EFFECT OF STORAGE TIME ON THE PROXIMATE AND MICROBIAL LOADOF PASTES FROM SOME VARIETIES OF TOMATOES GROWN IN A HYDROPONIC SYSTEM

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ABSTRACT

Tomato products are of considerable importance worldwide and the demand for tomato paste is increasing rapidly both in domestic and international market. Hydroponic method is a soilless technique for growing crops. It involves the growing of plants in a liquid nutrient solution with or without the use of artificial media. This study was carried out to evaluate the effect of storage period on the proximate and microbialload of paste from varieties of hydroponics (Cherry, Plum, UTC and Beefsteak) tomato paste;the pastes were kept at room temperature for shelf studies. The proximate and microbial analyses were carried out using standard methods.Each of the four varieties of tomato paste is significantly different in proximate analysis; moisture content was higher than other parameters analyzed irrespective of storage period.The bacteria countof the paste shows that the bacteria load of sample C ($2.50x10^6$cfu/mL) has the lowest bacteria count when compared to the rest of the samples, whilesampleA (UTC tomato paste)had the highest bacteria load of $8.50x10^6$cfu/mL. There is no fungi growth in the four samples at 0, 14 and 28 days except that sample A had $1.15x10^6$cfu/mL fungi growth on the 28 days. On the 42 days sample A recorded high fungi growth to be $1.55x10^6$cfu/mL while sample C recorded $1.25x10^6$cfu/mL and sample B and D has no fungi growth. In recent years hydroponics is seen as a promising strategy for growing different crops. As it is possible to grow short duration crop like vegetables round the year in very limited spaces with low labour, so hydroponics can