discussion
Results obtained for proximate and mineral composition as presented in Tables 1(a and b) and 2(a and b) revealed that both *C. olitorus* (24.69%) and *A. cruentus* (27.75%) had higher levels of crude protein content as well as higher carbohydrates (with *C. olitorus* having 50.5% and *A. cruentus* 29.60%) than other proximate components. In all the mineral contents analysed, both vegetables had higher percentage of potassium, followed by magnesium, calcium and phosphorus in hierarchical order. However, the phosphorus level in *A. cruentus* (21.5%) is higher than that of *C. olitorus* (5.42%). Thus, protein, macro minerals and vitamins are the major components of vegetables. This notion is in agreement with Mepba *et al*., (2002) and Rice and Tindal (1987) which reported that indigenous vegetables are generally cheap sources of protein, vitamins and minerals paricularly in Tropical Africa where starchy crops are the staple foods. However, there were no significant difference ($p \geq 0.05$) in the level of micro-nutrients in both vegetables. The moisture content of *C. olitorus* ranged from 23.28 to 7.20%. Here, the moisture content in *C. Olitorus* is significantly ($p < 0.05$) higher (23.28%) than that of *A. cruentus* (8.35%). Besides, the percentage fat content in *C. olitorus* was moderately higher (11.81%) than *A. cruentus* (2.70%).

Conclusion and Recommendations
This study revealed proximate and mineral composition of two indigenous vegetables mostly consumed in South Western Nigeria. They contain appreciable amount of nutrients (protein, minerals, CHO and fibres/roughages) which could be consumed for normal growth.
As those vegetables are adapted to the rainforest region of the country, there is therefore the need for education of the people about the available vegetables around them with their dietary and medicinal use to promote increased production and adequate consumption. Government effort should also be geared towards encouraging urban commercial agriculture with inward search into the available vegetables in each community.

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Table 1a: Proximate Composition (mg/100g) of *Corchorus olitorus* consumed in SouthWestern Nigeria.

SAMPLE	MOISTURE	% CRUDE PROTEIN	%CRUDE FAT	%CRUDE FIBRE	% ASH	% CHO
REPLICATE 1	7.20±0.14[b]	22.51±0.09[a]	10.28±0.02[a]	2.38±0.08[a]	7.11±0.02[b]	50.5±0.02[b]
REPLICATE 2	7.25±0.21[c]	24.69±0.04[c]	10.23±0.02[a]	7.07±0.03[a]	7.07±0.03[a]	49.18±0.02[b]
REPLICATE 3	23.28±0.14[a]	23.28±0.02[b]	11.81±0.02[c]	8.55±0.01[b]	8.55±0.01[c]	43.9±0.03[a]

Table 1b: Proximate Composition (mg/100g) of *Amaranthus cruentus* consumed in SouthWestern Nigeria.

SAMPLE	MOISTURE	% CRUDE PROTEIN	%CRUDE FAT	%CRUDE FIBRE	% ASH	% CHO
REPLICATE 1	7.00±0.14[c]	25.96±0.09[a]	1.70±0.02[a]	11.70±0.02[a]	22.58±0.02[a]	31.17±0.01[c]
REPLICATE 2	7.85±0.07[b]	26.18±0.02[b]	2.70±0.02[c]	12.45±0.01[c]	22.28±0.02[a]	28.60±0.02[a]
REPLICATE 3	8.35±0.21[a]	27.75±0.02[c]	1.25±0.07[b]	11.70±0.14[b]	22.21±0.03[a]	29.60±0.01[b]

Table 2a: Mineral Composition of *Corchorus olitorus* consumed in SouthWestern Nigeria.

MINERAL	Replicate 1	Replicate 2	Replicate 3
Ca (g/kg)	6.62±0.01[a]	6.51±0.02[b]	7.50±0.02[c]
Mg (g/kg)	6.93±0.07[b]	6.67±0.01[a]	7.57±0.04[c]
K (mg/kg)	22.69±0.1[b]	20.84±0.02[a]	22.99±0.01[b]
Na (mg/kg)	1.18±0.02[b]	1.06±0.01[a]	1.21±0.02[b]
Mn (mg/kg)	0.11±0.02[a]	0.14±0.01[a]	0.13±0.02[a]
Fe(mg/kg)	0.35±0.02[a]	0.40±0.01[a]	0.44±0.02[a]
Cu (mg/kg)	0.03±0.02[a]	0.04±0.02[a]	0.04±0.03[b]
Zn (mg/kg)	0.02±0.16[b]	0.04±0.1[a]	0.05±0.10[c]
Co (mg/kg)	0.003±0.01[a]	0.005±0.001[a]	0.006±0.001[a]
Cr (mg/kg)	0.004±0.001[b]	0.003±0.01[b]	0.003±0.001[a]
Cd (mg/kg)	0	0	0
Pb (mg/kg)	0	0	0
Ni (mg/kg)	0.003±0.001[b]	0.001±0.00[a]	0.002±0.001[b]
Hg (mg/kg)	0.002±0.001[a]	0.003±0.001[a]	0.002±0.01[a]
P (mg/kg)	4.93±0.08[b]	3.855±0.0219[a]	5.42±0.014[c]

Table 2b: Mineral Composition of *Amaranthus cruentus* consumed in SouthWestern Nigeria.

MINERAL	Replicate 1	Replicate 2	Replicate 3
Ca (g/kg)	7.81±0.01[b]	7.79±0.01[b]	7.04±0.02[a]
Mg (g/kg)	13.00±0.01[c]	8.13±0.002[a]	11.69±0.02[b]
K (mg/kg)	101.59±0.01[c]	99.59±0.01[b]	97.00±0.01[a]
Na (mg/kg)	7.59±0.01[b]	8.89±0.01[c]	6.97±0.02[a]
Mn (mg/kg)	0.29±0.02[b]	0.33±0.03[c]	0.28±0.01[a]
Fe(mg/kg)	0.79±0.01[b]	0.69±0.02[a]	0.63±0.02[a]
Cu (mg/kg)	0	0	0
Zn (mg/kg)	0.02±0.1[a]	0.02±0.1[a]	0.02±0.1[a]
Co (mg/kg)	0.05±0.014[b]	0.055±0.007[a]	0.035±0.007[a]
Cr (mg/kg)	0.055±0.007[a]	0.045±0.007[c]	0.035±0.007[b]
Cd (mg/kg)	0	0	0
Pb (mg/kg)	0	0	0
Ni (mg/kg)	0.005±0.001[a]	0.005±0.001[a]	0.005±0.001[a]
Hg (mg/kg)	0.002±0.001[a]	0	0.002±0.01[a]
P (mg/kg)	15.96±0.1[a]	12.315±0.021[b]	21.5±0.021[a]

ASN 53rd Annual Conference Proceedings (Sub-Theme: Agricultural Engineering, Processing & Value Addition)

Physical Properties Of Dried Meat Product (*Banda*) as Influence by Tenderizer Type, Concentration and Application Method

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Abstract
The paper analyzes the influence of types of tenderizer, concentration and application methods on physical properties of dried Meat Product (*banda)*. Four hundred and sixteen (416) pieces of *Banda* samples were laid out in a factorial arrangement of four tenderizer types (Trona, Potash, Alum and Baking powder) at four concentrations (0g/l, 5g/l, 10g/l and 15g/l) and two application methods (Boiling and Soaking). The experiment followed a Completely Randomized Design (CRD). The samples were randomly allocated to 32 treatment combinations. Results indicated that, type and concentration of tenderizer had significant ($P<0.05$) effect on softness, cooking yield and water holding capacity. Application method had effect only on cooking yield. It was concluded that tenderization of *banda* with alum at the concentration of 5g/l either by boiling or soaking engenders better physical properties.

Key words: Alum, Potash, Softness, cooking yield, water holding capacity

Introduction

Meat is defined as animal flesh used for food. It most often refers to skeletal muscle and associated fat; it is used to describe other edible tissues and organs such as liver, kidneys, lungs and skin (Lawrie and Ledward, 2006). Ajiboye *et al*. (2011) describe meat to contain the flesh of animal and all processed or manufactured products which might be prepared from muscle tissues. It can be fresh, cured, dried or otherwise processed product. Dressed carcass and fresh meat can only remain fresh for a short time before spoilage sets in. Frederick (2011) pointed out that deteriorative changes in meat begin after rigor mortis that follows animal slaughter. Contamination by micro-organisms is the major cause of meat deterioration which can lead to spoilage. Spoilage in meat is undesirable due to change in colour, unpleasant odour, loss of eating quality and rejection by consumers. It is necessary to prevent spoilage by preserving the little meat available (Brigitte *et al*., 2004). The use of local tenderizers in traditional meat cooking is common however, some substances like trona ($Na_2CO_3.N_aHCO_3.2H_2O$), potash (K_2CO_3), alum ($KAL(SO_4)_2.12H_2O$) and baking powder ($NaHCO_3$) are traditionally used in tenderization (Ribah, 2012) but studies on the suitable type of tenderizer to be used and its related influence on chemical properties of *banda* are scanty. The objective of the study is to determine the influence of type of tenderizer, concentration and application method on the physical properties of dried meat product (*banda*).

Materials and Methods

Study Area

The study was conducted at the department of agricultural education, Adamu Augie College of Education Argungu, Kebbi State.

General Experimental Layout

Four hundred and sixteen (416) pieces of *banda* bought from meat market were used for the experiment. Samples were laid out in factorial arrangement of four tenderizer types (trona, potash, alum, and baking powder), four concentrations (0, 5, 10 and 15g/l) and two application methods (boiling and soaking) replicated thirteen (13) times. The experiment followed Completely Randomized Design where the samples were randomly allocated to 32 treatment combinations.

Data Collection

Each 13 pieces batch of meat samples meant for the soaking application method were soaked in one litres of their respective tenderizers at each of the four concentrations for one hour, after which they were drained and boiled in plain water for 40 minutes. In the boiling application method, there was no draining of tenderizer solutions. The samples were boiled in the tenderizers for 40 minutes. The physical data measured were softness, cooking yield and water holding capacity. Softness was determined by a sensory panel of 10 judges using a 14cm line scale as described by Stone and Sidel (2004). A horizontal scale of 1−14 centimeters starting from very tough to very soft was drawn on the score sheet. Meat samples after each batch of cooking were pressed using index and thumb fingers by the panelist. Depending on the judgement by the individual panelist, a vertical line were drawn on the scale corresponding to the softness feeling intensity of the sample after which, a ruler were used to measure the length between 0cm to the marked area on the scale. The values obtained from the judgement of panelist were used for the analysis. Cooking yield was determined as the percentage increase in weight of *banda* after cooking using the mathematical relationship:

$$\text{Cooking yield} = \frac{weightofcookedsample - weightofrawsample}{weightofrawsample}$$

Water holding capacity was determined using the filter paper method. Meat samples of approximately 12grams were compressed onto a Whatman No.1 filter paper between two flexi glasses according to the USDA (2012) method. Total area of exudate released after pressing was determined by measuring the circumference using thread and is used as an indicator of water holding capacity. The larger the water infiltrated area on the paper, the poorer the water holding capacity of thesample.

Data Analysis

Tenderizer type, concentration and application method were compared for all the physical properties using General Linear Model (GLM) univariate procedure of SPSS (version 16). Significant means were separated using Tuckey test.

Results and discussion

Softness

Tenderization with alum resulted in to greater softness (7.14) on the rating scale than potash (5.85). The highest result in alum could be due to its coagulating properties in water where it binds tiny particles to settle by gravity, clearer water will be absorbed more easily and soften the meat tissue. The high tenderizing effect of alum was in agreement with the report of Ribah *et al*. (2013), that *banda* tenderization with alum resulted in greater softness than tenderization with either baking powder or potash. The lower softness of meat tenderized in potash could be as a result of loss of potassium during boiling. Skinner (2005) theorized that, boiling meat is a way of losing potassium. As a result of loss of potassium, pH will be reduced and free water percentage decreased markedly thereby resulting to lower softness. Samples tenderized with concentration of 15g/l recorded higher softness (7.85) than other concentrations on the rating scale. This could be due to the solubility of myofibrillar protein (myosin) that increases as the salt concentration increases. Hamm (1961) theorized that, as the concentration of salt incorporated in meat increases, it causes a repulsion of peptide chains on myofibrillar protein, allowing more water to enter this space which can increase the softness of meat. The greater effect of higher concentration on softness agrees with the findings of Ribah *et al*. (2013) where the highest effect was observed from samples tenderized with the highest tenderizer concentration.

Cooking yield

Samples tenderized with alum and potash had greater cooking yield (0.49 and 0.48) on the rating scale. The degree of swelling depends on pH which is causing changes in the net charge of the protein network (Hamm, 1994). The high pH was believed to increase the potassium ion binding to the negatively charged myofilaments and simultaneous weakening of the binding of carbonate ions and this effect will cause a loosening of myofibrillar lattice and swelling occurs. The low effect of cooking yield from samples tenderized with baking powder could be attributed to the reduced pH (8.27) of the cooking solution. As pH of cooking solution decreased, the free water (%) in meat tissue decreased markedly, and cook yield decreased (Rhonda, 1998). Samples tenderized with concentration of 0g/l had the highest effect (0.52) on cooking yield. The nature of tenderizing solution could account for the low cooking yield of samples tenderized in concentrations of tenderizer solutions because, the surrounding water may be driven into the meat under osmotic pressure and heating would cause the denaturation of myofibril and collagen, and generate the contracting stresses in the cellular structure of the meat. As a result, the water may drain out of the meat leading to a decrease in dimension and shrinkage (Mayor and Sereno, 2004). Salt solutions induce muscle fibre shrinkage at highest concentration (Offer and Knight, 1988) due to hydrolysis and possible leaching of muscle fibre proteins. Boiling had greater effect (0.56) on cooking yield than soaking (0.36). This might be explained by the combine effect of tenderizer salts and heat that increases the hydration of meat tissue there-by improving the cooking yield.

Water holding capacity

Samples tenderized with potash had greater infiltrated area covered by the exudate released from meat samples after pressing (1.00) which indicated lower water holding capacity. Samples that are tenderized with baking powder and trona had high water holding capacity which was attributed to their higher buffering capacity and the ability to raise the pH higher during cooking than sulphate (Sheard and Tali, 2004). Increasing the meat pH improves water-holding capacity by moving the meat pH further from the meat protein isoelectric point. As the pH moves further from the isoelectric point, water-holding capacity increases due to an increase in the amount of negative charges on the meat proteins that can bind water (Rhonda, 1998). The higher water holding capacity of trona had conformed to the report of Marian *et al.* (2003) where addition of sodium bicarbonate compounds improves the water-holding capacity of cooked beef. Samples tenderized with varying tenderizer concentrations show larger area covered by exudate released from meat samples indicating lower water holding capacity than concentration of 0g/l (0.28). The large amount of water release might be attributed to the addition of salts from tenderizers as salt solutions at higher concentration causes muscle fibre shrinkage due to hydrolysis and leaching of muscle fibre proteins that can lead to the release of moisture (Offer and Knight, 1988). It could be due to increase in the pH of tenderizer solution by addition of salts from tenderizers that enables myosin filaments to depolymerize and myofibrils to swell resulting to improved hydration of meat (Hamm, 1986).This finding does not agrees with the result of Valquíria*et al*. (2013) which observe an increase in the water holding capacity in the salted dried pork meat compared to non-salted which she was attributed to the differences of animal from which meat samples were obtained.Application method had no effect on water holding capacity of *banda*.

Conclusion

It was concluded that, type and concentration of tenderizer had significant effect on physical properties of dried meat product irrespective of application method.

Recommendation

It was recommended that for better product performance in terms of physical properties, dried meat products should be tenderized with alum at the concentration of 10g/l using boiling application method.

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Table1. Physical properties of dried meat according to type, concentration and application method of tenderizer

Factor	Physical Property		
	Softness	Cooking yield	Water holding capacity (cm^2)
Overall Mean	6.35	0.46	0.70
Tenderizer			
Alum	7.14^{a}	0.49^{a}	0.89^{b}
Baking powder	6.14^{ab}	0.42^{c}	0.44^{c}
Potash	5.85^{b}	0.48^{a}	1.00^{a}
Trona	6.20^{ab}	0.45^{b}	0.47^{c}
SE	0.36	0.01	0.02
Concentration			
0g/l	3.99^{c}	0.52^{a}	0.28^{b}
5g/l	7.00^{ab}	0.39^{c}	0.82^{a}
10g/l	6.54^{b}	0.46^{b}	0.83^{a}
15g/l	7.85^{a}	0.47^{b}	0.87^{a}
SE	0.36	0.01	0.02
Application method			
Boiling	6.46	0.56^{a}	0.68
Soaking	6.23	0.36^{b}	0.72
SE	0.25	0.004	0.02

Values bearing different superscripts along the same column within a subset differ (P<0.05)

ASN 53rd Annual Conference Proceedings (Sub-Theme: Agricultural Engineering, Processing & Value Addition)

Proximate Analysis of Chicken Weed (*Portulaca quadrifida* L.) as Influenced by Soil Textural Class in Sokoto, Nigeria

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Abstract
Pot experiment was conducted at the Biological garden of the Usmanu Danfodiyo University Sokoto, Nigeria during the 2017 wet season to study the potentials of different soil textural class on the proximate composition of Chicken weed (*Portulaca quadrifida*). Soil samples were collected, bulked, air dried, gently crushed and sieved. The fine portions of the soil from each textural class were then subjected to laboratory analysis for the determination of physical and chemical properties using standard procedures. The experiment comprised of 3 × 7 treatments combinations, it consisted of three different soil textural class and seven stem cutting types of *P. quadrifida*. Results indicate that Loamy sand was more favourable for ash content, crude fibre and silty clay favoured carbohydrate. Ash content and Nitrogen free extract were favoured with the use of NLA-D and Nitrogen free extract was favoured with use of NLA- D, Lipd, crude fibre and Nitrogen free extract were favoured with the use of NLA-P. NLR- P produced the highest Lipid, Nitrogen free extract and carbohydrate, while the use of SRA also favoured Lipid, Nitrogen free extract and crude protein. IN-D and IN-P did not regenerate to be used for the analysis. These findings revealed that, for higher proximate of Chicken weed, planting in a loamy sand is preferably.

Keywords: Chicken weed, Proximate, Stem Cuttings, Soil textural

Introduction

Chicken weed (*Portulaca quadrifida)* is a succulent annual herb that has a prostrate stem rooting at the nodes that reproduces from seed and it is a pan-tropical weed of cultivated fields that are commonly found on poor soils, lawns, road sides and waste areas (Akobundu *et al*. (2016). Netala *et al*. (2014) described *Portulaca* (Purslane) as a mat-forming, extremely tough plant that thrives in adverse conditions and are classified under the same genus *Purtulaca* (Purslane) and family of *Portulacaceae* which are both referred to as edible weeds.. *Portulaca quadrifida* originates from India, and has been widely distributed in other temperate and tropical areas of the world (Lie *et al*., 2015 and Zhou, 2015). *Portulaca quadrifida* is one of the most important weeds causing yield losses in crop production. *P. quadrifida* is a significant weed in maize (*Zea mays*) and onions (*Allium cepa*) (Kachare *et al*., 2005). Most agricultural weeds are usually regarded as undesirable and targeted for eradication. However, Maroyi (2013) reported that weeds are useful to human beings as food and traditional medicines. Edible weeds could contribute in many ways to basic primary health care, food security, balanced diets of rural and urban households (Maroyi, 2013). This study was therefore conducted to document potentials of different soil types on proximate composition of chicken weed.

Materials and methods

Pot experiment was conducted at the Biological garden of the Usmanu Danfodiyo University Sokoto, Nigeria during the 2017 wet season to study the potentials of different soil textural class on the proximate composition of Chicken weed (*Portulaca quadrifida*). Sokoto lies between latitude 12^0 01' N and 13^0 58' N and longitude 4^0 8' E and 6^0 54' E (Mamman *et al*., 2000) in the Sudano sahelian agro-ecological Zone of Nigeria. To ascertain the nutrient status of the soil to be used, soil belonging to sandy, silty clay and loamy sand textural classes were sampled randomly at the depth of 0 - 15 cm using soil auger. Soil samples were collected, bulked, air dried, gently crushed and sieved to pass through 2 mm sieve. The fine portions of the soil from each textural class were then subjected to laboratory analysis for the determination of physical and chemical properties using standard procedures. The experiment comprised of 3 × 7 treatments combinations, it consisted of three different soil textural class (Sandy, silty clay and Loamy sand) and seven stem cutting types of *P. quadrifida* (NLA-D - node leaf attached at distal stem location, NLR-D - node leaf removed from distal stem location, NLA-P - node leaf attached at proximal stem location, NLR-P- node leaf removed from proximal stem location, IN-D internodes at distal stem location, IN-P- internodes from proximal stem location and SRA- stem roots attached) and were laid out in a Completely Randomized Design (CRD) with three replications. Three stem cuttings each were planted on each pot as described by the design and pots were surface irrigated every other day throughout the growing period. At harvest (60 days after planting) the plants were completely uprooted, washed and rinsed with clean ordinary water. The fresh leaves were collected from each treatment and oven dried to a constant weight and later samples were crushed into powder form for proximate analysis

Results and Discussion

The result on physical properties of the soils showed that sample A was Sand (92.2%) and moderately alkaline (pH 7.7), sample B was silty clay (29.4%) and neutral (pH 6.8), while sample C was loamy sand (82.4%) and moderately alkaline (pH 7.3). Organic carbon was low in sandy and silty clay (0.04 and 0.96 – 1.0 g kg^{-1}) respectively. Total nitrogen for sandy, silty clay and loamy sand are low (0.025, 0.081 and 0.039 %) respectfully, including available phosphorus and exchangeable bases was low. This result is line with the report of Shehu *et al* (2015) who stated that, status of selected soils in Sudan savanna are low in organic carbon, Total N and available P. Table 1 presents result on the influence of soil textural classes and stem cuttings on proximate composition (Ash, lipids, crude fibre, nitrogen free extract, crude protein and carbohydrate contents) of *P. quadrifida* during 2017 rainy season in Sokoto. The result showed that loamy sand produce the highest ($p<0.05$) ash content and Crude fibre of *P.quadrifida*, though at par with sandy soil in both cases. The lowest ash content and Crude fibre were recorded with silty clay. Carbohydrate was highest when silty caly was used, while both sandy and Loamy sand produced the lowest carbohydrate. High ash content and crude fibre are more inclined with *P. quadrifida* growing under soil pH of 7.3 (moderately alkaline) in loamy sand, while carbohydrate is more with *P. quadrifida* growing under soil with a pH of 6.8 (slightly acidic) in silty clay soil. Even though Kokad and Ahmad (2010) reported that *P. quadrifida* is more adapted to saline soils. Stem cuttings significantly ($p<0.05$) affects the proximate compositions of *P. quadrifida*. The result showed that NLA-D recorded the highest ash content and the result is statistically similar to the result obtained with Lipid and Nitrogen. Similar highest result was recorded in combination of NLR –D and NLR – P with Lipid, NLA- P with Crude fibre and NLR- D, NLR- P and SRA with Carbohydrate and SRA with Crude protein. The lowest proximate composition was recorded in combination of NLR- D and NLR-P with ash content, NLR- P with Crude fibre and NLA- P with Carbohydrate. IN-D and IN-P did not regenerate. In this regard, similar research was reported by Jiun (2012) who indicated that *Peperomia pellucida* was analyzed to be rich in crude protein, carbohydrate and total ash contents. Therefore it is recommended that the growing of Chicken weed from stem cuttings should be encouraged at both household and community levels to enhance the nutritional and healthy status of the populace.

Conclusion

Chicken weed have been used in Indian and other Asian countries to cure the sick and as a vegetables. The potentials have not really been investigated in our community. Based on these finding Chicken weed is loaded with protein, carbohydrate, fat, ash and energy that could contribute to our livelihood by providing balanced nutrients, improve food security and health.

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Table 1: Influence of soil textural class and stem cuttings on proximate composition of *P. quadrifida* during 2017 rainy season in Sokoto.

	Proximate composition (%)					
Treatment	Ash	Lipid	Crude fibre	Nitrogen	Crude	Carbohydrate
Soil Textural Class (STC)						
Sandy (%)	3.05ab	0.55	0.69b	0.14	0.85	18.64b
Silty clay (%)	2.83b	0.48	0.69b	0.14	0.85	18.95a
Loamy sand (%)	3.17a	0.55	0.76a	0.13	0.85	18.53b
SE±	0.08	0.03	0.02	0.003	0.03	0.10
Stem cuttings (SC)						
NLA – D	4.78a	0.78a	1.00b	0.19a	1.21ab	25.58c
NLR – D	3.89c	0.67a	0.89c	0.19a	1.20ab	26.64a
NLA – P	4.33b	0.72a	1.11a	1.18a	1.16ab	26.01c
NLR – P	3.83c	0.78a	1.00b	0.18a	1.14b	26.59a
IN – D	0.00d	0.00b	0.00d	0.00b	0.00c	0.00d
IN – P	0.00d	0.00b	0.00d	0.00b	0.00c	0.00d
SRA (control)	4.28b	0.72a	1.00b	0.19a	1.28a	26.13b
SE±	0.12	0.04	0.03	0.005	0.04	0.15
Interaction						
STC ×SC	NS	NS	NS	NS	NS	NS

Means followed by same letter (s) in a column are not significantly different at 5% level of probability using Fisher's least significant difference test. NS= not significant, **= significant at 1% level.

Key: Node leaf attached at distal stem location (NLA-D); Node leaf removed from distal stem location; NLR-D; Node leaf attached at proximal stem location; (NLA-P); Node leaf removed from proximal stem location (NLR-P); Internodes at distal stem location (IN-D); Internodes from proximal stem location (IN-P) and Stem roots attached (SRA).

Proximate, Mineral and Phytochemical content analysis of *Sida acuta* (Burm) F in Nekede Owerri, Imo State.

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Abstract
Sidaacuta, a shrub in the Malvaceae family is widely distributed in pan tropical areas and it has many herbal and medicinal values that vary from one region to another. The proximate and mineral composition of *Sidaacuta* leaves were determined and quantified in this study using standard analytical methods. The result for proximate composition (%) was 33.40, 1.60, 13.39, 3.50, 2.63 and 78.88 for moisture content, ash content, crude fibre, crude fat, crude protein and carbohydrates respectively and values obtained for the mineral composition (mg/100g) were 31.32, 10.93, 112.83, 9.48, 22.56, 0.42 for calcium, iron, potassium, sodium phosphorus and nitrogen respectively. These food nutrients are in amounts comparable to those of leafy vegetables which are consumed locally for good nutrition. Therefore *Sidaacuta* leaves would provide nutritional benefits for humans.Phytochemicals are chemical compounds produced by plants, generally to help them thrive or thwarts competitors, predators or pathogens. The result for phytochemical composition of *Sidaacuta* as determined and quantified in this study using standard analytical methods were Alkaloid 7.7%, Flavonoid 7.0%, Saponin 5.5%, Oxalate 1.81g/100g, Lipid 2.6%, Cyanogenic Glycoside 626.4mg/100g, Tanin 748.6mg/100g, Phenol 0.44mg/cm^3. *S. acuta* is composed of significant amount of essential food nutrients. The quantity of this phytochemicals are responsible for its diverse medicinal and therapeutic use and effectiveness, therefore more work should be done on the screening and evaluation of the potential of its phytochemicals in medicine and drug production.

Introduction

Sida acuta Burm F. commonly known as wireweed or broom weed is an erect branched small perennial herb or small shrub which grows abundantly on cultivated fields, waste areas, road sides and open clearing in Nigeria (Akobundu,& Agyakwa, 1998). It is believed to have originated in Central America, but today has a pantropical distribution and is considered a weed in most areas (Parsons and Eric, 2001).
The plant is an undershrub with mucilaginous juice. The leaves are alternate, simple, lanceoliate to linear, rarely ovate to oblong, obtuse at the base, acute at the apex, coarsely and remotely serrate; the petiole is much shorter than the blade, stipulate, are unequally paired at the node with reticulate venation (Wikipedia, 2018).

Sida has a variety of local uses. The leaf juice is used in India for vomiting and gastric disorders. In Nigeria, the infusion of the leaves is given to women in labour; the decoction of the leaves is prescribed during malaria fever; the root is a bitter tonic, astringent and antipyretic. In Nicaragua, the decoction of the entire plant is taken orally for asthma, fever, aches and pains, ulcers, anthelmintic medication as well as for venereal diseases (Oboh and Onwukaeme, 2007).

Proximates are used in the analysis of biological materials as a decomposition of a human consumable good into its major constituents. They are a good approximation of the contents of packaged comestibles goods and serve as a cost-effective and easy verification of nutritional panels (Wikipedia, 2018).

Mineral elements though usually form a small portion of total composition of most plant materials and of total body weight; they are nevertheless of great physiological importance particularly in the body metabolism. Besides several organic compounds, it is now well established that many trace elements play a vital role in general wellbeing as well as the cure of diseases (Prasad, 1993).
Several studies have reported elemental contents in plant extracts which are consumed by humans either as herbal health drink or medicine (Abou Arab,& Donia, 2000).
These elements are present which are used as a dietary item as well as ingredient in the medicinal preparation (Ram *etal*., 2010).
Determination of mineral elements in plants is very important since the quality of many foods and medicines depends upon the content and type of minerals (Bahadur *etal*., 2011). In this way, not only must the absolute amounts of minerals be estimated in the edible portions of food or parts of medicinal plants, but these minerals must also be in forms that are bioavailable for organisms. In recent years, scientist and nutritionist have started believing in the therapeutic role of metals in human health (Udayakumar& Begum, 2004). Ashes give an idea of the mineral matter contained in a plant because mineral matter of the reality may be the cause of a pharmacological effect (Sunggyu, 2005).
Minerals are required by living organisms and can help to prevent occurrence of some diseases. Some plants contain significant amount of minerals, the presence and quantity depend on plant family, history and phytochemical properties of the plant (Houghton, 2007)

Plants are composed entirely of chemicals of various kinds (Breslin, 2017). Phytochemicals are chemicals produced by plants through primary or secondary metabolism. They generally have biological activity in the plant host and play a role in plant growth or defense mechanism against competitors, pathogens or predators (Molyneux, *etal*., 2007).
Phytochemicals generally are regarded as research compounds rather than essential nutrients because proof of their possible health effects has not been established yet (Micronutrient Information Center, 2017). Phyto chemicals under research can be classified into major categories such as carotenoids and polyphenols which include phenolic acids, flavonoids and stilbenes/lignans. Flavonoids can be further divided into groups based on their structure, such as anthocyanins, flavones, flavanones, isoflavones and flavanols (Micronutrient information Center, 2015).

Phytochemicals have been used as poison and in traditional medicine. For example, salicin, having anti-inflammatory and pain-relieving properties was originally extracted from the bark of the white willow tree and later synthetically produced to become the common over-the-counter drug, aspirin (Sneader, 2000). The tropane alkaloids of *Atropa belladonna* were used as poisons, and early humans made poisonous arrows from the plant.
As of 2017, the biological activities for most phytochemicals are unknown or poorly understood, in isolation or as part of foods (Molyneux, *etal*., 2007).
The phytochemical category includes compounds recognized as essential nutrients which are naturally contained in plants and are required for normal physiological functions, so must be obtained from the diet in humans (USDA, 2016).
The plants *Sida acuta* contain bioactive constituents such as alkaloids, flavonoids, cardiac and saponin glycosides. These could be collectively or individually responsible for the activities of the plant as reported earlier. The plant has also been subjected to Phaarmacognostic study. The macroscopical and microscopical character obtained for the leaves of *Sidaacuta* could serve as diagonistic parameters for the plant (Oboh and Onwukaeme, 2007).

Materials and Method
The laboratory analysis was carried out at the Crop Science Laboratory of Federal University of Technology Owerri in November 2018.
The *Sidaacuta* plant leaves were collected inside the Federal Polytechnic Nekede premises and identified by the Agricultural Technology Department. The plants were washed, air dried for five days before bagging and labeling then sent to the Lab.
Proximate Analysis

Proximate analysis of moisture, protein, fat, crude fiber and carbohydrate contents were carried out according to the procedures of Association of Official Analytical Chemist (A.O.A.C., 2000).

Moisture Content

This was determined by hot air oven method. An empty crucible was weighed and approximately 20g of the sample was transferred into the crucible. This was taken into the hot air oven and dried for approximately 8 hours at 100^0c. The crucible and its content were transferred to a desiccators to cool it down to room temperature. Their weights were taken. The loss in weight was regarded as the moisture content and expressed in percentage.

Ash Content

About 10g of the leaf sample was weighed into a crucible and the sample was incinerated in a muffle furnace at 660 ^{0}c until a constant weight was obtained. The sample is cooled in a desiccators and weighed to obtain the ash content.

Crude Fibre

About 10g of the leaf sample was weighed into a 500cm^3 flask and 100cm^3 of TCA digestion reagent was added. The mixture was brought to a boiling point and refluxed for exactly 40 mins. The flask was removed from the heater, cooled a little and filtered. The residue was washed with hot water. The sample was dried at 105^0c. After drying it was transferred to a desiccators and noted as W1. It was burnt in a muffle furnace at 600^0c for 6hours, allowed to cool and reweighed as W2. The crude fibre was determined according to the given formula.

Crude Fat Content

The soxhlet extraction method was used here. About 2g of the sample was put into a thimble which was weighed empty. The weight of the extraction flask was noted empty and when half filled with ether. Extraction was carried out using boiling temperature of 40-60 ^{0}c.at completion of extraction which lasted for 8 hours, the solution was removed by evaporation on a water bath and the remaining part in the flask was dried at 80 ^{0}c for 30 minutes in an oven and then cooled in a desiccators. The flask was weighed and percentage fat content calculated with the given formula.

Crude Protein Content

The micro Kjedal method was employed. About 2g of the sample was put into the digestion flask. 10g of the $CUSO_4$, Na_2SO_4 (catalyst) in the ratio of 5:1 respectively and 25 ml concentrated H_2S0_4 were added to the digestion flask. The flask was placed in a fume cupboard and heated until frothing ceased giving a clear light blue green coloration. The mixture was allowed to cool and diluted with distilled water until it reached the 250cm^3 mark of the volumetric flask. Distillation apparatus was connected and 10 cm^3 of the mixture poured into the receiver of the distillation apparatus, also 10 cm^3 of 40% NaOH was added. The released ammonia was then treated with 0.02m HCl until the green colour change to purple. Percentage of Nitrogen in the sample was calculated using the provided formula. Also the protein content was determined with the given formula.

Carbohydrate Content

This was calculated by the difference of the ash, fibre, fat, protein added together and the difference from 100 taken as the carbohydrate content.

Mineral Content

Approximately 2g of each leaf sample was converted to ash using muffle furnace set at 660 0C for 2 hours. The sample was allowed to stay in the furnace for 24 hours to enable it cool to room temperature. 5 cm^3 of concentrated HCl was used to dissolve each sample and the mixture transferred to 100 cm^3 volumetric flask and distilled water was used to bring the volume to mark.

The clear solution was taken to the AAS (Atomic Absorption Spectrophotometer) for the mineral determination.

Phytochemical Analysis

Alkaloids

Exactly 200cm^3 of 10% acetic acid in ethanol was added to 2.5g of the leaf which is in a 250cm^3 beaker and allowed to stand for 4 hours. The extract was concentrated on a water bath to ¼ of the original volume followed by addition of 15 drops of conc. NH_4OH dropense to extract until the precipitation was complete immediately after titration. After 3 hours of mixture sedimentation, the supernatant was discarded and the precipitate washed with 20cm^3 of 0.1M NH_4OH and filtered using filter paper. The residue was oven dried after which the weight was noted. The alkaloid was thus calculated using the given formula.

Flavonoid

Exactly 50 cm^3 of 80% aqueous methanol was added to 2.5g of the leaf in a 250cm^3 beaker, covered and allowed to stand for 24 hours at room temperature. After discarding the supernatant, the residue was re-extracted three times with the same volume of methanol. The leaf samples were filtered and dried over a water bath in a crucible. The content was cooled in a desiccator after which it was weighed. Flavonoid was determined using the given formula.

Saponin

100cm^3 of 20% aqueous ethanol was added to 5g of the leaf sample which was ground into powdered form in a 250cm^3 conical flask. The mixture was heated over a hot plate for 4 hours with continuous stirring at a temperature of 55 ^{0}c. The residue of the mixture was re-extracted with another 100cm^3 of 20% aqueous ethanol after filtration and heated for 4 hours at a constant temperature of 55 ^{0}c with constant stirring. The combined extract was evaporated to 40cm^3 over water bath at 90 ^{0}c. 20 cm^3 of diethyl ether was added to the concentrate in a 250 cm^3 separating funnel and rigorously agitated from which the aqueous layer was recovered where the ether layer was discarded. This purification process was repeated twice. 60 cm^3 of n-butanol was added and extracted twice with 10 cm^3 of 5% sodium chloride. After discarding the sodium chloride layer, the remaining solution was transferred into a crucible and dried in an oven to a constant weight. The saponin content was determined using the given formula.

Oxalate

20 cm^3 of 0.3M HCl was added to 2.5g of the leaf and the mixture heated at a temperature of 50 ^{0}c for 1 hour with constant stirring using a magnetic stirrer. For oxalate estimation, 1 cm^3 of 5M NH4OH was added to 5 cm^3 of extract to ensure alkalinity. Addition of 2 drops of phenolphthalein indicator, 3 drops of glacial acetic acid and 1 cm^3 of 5% $CaCl_2$ to make the mixture acidic before standing for 3 hours was followed by centrifugation at 3000 rpm for 15 minutes. After discarding the supernatant, the precipitate was washed three times using hot water by mixing thoroughly each time followed by centrifugation. Then, to each tube, 2 cm^3 of 3 M H_2SO_4 was added and the precipitate dissolved by warming in a water bath at 70 ^{0}c. 0.01 M $KMn0_4$ was titrated against the content of each tube at room temperature until the first pink colour appears throughout the solution. The solution was allowed to stand until it turned colourless, after which it was retitrated again until a pink colour appears and persists for at least 30 seconds. Titration reaction of oxalate was calculated with the given formula.

Cyanogenic Glycoside

1g of leaf sample was weighed into a round bottom flask and 200cm^3 of distilled water added to it.

The mixture was allowed to stand for 2 hours for autolysis to occur. Full distillation was carried out in a 250cm^3 conical flask containing 20 cm^3 of 25% NaOH in the sample after adding an antifoaming agent like few drops of tannic acid. 8cm^3 of 6M NH_4OH and 2 cm^3 of 5% Kl were added to the distillate, mixed and titrated with 0.02 M ANO_3 using a burrette to end point content of the cyanogenic glycoside in the sample was determined using the given formula.

Lipid

2.5g of the leaf sample was added into a soxhlet extractor connected to a condenser and a flat bottom flask containing enough quantity of petroleum ether. The lipid was extracted from the leaf sample for 3 hours by heating on a hot plate at 50 0^C. The extractant i.e. petroleum ether was distilled off and the lipid recovered by cooling in a desiccators. The lipid content was determined using the given formula.

Tanin

Folin-Denis reagent was made first. Approximately 1.0g of the plant leaf sample was weighed into a cornical flask with 100cm^3 of distill water. The mixture was boiled gently for 1 hour and filtered using filter paper. 5.0cm^3 of the Folin-Denis reagent was added to the filtrate along with 10cm3 of saturated Na_2CO_3 solution into 50 cm^3 of distilled water and 10cm^3 of diluted extract was carried out after being pipetted into a 100cm^3 cornical flask for colour development. The solution was allowed to stand for 30 minutes in a water bath set at a temperature of 25^{o}C after thorough agitation. The solution was subjected to a spectrophotometer and its absorbence obtained at 700 nm and compared on a standard tanic acid curve. The standard curve was obtained by dissolving 0.2g of tannic acid in distilled water and dilution to 200 cm^3mark (1 mg/cm^3). Varying concentrations (0.2-1.0 mg/cm^3) of the tannic acid was pipetted into five test tubes to which 5cm^3 Folin-Denis reagent solutions were added along with 10 cm^3 saturated Na_2SO_3 solution and made up to 100cm^3 mark. The solutions were left to stand for 30 minutes in a water bath at 25^{o}C. The absorbence was ascertained at 700 nm with the aid of a spectrophotometer. Absorbence versus tannic acid concentration was plotted to obtain a standard curve.

Phenol

2g of the leaf sample was first defatted with the aid of Soxhlet apparatus. 0.5g of the defatted sample was boiled for 15 mins with 50 cm^3 ether for extraction. The mixture was filtered and the filtrate collected. 10 cm^3 of distilled water, 2 cm^3 of 0.1M NH_4OH and 5cm^3 of concentrated alcohol were added to 5 cm^3 of the extract and left to react for 30 minutes for colour development. The absorbence was measured at 505 nm with the help of a spectrophotometer and the concentration read off the graph. The graph was obtained by dissolving 0.2g of tannic acid in distilled water and diluted to 200 cm^3 in preparation for phenol standard curve. Varying concentrations (0.2-1.0 mg/cm^3) of the standard tannic acid solution were pipetted into 5 different test tubes to which 2cm^3 water were added. The solution was made up to 100cm^3 volume and left to react for 30mins. The absorbence was measured at 505 nm and a graph plotted.

Result and Discussion

Table 1, shows the proximate content analysis of *Sidaacuta* leaves. The moisture content value of 13.40% obtained for *Sida* leaves in this study is high and this could be because the leaves were harvested during the peak of the rainy season. The value is quite higher compared to 9.3% obtained by (Raimi, *etal*., 2014) in a similar study. The ash content of 1.60% is also lower than 6.33 obtained by (Raimi, *etal*., 2014). However, the fibre content of 13.39% is appreciably high. The fat content is also low 3.50% suggesting that it can be used to control obesity in humans. The crude protein content is however low, 2.625% but it is a very high and rich source of carbohydrate, 78.88%.

Table 2, shows the mineral content of *Sida acuta* analyzed. The result indicate that Sida is a rich source of calcium 31.32mg/100g no wonder herbalist use it for the treatment of arthritis and other related bone issues. The iron content is not too low 10.93mg/100g, potassium content is very high 112.83mg/100g, and sodium content is low at 9.48mg/100g, while phosphorus and nitrogen content are appreciatively high and very, very low respectively.

The result of the phytochemical analysis of *Sida acuta* leaves is shown in table 3. The phytochemicals, tannins, saponins, alkaloids, flavonoids, oxalate, lipids, cyanogenic glycosides and phenol were found to be present in *S. acuta* leaves and are in amounts to be of medicinal value.

Sida acuta has 7.7% alkaloid from this study. Many plants containing alkaloids and flavonoids are used as diuretic, antispasmodic, anti-inflammatory and analgesic effects (Ujowundu, *etal*., 2010). Alkaloids are capable of reducing headache associated with hypertension. It has been reported that alkaloids can be used in the management of cold, fever and chronic catarrh.

Flavonoids are known for their antioxidant activity and hence they help to protect the body against cancer and other degenerative diseases. From this study, *Sida acuta* has 7.0% flavonoids. Flavonoids have been shown to have antibacterial, anti-inflammatory, anti-allergic, anti-mutagenic, antiviral, antineoplastic, antithrombotic and vasodilatory activity (Mensah, *etal*., 2013), (Iniaghe, *etal*., 2009).

Tannin content of *S. acuta* obtained was 748.6mg/100g. Tannins are known to exhibit antiviral, antibacterial and antitumor activities. It was reported also that certain tannins are able to inhibit HIV replication selectively and is also used as a diuretic (Tijjani, *etal.,* 2012). Tannins are well known for their antioxidant and antimicrobial properties as well as for soothing relief, skin regeneration, as anti-inflammatory and diuresis (Mensah, *etal*., 2013).

From table 3, saponin content of S. acuta is 5.8%. Saponins are expectants, cough depressants and administered for hemolytic activities. In medicine, saponin is used as hypercholesterolemia, hyperglycemia, antioxidant, anticancer, anti-inflammatory and weight loss. It has also been reported to have antifungal properties (Tijjani, *etal.,* 2012). Saponnins exhibit cytotoxic effect and growth inhibition against a variety of microbes making them have anti-inflammatory and anticancer properties (Iniaghe, *etal*., 2009).

Sida acuta contains the antinutrient Oxalate which is in many leafy greens, vegetables, fruits nuts and seeds. However the oxalate content is very small 1.81%. Oxalate is an organic acid which can be produced by the body.

The phenolic content is 0.44mg/cm^3. Phenols also found present in plant sources are major group of compounds acting as primary antioxidant or free radical scavenger (Adesuyi,*etal*., 2011)

The lipid and Cynogenic glycoside content of Sida acuta from table 3 are quite low 2.6% and 626.4mg/100g.

Conclusion

The analysis of the proximate and mineral composition of *Sida acuta* leaves in this study has shown that *S. acuta* is composed of significant amount of essential food nutrients. These food nutrients are in amounts comparable to those of leafy vegetables which are consumed locally for good nutrition. Therefore *Sidaacuta* leaves would provide nutritional benefits for humans and livestock. Having seen the phytochemical composition of *Sidaacuta* and its medicinal and therapeutic prospects, hence more work should be done on the screening and evaluation of the potential of its phytochemicals in medicine and drug production.

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Table 1: Proximate Content Analysis of *Sidaacuta* Leaves

Proximate	Percentage
Moisture content	13.40
Ash content	1.60
Crude fibre	13.39
Crude fat	3.50
Crude protein	2.63
Carbohydrate	78.88

Table 2: Mineral content analysis of *Sida acuta*

Minerals	Composition (mg/100g)
Calcium	31.32
Iron	10.93
Potassium	112.83
Sodium	9.48
Phosphorus	22.56
Nitrogen	0.42

Table 3: Phytochemical composition of *Sidaacuta*

Phytochemicals	Composition
Alkaloid	7.7 %
Flavonoid	7.0 %
Saponin	5.8 %
Oxalate	1.81 g/100g
Lipid	2.6 %
Cyanogenic Glycoside	626.4 mg/100g
Tanin	748.6 mg/100g
Phenol	0.44 mg/cm^3

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Quantitative and Correlation of the Bioactive Phytochemicals in Fruits of Date Palm (*Phoenix dactylifera* L) Accessions in Nigeria

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Abstract

Fruits are known to have different levels of antioxidant properties due to the presence of multiple types of chemical compounds in varying amounts. The phytochemical properties of twenty-one date fruits accessions from the experimental field of Nigeian Institute for Oilpalm Research (NIFOR) Date palm research substation, dutse, jigawa state, were employed and also quantified in order to substantiate the antioxidant and medicinal claims. The phytochemical analysis of saponins, alkaloids, tannins, flavonoids, and phenols was carried out using Atomic Absorption Spectrophotometer (AAS).the result revealed the total phenolic and tannin content to be highest in accession R5P8 (73.92mg/100g) and R7P1 (5.540mg/100g) there were no significant differences between accession R1P10 and R4P29 with the same value (12.10mg/100g). The lowest saponin content was recorded in accession R1P18 (203mg/100g) and the lowest alkaloid content was recorded in accession R5P20 (0.234mg/100g).Among the phytochemicalsin all the accessions, a very strong correlation was observed between tannin and saponin content while a very weak correlation was observed between flavonoids and Alkaloids.There is an overview of pharmacological properties of date palm. Date fruit has potent constituents that have therapeutic implication in prevention of diseases through anti-oxidant, anti-inflammatory,anti-tumor and ant diabetic effect. The accessions studied with considerable amount of phytochemicals could serve as a tool for future breeding programmes

Keywords: Accession, Datepalm, Breeding, Phytochemicals, Correlation

Introduction

The medicinal values of some plants lie in some chemical substances that produce definite physiological actions in human body. The most important of these bioactive constituents are alkaloids, tannis, flavonoids and phenolic compounds. Many of these indigenous medicinal plants are used as spices and food plants (Okwu, 1999 & 2001). An Ethno botanical and ubiquitous plant serves as rich resources of natural drugs for research and development (Kong *et al,* 2008). However, Human body is characterized by continuous production of free radicals and other reactive oxygen species due to aerobic metabolism. At the same time antioxidants and antioxidant enzymes exert synergistic action in removing the free radicals (Uttara *et al*., 2009). According to the polyphenol content, different fruits show different antioxidant capacities (Saura-calixto and Goni, 2006) and recent research has confirmed that vegetables and fruits play an important role in the prevention and treatment of different diseases caused by oxidative damage (Hung*et al*., 2015). Flavonoids are the largest group of phenols found in fruits, vegetables, grains, bark, roots, stems, flowers, tea, and wine and play a role against oxidative stress, inflammation, allergy, viral infection, and cancer (Middleton, 1998).

Materials and Methods

Plant materials: Fresh fruit sample without any physical and microbial damage were collected among the genepools in the experimental field of Nigerian Institute for Oilpalm Research (NIFOR) date palm research substation, dutse,Jigawa state. The samples were packed and sealed in thick polythene bag. Each of the samples was given an entry number, information regarding the gene pool name and palm number until use.

Sample Preparation: The fruits were washed properly first with tap water and then with distilled water to remove dirts, they were then depulped (removal of seeds from fruits). the fruits were then shade dried at room temperature for two weeks and they were den grinded into powder. The powder was then passed through a 0.5mm metallic mesh. The resultant fine crude powder were then used for phytochemical investigation.

Test for Saponin Contents: Total saponins were determined according to the method described by Makkar *et al*., (2007). Vanillin reagent (0.25 ml; 8%) were added to each of the solution followed by sulphuric acid (2.5 ml; 72% v/v). The reaction mixtures were mixed well and incubated at 60^0C in a water bath for 10 minutes. After incubation, the reaction mixtures were cooled on ice and absorbance at 544 nm (UV visible spectrophotometer) were read against a blank that does not contain the extract. The standard calibration curve was obtained from suitable aliquots of saponin (0.5 mg/ml in 50% aqueous methanol).

Test for Alkaloids: The total alkaloids concentration was quantified based on the reaction between alkaloid and bromocresol green (BCG) spectrophotometric method. The pH of the phosphate buffer solution were adjusted to neutral with 0.1 N NaOH and 1 ml of the solutions were transferred to a separating funnel, and then 5 ml of BCG solution along with 5 ml of phosphate buffer was added. The mixtures were shaken and the complex formed was extracted with chloroform by vigorous shaking. The extracts were collected in a 10 ml volumetric flask and diluted to volume with chloroform. The absorbance of the complex in chloroform was measured at 470 nm (Shams *et al*., 2008; Sharif *et al*., 2014).

Test for Tannins: The tannins were determined by Folin-Ciocalteu method. About 0.1 ml of the solution was added to a volumetric flask (10 ml) containing 7.5 ml of distilled water and 0.5 ml of Folin-Ciocalteuphenol reagent, 1 ml of 35 % Na_2CO_3 solution and diluted to 10 ml with distilled water. The mixture was shaken well and kept at room temperature for 30 minutes. A set of reference standard solutions of Gallic acid (20, 40, 60, 80 and 100 μg/ml) was prepared in the same manner described earlier. Absorbance for test and standard solutions was measured against the blank at 725 nm with UV/Visible spectrophotometer. The tannin content was expressed in terms of mg of GAE /g of extract (Marinova *et al*., 2005)

Test for Flavonoids: The total flavonoid content was determined by aluminium chloride colorimetric assay as described by Zhinshen *et al*., (1999). The aliquots of the samples 0.5 ml and standard solutions (0.01-1.0 mg/ml) of Quercetin was added with 2 ml of distilled water and subsequently with 0.15 ml of sodium nitrite (5 % $NaNO_2$ w/v) solution was added. After 6 minutes, 0.15 ml of (10 % $AlCl_3$ w/v) solution was added. The solutions were allowed to stand at 6 minutes and after that 2 ml of sodium hydroxide (4 % NaOH w/v) solution was added to the mixtures. The final volume was adjusted to 5 ml with immediate addition of distilled water, mixed thoroughly and allowed to stand for another 15 minutes. The absorbance of each mixture was determined at 510 nm against the same mixture. The total flavonoid content was determined as mg quercetin equivalent per gram of sample with the assistance of calibration curve of quercetin.

Test for Phenols: The total phenol content was estimated and measured spectrophotometrically by Folin-Ciocalteu colorimetric method, using Gallic acid as the standard and expressing results as Gallic acid equivalent (GAE) per gram of sample. Different concentions (0.01-0.1 mg/ml) of Gallic acid was prepared in methanol. Aliquots of 0.5 ml of the test sample and each sample of the standard solution was taken, mixed with 2 ml Folin-Ciocalteu reagent (1:10 in deionized water) and 4 ml of saturated solution of sodium carbonate (7.5 % w/v). The tubes were covered with silver foils and incubated at room temperature for 30 minutes with intermittent shaking. The absorbance was taken at 765 nm using methanol as blank. The total phenol was determined with the assistance of standard curve prepared from Gallic acid (Ainsworth and Gillespie, 2007).

Results and Discussion

The results obtained for the phytochemical screenings are shown (), from the result, accession R5P8 had the highest phenolic content of 73.92mg/g. this value was significantly the same with R1P10 with value of 72.220mg/g but significantly different from all other accessions. The lowest was obtained in accession R13P1 with the value of 15.10mg/g. this value was significantly different from all other accessions. The saponin contents was highest in accession R16P31with the value of 888mg/g, this value was significantly different from all other accessions .the lowest saponin content was observed from accession R1P18 with the value 203.0mg/g, this value was significantly different from all other accessions. The accession R13P5 had the highest alkaloid content with the value of 10.684mg/g, this value was significantly different from all other accessions. The lowest alkaloid content was obtained from accession R16P13 with value of 0.23mg/g, this value was significantly the same with accession R5P20 and R1P18 with the values 023mg/g but significantly different from all other accessions. The results of the tannin contents showed that accessions R5P8 had the highest tannin content with a value of 5.54mg/g, this value is significantly different from all other accessions. The least was observed in the accessions ZARIA with the value 0.0005mg/g though there were no significant differences in accessions R16P13, R13P9, R6P20 with the value 2.140mg/g but they are significantly different from the values among all other accessions. The flavonoid content was highest in accession R6P20 with the value of 12.18mg/g, this value was significantly the same with R1P10 and R4P29 but significantly different from all other accessions. The lowest was observed in R13P5 with the value of 2.77mg/g, this value is significantly the same with accessions R2P4 and R3P22 with the values 2.88mg/g and 2.85mg/g respectively. The phenol content was positively correlated with Tanin, flavonoid and saponin with their values (0.325335, 0.300383, 0.054061) while it was negatively correlated with Alkaloid having the value (-0.01975). however, a very strong correlation was observed between tannin and saponin (0.420871). in addition, flavonoid and saponin had a very weak correlation, though Alkaloid was also observed to have a weak correlation with all the phytochemicals studied (Table 1). Date fruits are considered as staple fruits and they are widely cultivated in semi-arid regions The phytochemical analysis of the studied Date fruit showed the presence of Alkaloids, Tannins, flavonoids, Phenols and saponins maybe due to significant contributions of the secondary metabolites.

However, the phenol contents of the date fruits recorded in the study was between 15.0mg/g and 73.92mg/g. This is in accordance with the reports of mohammed *et al* (2014) on Sudanese date fruits (35.82-199.34 mg/g) though lower than the findings reported by Al-turki *et al* (2010) on the Tunisian date fruits, and krishmony *et al* (2018) on Palmyra palm, The differentiations to colour, sensory and antioxidant properties among the studied accessions might be due to the presence of phenols, this is in conformity with the report of Robinson J.C (1996) on Banana and Plantain, Eleazu *et al* (2011) on Plantain. Phenols are very important plant constituents because of their free radicals scavenging ability which in turn due to the presence of hydroxyl groups in them. Dietery Phenols From date consumption may supply substantial antioxidants which, in turn, may provide health promoting and disease preventing effects (Tohidi, Rahimmalek & Arzani, 2017). This implies that the fruits of datepalm are rich source of anti oxidants because studies have shown that anti oxidants capacity of plants are tightly correlated with phenol compounds. The tannin content was between 0.005mg/g-5.540mg/g which might be due to the genetic variations in astringency contents among the studied accessions, the presence of tannin content also shows that date fruits could quicken the healing of wounds and inflamed mucus membrane, This is in line with the findings of Ogbonna *et al*., (2016) on banana, Ojobor *et al.* (2018) on coconut, sadiq *etal*., (2013) on Datepalm, Saha *et al*., (2017) on date palm. Tannins play an important role in the prevention of cancer and also used for the treatment of inflamed and ulcerated tissue (Mota *et al*., 1985; Aiyegoro and Okoh, 2010). So date palm fruits could be used as medicine in the treatment of many health challenges.The flavonoid contents obtained in this study was between 2.77mg/g – 12.18mg/g which is a considerable amount present in fruit crops. This is in conformity with the findings of saha *et al.,* (2017) on date palm, Tapas *et al.*, 2008) on *Phoenix sylvestris,* Ojobor *et al.,* (2018) on Coconut. However, it is an evident that date fruits can act as potent antioxidants and metal chelators. The presence of flavonoids in fruits have long been recognized to possess anti-inflammatory, anti-allergic, hepatoprotective, antithrombotic, antiviral, and anticarcinogenic activities, with this date palm is an excellent crop to possess medicinal values. The pronounced variations observed in saponin contents of the studied date palm fruits is in agreement with the report of Saha *et al* 2017, they observed significant differences in the saponin contents among all the fruits of the studied date cultivars. Similar results have been reported by Hasan *et al* (2012) on some Medicinal plants in Nigeria, Tiwari *et al.,* 2014) on *Gymnema sylvestre*. However, from the results of saponin content in the fruits recorded in this study (217mg/g-888mg/g), shows that date palm fruit could be used as a traditional medicine for many health beneficial effects, Studies have shown that Saponins are also used as a major constituent of traditional Chinese medicine (Liu and Henkel, 2002). The alkaloid content was between 0.23mg/g-10.684mg/g. A high amount of alkaloids recorded in this study indicate that date fruit could play a wide range of physiological actions on human health care such as antibiotics, anticancer and different degenerative diseases. This is in agreement with the findings of Ogbonna *et al* (2016) on banana, Kasolo *et al* (2010) on Moringa. Alkaloids are in great demand for pharmaceutical formulations especially for the lethal diseases such as cancer and inflammatory disorders. Alkaloids are heterogeneous group of naturally occurring compounds found in the leaves, bark, roots or seeds of plants. They are the most effective plant substance used therapeutically as analgesic, antimicrobial and antibacterial agents. The positive correlation observed between phenol and flavonoid and Phenol and saponin are in agreement with the findings of Chaudhuri *et al.,* (2013) where they also observed a linear positive correlation between phenol and flavonoid (0.967) and phenol and saponin (0.960), the positive correlation between tannin and saponin (0.985) and tannin and flavonoid (0.989) are also in agreement with the findings of chaudhuri *et al*., 2013 but the values are higher when compared with the ones obtaind in this study (Table 1), the negative correlation observed between flavonoid and saponin (-0.09262) in this study disagrees with the findings of chaudhuri *et al.,* 2013, where a complete correlation (1.00) was obtained between flavonoid and saponin.

Conclusion

It can be concluded that Nigerian date fruits may be considered as a potential source of antioxidants, since they contain important phytochemicals that posses bioactive properties and maybe used as external therapeutic supplements.

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Figure 1: phytochemicals of some of the studied parameters

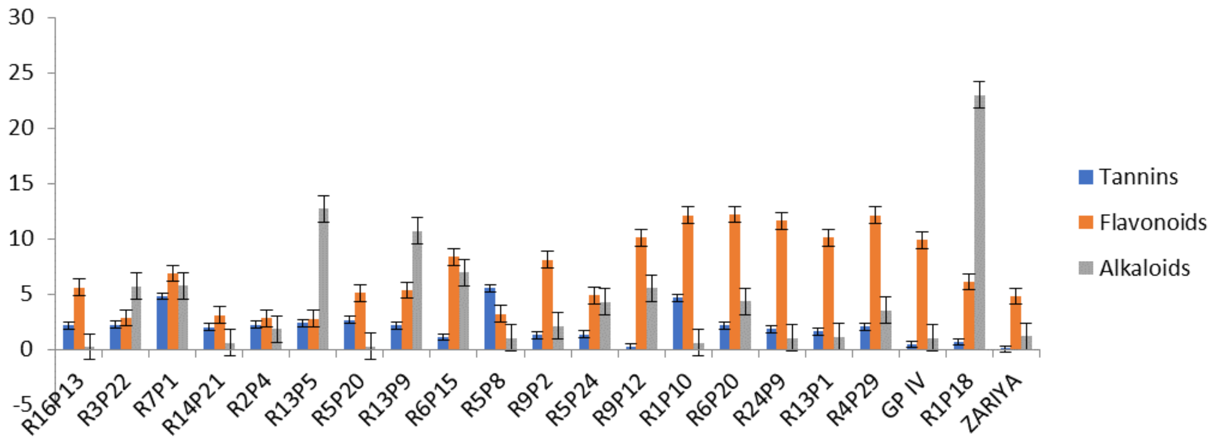

Figure 2: phytochemicals of some of the studied parameters

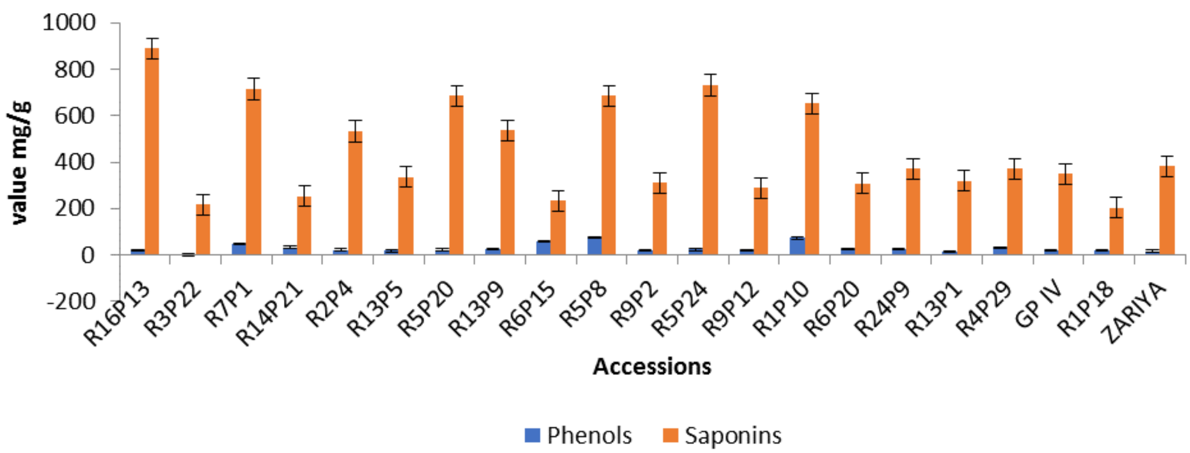

Table 1: Correlation Coefficient of the Accessions based on Phytochemicals

	Phenols	*Tannins*	*Flavonoids*	*Saponins*	*Alkaloids*
Phenols	1				
Tannins	0.325335	1			
Flavonoids	0.300383	0.07277	1		
Saponins	0.054061	0.420871	-0.09262	1	
Alkaloids	-0.01975	-0.12149	-0.24924	-0.26323	1

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Rice Processing as a Means of Poverty Reduction among Nigerian Women

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Abstract
The ultimate objective of development endeavors and policies is the eradication of poverty. Particularly today, poverty in Nigeria is the primary development challenge facing the country. The incidence of poverty in Nigeria is more in the rural area and particularly among women therefore empowering women and poverty reduction has become a much-discussed subject among many political leaders, civil rights activists, and women's associations. Women's contribution to economic development cannot be over-emphasized. Thus, female-headed households have become an easily identifiable group on which to target poverty alleviation measures. Rice which is a major staple food in Nigeria whose demand outpaced production could be an engine for economic growth. This paper untangles the potentials rice processing has in reducing poverty among Nigerian women. These potentials was identified through a multiple pathways which includes offering employment opportunities to women, enhance women empowerment through conscious provision of adequate knowledge, increase income, the paper concludes that with appropriate technological, institutional, and policy support, rice processing could offer opportunities of employment for women, enhance women empowerment, and thus accelerate attainment of food security and poverty reduction.
Keywords: Rice, Processing, Poverty reduction, Nigeria, women

Introduction
Rice is an important staple in many African countries. For some decades, it has been the most rapidly growing food source across the continent (Norman and Kebe, 2010; Diagne, Didier, Marco and Kazuki., 2012, IFPRI, 2016). According to Ben-Chendo *et al* 2017, more than 50% of the population largely depends on rice for about 80% of its nutrients requirements. However, the local production is largely insufficient to meet the consumer needs. (Diagne, Didier, Marco and Kazuki., 2012). In 2016, Africa produces an average of 30.8 million tons of rice and Africa also consumes a total of 45.2 million tons of milled rice (FAO, 2017). In order to meet up with the consumers' demand, Africa imported 14.4 million tons of milled rice in 2016 (FAO, 2017). With high food and fuel prices predicted to last well into the coming decade, relying on rice imports is no longer a sustainable strategy for Africa. Therefore there is need to develop the rice sector in Africa as a means of eliminating extreme poverty, achieving food insecurity, and raising the standard of living of millions of Africa poor (Diagne, Didier, Marco and Kazuki., 2012). Rice grow everywhere in Nigeria and between 2001 and 2003 production was estimated at 2.03 million tons while consumption was 3.90 million tons. The balance of 1.90 million tons was obtained by importation (FAOSTAT, 2007). Recently, available statistics shows that the country was able to produce only 3.2 million tons of paddy annually (Osanyinlusi and Adenegan, 2016). However, compared to the annual consumption level of 5.2 million tons, the above estimate is far below the national requirement since the average Nigerian consumes 40kg of rice per year, representing 9% of total caloric intake and 20% of total cereal consumption (FUNAI, 2016). In Nigeria, out of 4.6 million hectares available for rice production, only 1.7million hectares are put to rice cultivation, despite that its production is labour intensive and labour represents major production costs (Nwachukwu, Agwu and Ezeh, 2008) and recently 2.7 million were put to rice cultivation (Tijjani and Bakari, 2014).

Poverty is an elusive term, capturing a wide range of dimensions which include social, economic, political, income, health and access to resources. Poverty has different meanings to different people depending on the type of definition used. According to Goulden and D'Arcy (2014), poverty is the inability to meet a range of needs. Poverty is on the increase in Nigeria, Poverty in all its forms has blighted the Nigerian society for generations, although there have been many programmes and projects with poverty reduction mandate implemented over the years, it appears they have not addressed the root causes of poverty. Several reports (National Bureau of Statistics (NBS), 2012; World Bank, 2017; United Nation (UN), 2017) among others have shown that greater numbers of Nigerians are living in abject poverty. Also, Ekong and Onye (2014), reported that in 2013, the Department for International Development (DFID) report shows that 63% of Nigeria are living below the poverty line of $1 daily even with plenty of natural resources such as oil. About 69 million Nigerians were poor in 2004 (Omonona, 2009; Diao, Nwafor and Alpuerto, 2009) and it increased to 112.5 million in 2010 (NBS, 2012) and currently, 119.5million are poor (World, Bank, 2017). Past research works in Nigeria (Abur, 2014; Adetayo, 2014) attest to the growing incidence and depth of poverty in Nigeria and so there is need for urgent intervention.

Gap in Rice Sector

The need to bridge the gap between rice demand and supply has led to increases in rice imports. Rice importation is one of the major sources of our country's foreign reserve depletion with over one billion naira spent daily on imported rice (Onyekwena, 2016). Nigeria ranks as the highest importer of rice in West Africa, and the 2nd largest importer of rice in the world, after Indonesia (Cadoni and Angelucci, 2013) as cited in (Onyekwena, 2016). Nigeria is the 6th highest consumer of rice in the world (FUNAI, 2016).

The demand for rice will continue to grow, given that a large component of rice in Nigeria is now being consumed by low-income households and rice has also become an important component of household food security in the country (IFPRI, 2016). The rapid growth of the Nigerian population has been partly responsible for the upsurge in demand for rice, (IFPRI, 2016). In 2014, the annual rice demand in Nigeria was estimated at 5.9 million metric tonnes (MT) (Sahel Capital Partners & Advisory Limited, 2015),it increased to 6.3 million MT in 2016 (Grow Africa, 2017).Despite many policies made by federal government of Nigeria in the rice sector, rice production has failed to keep pace with the growing domestic demand. In 2014, rice demand was estimated at 5.9 million metric tonnes (MT) while only 2.7 million MT was locally produced, leaving a supply gap of 3.2 Million MT (Sahel Capital Partners & Advisory Limited, 2015). Nigeria has not been able to achieve self-sufficiency in rice production as a result of inefficiency in processing and marketing according to National Rice Development Strategy (NRDS, 2009).

Poverty Spread across Nigeria

Poverty manifests itself more in the rural areas than the urban area due to low productivity of agriculture which they depend upon and among female headed households. For any meaningful economic growth and poverty reduction, there is the need to enhance and improve access to social services, including health and education to the rural people and women. Some of the dimension of poverty in Nigeria as identified in literature are discussed below.

In the rural: Poverty is widespread in both rural and urban areas in Nigeria. The rural areas, however, record a higher incidence, depth and severity of poverty than the urban areas. The National Bureau of Statistics (2012) records shows that more than half of rural households are 'absolutely poor' while the proportion is much lower in the urban areas. The National Bureau of Statistics attributed the high incidence of poverty in the rural areas to their dependence on low-productivity agriculture, lack of access to opportunities and poor social and economic infrastructure. Women represent the majority of the rural poor (up to 70%), especially where migration, marital instability, male mortality and single parenthood have left them as heads of households; women carry most of the responsibility for household food security.

Across regions: Poverty in Nigeria also has a regional dimension. Statistics show that poverty incidence is more in the northern part of the country than those living in the other parts of the country. More specifically, NBS, 2012 reports shows that in 2004 the poverty incidence was highest in the North-East zone (67.3%) and lowest in the South-East zone (34.2%), with similar figures for 2010.

Across state: Poverty in Nigeria also exhibits disparities by states. NBS, 2012 reports shows that the eleven states with the highest incidences of poverty are in the northern part of Nigeria, with Jigawa topping the list with a poverty incidence of 90.9 per cent while Oyo State has the lowest poverty incidence (20.9 per cent).The NBS has it that the cost of living, low productivity, poor infrastructure, and unemployment are responsible for the disparity.

Between gender: Lastly, poverty in the country has a gender dimension. The incidence of poverty is higher among females than males. This disparity is attributed to the women's relative lack of access to education and technical skills as well as lack of access to capital and other means of production including land (NBS 2012).

Rice as a Poverty Reduction Crop: Empirical Evidence: In the work of Norman and Kebe (2010), they noted that the income generated from rice cultivation and postharvest activities provides cash to cover the expenses of clothing, housing, education and other social activities of the majority of people in rural areas and that in general, rice production is the key to the improvement of rural livelihoods, not only of small rice farmers but also of poor families in urban area. They concluded that the numerous activities in rice production provide employment to millions of people who work either directly or indirectly. After rice harvesting, farm activities shift to post-production operations, namely threshing, drying, milling, storage and trade. The preparation of milled rice for consumption, the transformation of milled rice to other products, and the utilization of broken rice, rice bran, rice hulls and husks, and rice straw provide additional employment opportunities for a large number of people.Isma' ila (2015) in his work on value chain analysis of rice (*oryza sativa*) in kano river irrigation project (krip) kano state, Nigeria revealed that Rice is the second most important food security crop in Nigeria and that it is a major source of revenue for small farmers in rural areas. According to him, Eighty percent of the rice crop is marketed, and it generates the largest contribution to rice producer household income, allowing the household to purchase other foods and he concluded that rice production and processing in the study area did not only contribute to the country's food security, but also contributed to income, rural employment generation and poverty reduction. According to National Rice Development Strategy (NRDS, 2009), Rice being the most important staple food for the world poorest people, has satisfied the conditions as a pro-poor crop that is contributing to income and food security of the people and the poor having relative advantage in its production.

Rice Processing

Rice processing simply refers to all activities involved in transforming raw paddy rice from whole grain after harvesting to the form or nature the consumer wants it while Rice milling is the act of removing the husk and bran from rice and exposing the white layer as either polished or brown rice. Processing helps to achieve form utility. Rice processing involves several steps: removal of the husks, milling the shelled rice to remove the bran layer, and an additional whitening step to meet market expectations. This process generated several streams of material which include the husks, the bran, and the milled rice kernel.

The traditional methods of processing rice paddy involve soaking of the paddy in water for 2 to 3 days to soften the kernel, followed by steaming of the soaked paddy for 5–10 minutes and dried in the sun, followed by pounding the dried paddy in a mortar and pestle device to remove the husk or use of simple machines for dehulling/milling; then the grain is cleaned using a winnowing basket. Though the traditional method of processing rice is simple, but tedious, it has very low outturn and results in breakages of rice kernels and incomplete removal of husks. More so, it has a short storage life as the fat in the bran develops rancidity.

The Modern Method Of Rice Processing Involves: Cleaning-After harvesting rice, it is transferred to the processing plant where foreign objects like stones and tree stumps are removed using Destoner

Hulling: Separation of husk from clean paddy. After the husk is removed, the product is called brown rice and is ready for the milling process.

Milling: This stage removes the bran layer of rice turning brown rice into white rice

Polishing- The surface of rice is smoothened and shine by passing it through a series of rollers

Grading- It is a process in which broken rice is separated out and separating rice into different lengths

Sorting-Discolored, yellow and immature rice is removed in this stage adding value to rice

Packing- The finished product is then packed and is stored to be delivered to valued customers.

In some parts of the world especially Asia, rice is processed into the following products:-

Rice flour - which is made from ground raw rice (glutinous or non-glutinous). It can be ground domestically using a blender, grain mills or traditional pounding methods.

Rice noodles: Flat rice noodles and round noodles are made from wet-milled rice flour. These are eaten with side dishes or in soups.

Rice-flour cakes: Glutinous rice (also known as sticky rice or waxy rice) flour is commonly used in making it.
Rice bran oil: Oil can be extracted from the rice bran and rice germ, and this is generally known as rice bran oil. Rice bran oil is high in vitamin E, other antioxidants and various plant sterols. It is believed to have many health benefits. Rice bran oil is used for cooking as well as in salad dressings. Rice bran and germ oil is also used as a nutritional supplement.
Rice-based alcoholic beverages: Alcoholic beverages made from rice are found throughout the rice-producing world.
Rice vinegar: Rice vinegar is a traditional product from China and Japan. It can range from clear or pale yellow to shades of red, brown and black. It has 4–5% total acidity.
Rice milk: In Thailand and the US, milk is made from rice for lactose intolerant people.
Rice syrup: Rice syrup is an alternative sweetener, made from cooked brown rice and enzymes, which break down the starch.
Rice crackers*:* Many kinds of rice crackers are produced across Asia including Japan it is often combined with seaweed.
Rice starch:Rice starch is used as a thickening agent in food preparation, including infant formula. The granular size of rice starch is relatively small. But In Nigeria, milled rice is mainly processed into foods like jollof rice, fried rice, rice stew and tuwo.

Women in Rice Value Chain

Women make significant contributions to rice farming, marketing, and play a dominant role in processing and buying rice for consumption. Yet, women still face many barriers and inequality inaccess to and control over resources such as information and inputs (new technologies and finance)(IRRI 2016). Basorun (2013), noted that over 50 percent of women involves in rice processing in rural Nigeria, also, more than seventy (70) percent of labour utilized in the rice vain chain are from women. Women are less involved in decision making in the rice vain chain and have less control over income and assets than men. These gender inequalities reduce women productivity in every aspect of rice vain chain by 20–30% compared to that of men (FAO 2011). Such inequalities also hinder the progress of other development outcomes such as family planning; maternal, newborn, and child health; nutrition; education; and food security (Gates 2014) as cited in IRRI, (2016). Rice processing among women is characterized by small holding, low access to credit facilities, manual operations due to their inadequate access to modern processing machines and inadequate access to timely extension services. These necessitate women rice processors to use manual processing.

Some of the challenges face by women in the rice processing industry in Nigeria.

Literature have identified different problems faced by women in rice processing, in the work of Basorun (2013), most of these problems and challenges were given as women lacking formal training, their processing tools are predominantly local that is they lack modern equipment and often use outdated milling machines, little institutional supports and inadequate funding. Other changes includes poor quality and insufficient paddy rice, poor marketing infrastructure, lack of collateral to obtain loan, lack of technical know-how in the few available modern processing machine, government interference through tax imposition. Women farmers do not have equal access to resources and opportunities that could enhance their productivity and income (Mutone- Smith, 2011). These constraints work to disadvantage women as value chain actors and to reduce their competitive advantage in comparison to men and as a result, women-led processing unit are trapped in a cycle of poor profits, poor investment capacity, and a general incapacity to expand. Therefore, addressing these problems is good first step towards alleviating the poverty of women in Nigeria through rice processing.

Rice processing as a means for poverty reduction among women: A Way Foward

Women are instrumental in development. Women work as a catalyst for change and are a major driver of growth and development (IRRI, 2016). Empirical studies have shown that women spend their additional income on food, healthcare, and children's education (which is an important stepping stone out of poverty), while men spend more of their income on personal items (Smith and Haddad 2000) as cited in IRRI., 2016. Thus, empowering women through rice processing by ensuring their equal access to resources, inputs, and technologies and allowing them to have greater control over income and assets can pave way for their community development, contributing to household food security, health and nutrition, and poverty reduction.

Not much has been done in rice processing as a means of poverty reduction among women but the research work conducted by Mustapha *et al.* (2012) shows that parboiling increased the income of the women, therefore, with appropriate technological, institutional, and policy support, rice processing and marketing could offer opportunities of employment for women, enhance women empowerment, and thus accelerate attainment of food security and poverty reduction.

Basorun (2013), noted that rice processing increases income. Women typically do not own key asset, they hardly access formal financial providers since they have no collateral and find it difficult to get a guarantor. This forces a reliance on micro-credit schemes which depend on the ability of women to maintain social capital and ensure compliance by all members, therefore,Poverty and hunger can be reduced among women rice processors by reducing processing risks, improve access to financial and other services, diversifying enterprise opportunities (processing rice into other products like oil, noodles, crackers, milk , vinegar etc) for these will increase the value(income)capture by women processors and income shows the ability of the household to purchase its basic needs of life.

In many areas, women still practice the traditional processing operations, such as manual threshing and winnowing, and poor seed management, which result in significant losses. Adoption of improved processing technologies (such as parboiling) can help in increasing the nutritional quality of rice grains, reducing processing losses thereby increasing the income realized by women processors, increase the amount of rice for consumption and ensuring food security and contribute to women's livelihood opportunities and well-being.

Women processors should be linked to other rice value chain actors for easy access to resources in order to expand their businesses, therefore they should be assisted through business development sources to find best location for stand and develop customer loyalty. Facilitate links to large-scale customers with predictable and regular demand requirements, such as barracks and schools. Rural women often have low levels of education and, as a consequence, low literacy and skills, regular extension visits that work specifically and separately with women to teach them new processing technologies and techniques will strengthen women's capacities and benefits and enable them to maximise value addition at this stage.

Conclusion

Rice being one of the most important food crops in Nigeria, need to be given adequate attention because of its great potentials of eliminating extreme poverty, achieving food insecurity, and raising the standard of living of millions of Nigerian poor women. Empirical findings such as Mustapha *et al.* (2012) has showed that parboiling increases the income of Nigerian women, therefore the paper concludes thatwith appropriate technological, institutional, and policy support, rice processing could offer opportunities of employment for women, enhance women empowerment, and thus accelerate attainment of food security and poverty reduction.

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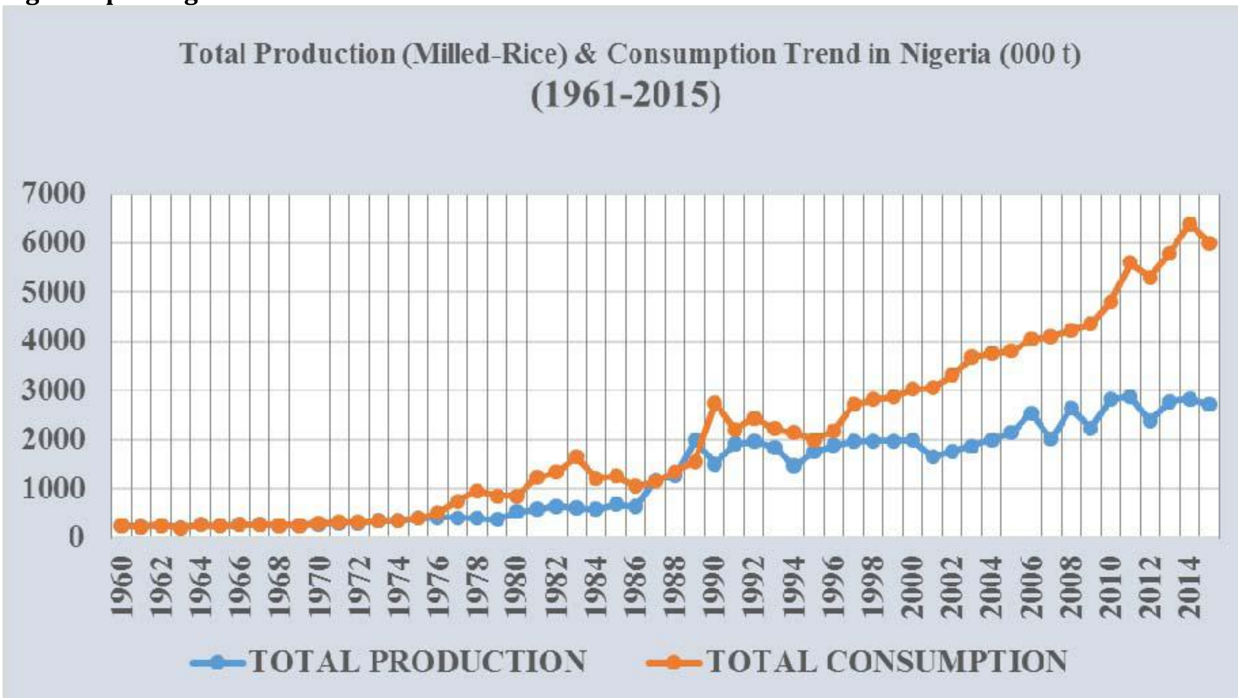
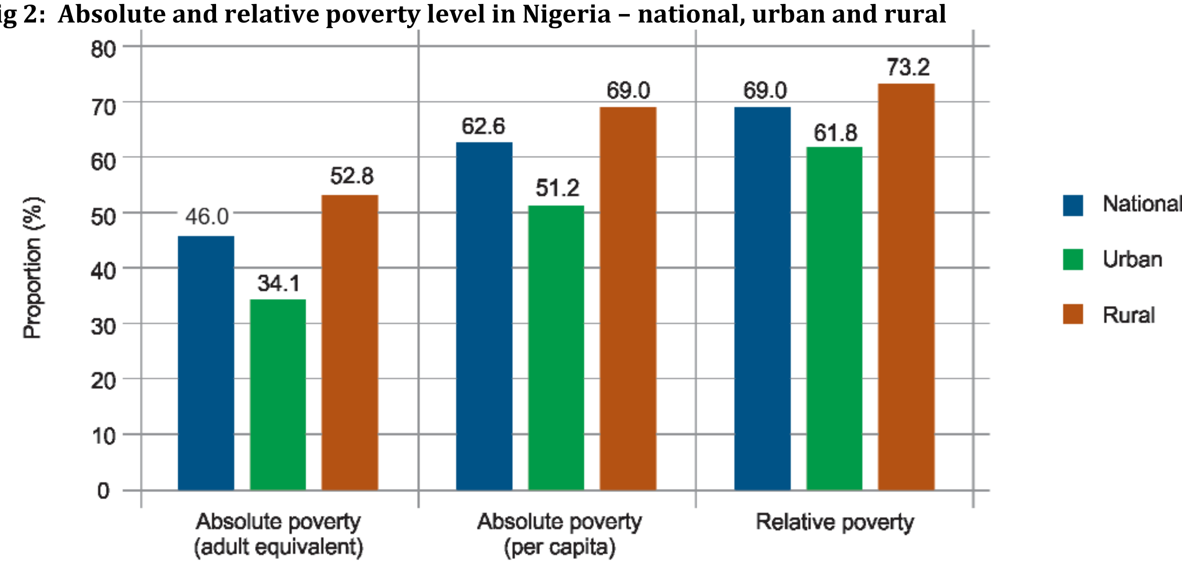
Fig 1: Gap in Nigeria's rice sector..



Source: World Rice Statistics, US Department of Agriculture

Fig 2: Absolute and relative poverty level in Nigeria – national, urban and rural



Source: NBS, 2013

ASN 53rd Annual Conference Proceedings (Sub-Theme: Agricultural Engineering, Processing & Value Addition)

Sweetpotato Value Addition in Nigeria: A Review

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Abstract
This paper attempts to review literature on Sweet potato value addition in Nigeria. It started with a little introduction of sweet potato and its value addition. This is followed by the contribution of different authors on various forms of sweet potato value addition in different regions of Nigeria, the review was concluded by discussing importance of adding value to sweet potato.

Introduction

Sweet potato (Ipomoea batatas (L) Lam is an important root crop grown extensively in tropical and sub-tropical zones. It is one of the world's most important food crops due to its high yield and nutritive value (Mwanja et al., 2017). The high nutritive value and performance under resource poor condition makes it attractive to farmers and households.It is a versatile, droughtresistant, high yielding crop with a short maturityperiod of three to five months adapting well to wide ecological conditions (Laurie *et al*. 2012). It is one of the major staple crops and the most important food security promoting root crop in the world, especially in sub-Saharan Africa (Low *et al*. 2009). In Nigeria, Sweet Potato is a food crop that is increasingly being recognized as having an important role to play in improving household and national food security, health and livelihoods of poor farming households. (**Adeyonu***et al.,* 2016). Sweet potato is a bulky, perishable commodity with a high weight- to- value ratio. This limits the distance over which Sweet potato can be economically transported. According to Abidin (2004), bulkiness and perishability affect postharvest system of sweet potatoes as it has a shelflife of about one week after harvesting, hence, it becomes imperative to process sweet potato into storable products (Ndunguru, 2003). Value addition is the transformation of raw agricultural commodities to consumer-ready food products. It includes local processing, packaging, cooling, drying, extracting or any other types of process aimed at improving the value of raw agricultural produce. Value addition focuses on perishable crops after harvest to reduce losses, enhance financial or nutritional crop-value, and assure food safety. Value addition has been identified as a pathway for farmers out of poverty. Value Addition entails deliberate activity to change the form of the raw sweet potato into a more refined or usable form thus increasing its value. It is the process of changing or transforming a commodity from its original state to a more valuable state through creating value, innovation or industrial innovation at an advanced stage. (Mmasa, 2013).

Sweet potato can be processed and utilized in various ways for both household and the market purposes (Orinda,2013). Sweet potato is used for human consumption, as livestock feed, and in industrial processes to make alcohol and starch. Sweet potato is high in carbohydrates. The orange-flesh varieties also provide vitamins A and C. In addition, the green leaves of the plant can be consumed by both humans and animals providing additional protein, vitamins and minerals (Yanggen and Nagujia, 2005). Some of the sweet potato products can be preserved for future use either alone or as additives to other foods. The sweet potato roots can be processed into dry chips and used in this form or ground into flour. The flour can then be used in enriching other different products such as weaning foods or used in combination with wheat flour to make other high value products such as cakes, biscuits, porridge, ugali, chinchin, crackers and other dishes (Nxumalo, 1998; Nungo, 2004).

Empirical literature of Sweet potato Value Addition in Nigeria

As was noted by Adeyonu *et al*. (2016),Bergh *et al*. (2012) opined that in Benue, Nasarawa and Kwara States, Sweet potato was mainly peeled and boiled, roasted, fried into chips or peeled sundried and milled into flour and that the majority of the farmers had not embraced value addition. There is little commercial processing into chips or flour, which could be stored for year round consumption for use in ugali, bread and cakes, or processing into fermented and dried products like fufu. Egeonu (2004) opined that Sweet potato could be made into a number of products including sparri (Sweet potato garri), flour, crisps, canned sweet potato, starch and sweet potato beer. However, getting Sweet potato processed into various forms require appropriate and efficient postharvest technology which may be out of reach of smallholder farmers because majority of them are poor. Study conducted by Micah Etukudo (2018) on Sweet potato Utilization Level among Households in Oyo State, Nigeria observed that majority (77.0%, 90.0%, 70.0%, 75.0% and 70%) of the respondents have not heard that sweet potato could be processed into other products such as starch, sparri (garri made from sweet potato), bread, and puff-puff respectively. On the use status of sweet potato, the study revealed that majority (91.3%, 96.3%, 91.3%, 75.0%, 91.3% and 92.5%) of the households has never used or consume starch, sparri (garri made from sweet potato), cake, chin-chin, bread and puff-puff (respectively) made from sweet potato. Omoare *et al*., (2015) in their work on value addition of sweet potato (*Ipomoea batatas L. Lam*): Impending Factors on Household Food Security and Vitamin A Deficiency (VAD) in Southwest and Northcentral Nigeriarevealed that most common (88.20%) processed sweet potato in the study area was in boiled, roasted, fried and chips forms. Sparri was not very common (0.50%) in the diet of rural dwellers in the study area. The reason adduced for this is that sweet potato can be easily boiled and roasted without much effort. This result corroborates the findings of Fawole, (2007) that the common processed products forms of sweet potato are boiled and roasted processed forms. In Africa, sweet potato is generally eaten boiled or roasted. However, various utilization methods such as making of chips, blending of sweet potato flour with wheat flour for products like chapatti, mandazi or porridge has not been fully developed in Nigeria (Tewe et al., 2003). Study conducted by Ezeano (2010) on technology use in sweet potato production, consumption and utilization among households in South eastern Nigeria stated that on the consumption, processing and utilization of sweet potato products, majority (70.8%) of the consumers indicated that they processed sweet potato into snacks (fried chips). Also 59.7%, 58.3%, 56.9%, 58.3% and 50.0% agreed that sweet potato is processed and utilized for fortification of fufu / pounded yam, chips, flour, fortification of baby‘s food, beverages *(kunu, Burukutu)* respectively. According to Ezeano (2006), the processing and utilization of sweet potato into other products have not received the expected result and attention of consumers, industries and others end – users probably because it is a relatively new technology. In addition to this fact, Tewe *et al* (2003) opined that sweet potato flour is usually unacceptable for consumption because of its dark colour and extremely sweet taste.

Importance of Value Addition in Sweet potato in Nigeria

Value addition in sweet potato has the potential to enhance the production of the crop and further play an important role in the food/nutritional security and income generation among the rural households and even urban markets (Nungo, Ndolo, Kapinga, and Agili2007; Westby *et al*., 2003). In addition, processing of sweet potato into non-perishable products also addresses the farmer's storage problems while ensuring food availability in time of scarcity (Westby *et al.,* 2003). Therefore, this is a key strategy to commercialize farming for small holder farmers in Africa. According to a study by Lemaga (2005), the introduction of sweet potato based enterprises to poor and marginalized smallholder farmers increases their income as a result of sweet potato products sales and their knowledge on post-harvest technologies leading to improved food security. Indeed, research carried out by the International Potato Centre (CIP) on sweet potato productivity in developing countries found that value addition is an important post-harvest need (Fuglie, 2007). Sweet potato flour could be used for making various food products such as cookies, cakes, bread, ketchup, noodles and vermicelli (Meludu et al., 2003; Van Ann, 2004; Alumira and Obora, 2005). Sweet potato flour could substitute 20 to 100 percent of wheat flour depending on the product being manufactured (Alumira and Obora, 2005). In Philippines, sweet potato is used in making food products like noodles, flour starch, soy sauce and alcohol or if immediately cooked, it can be further processed into wine vinegar and desert. (Ememwa *et al.*, 2008) observed that value addition done on farm produce is a key strategy to commercializing smallholder farming communities. It has the ability of processing perishable farm produce, reduction of bulkiness thereby allowing diversification of consumption, enhancing acceptability and marketability. Value addition increases the product's shelf life hence contributes significantly to a household's food security while at the same time increasing income generation.

Conclusion

In conclusion therefore, Sweet potato value addition is important intervention to embark in. This is due to the fact that urbanization, changing lifestyles, increasing middle income earners, market socializing and trade liberalization which have led to an extraordinary increase in demand for high value products. The concept of value addition in agriculture in the developing economies like Nigeria is widely becoming an acceptable strategy adopted by both government and non-governmental organisations towards improving the income generation of the rural communities.

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ASN 53rd Annual Conference Proceedings (Sub-Theme: Agricultural Engineering, Processing & Value Addition)

The Role of Cereals in Maintaining Food Security

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Abstract
Cereals are any grasses grown for their edible starchy grains (caryopsis). Major cereals produced in Nigeria include rice, sorghum, maize, millets, wheat and barley. They provide over half of the world's food calories and are the major dietary energy suppliers all over the world and thereby ensuring food security and sharpening human civilization. Cereals were the first agricultural attempts by early man and they are still being enjoyed today. Solving Nigeria cereals problems is an indirect and powerful approach to alleviate poverty and improve the standard of living for Nigerian farmers. Rice is the staple food for more than half the world's population, used for animal consumption and in industries for the production of wide range of substances including glucose.

Keywords: Cereals, Food Security, Human Civilization

Introduction

Cereals are regarded as agronomic crop plant belonging to the grass family used mainly as staples. They are grown in large quantities and provide more energy worldwide than any other type of crops. Apart from carbohydrates, cereals are rich in vitamins, minerals, fats, oils and proteins (Agbogidi *et al*., 2006). Rice is primarily a high-energy or high caloric foods. Rice provides 21% of global human per capital energy and 15% of per capital protein. (Eruotor, 2014). Cereals include rice (*Oryza sativa*), barley (*Hordeum vulgare*), maize (*Zea mays*), wheat (*Triticum aestivum*), millet (*Pennisetum glaucum*), sorghum (*Sorghum bicolor*) and oats (*Avena sativa*) (Veigh, 2009).

Role of cereal in food security

Eruotor (2014) regarded rice as the staff of life because of its integral role in maintaining food security worldwide. Cereals have been shown to play a diverse role in ensuring adequate food security worldwide. They are used as breakfast food. Cereals can also be stored for a long time if well preserved. They are also cheap and easy to access. Some breakfast cereal foods include porridge, rice flakes and corn flakes. Cereals are also very rich in fibre content which helps in preventing weight gain and heart diseases. Rice hulls are used as fuel, soil mulch, conditioners for commercial fertilizers and in furfural, a liquid alcohol used as a solvent in plastics (Okamah and Eruotor, 2012). The comparative protein yield of some cereal food crops is presented in Table 1. Similarly the proportion of comparative energy yield of cereal and non-cereal energy crops is shown in Table 2 and Table 3 shows the role of some cereal crops in food security.

Challenges, way forward and Conclusion

It has been established that cereals play an integral role in maintaining food security. Their production is however challenged by impact of climate change, land degradation, and persistent biotic and abiotic stress, poor mechanization, teeming population growth, inadequate or weak environmental policy, dwindling financial and preservation technique and high production cost. Cereal production will be enhanced by the availability of new tools, restoration of degraded soils, and improved cereal food storage and stress tolerant crops among others.

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Table 1: Comparative protein yield of some tropical food crops

Crops	Average tropical yield (tha-1)	Protein content (%)	Average protein yield (kgha-1)
Cereals			
Rice	2..69	7.5	202
Maize	1.59	9.5	146
Sorghum	0.87	10.5	91
Millet	0.65	10.5	68

Source: Adapted from Norman *et al*. (1995)

Table 2: Proportion of comparative energy yield of cereals and non-cereals energy crops

Edible energy crops (%)	Proportion of energy (%)	Edible energy value	Edible energy per ha (M3 x 103)
Cereals			
Rice	70.0	14.8	27.9
Maize	100	15.2	24.2
Sorghum	90	14.9	11.7
Millet	100	15.0	9.8

Source: Adapted from Norman *et al*. (1995).

Table 3:Roles of cereals in food security

	Cereal crops	Role in food security
1	Rice	Flour production of rice crackers and rice noodles Bran – ingredient in some baked products like bread, Rice bran oil is used for baking and cooking purposes, wine produced hulls used as fuel.
2	Wheat	Flour used to make a whole wide range of foods – bread, noodles, pasta, biscuits, cakes, pastries, snack foods, sauces and confectionery.
3	Semolina	Mainly for pasta
4	Barley	Production of alcoholic beverages, Barley flakes, Barley girts to make stew, soups, hamburgers, Barley flour to make bread and noodles.
5	Corn	Fresh ones as vegetable. Corn starch has a range of uses, corn syrup and girts are used in breakfast and snack food like corn chips, popcorn. Corn is used in brewery industry to produce beer and corn is excellent fodder for animals.
6	Millet	Can be boiled and eaten like rice. Used for brewing local beer and the straw for feeding livestock.
7	Sorghum	Flour to make unleavened bread. Sorghum is used to make alcoholic beverage and the seeds can be popped.
8	Oats	Eaten as porridge, making of oat meal cookies, bread and drinks.

Source: Agbogidi (2006); Eruotor (2014)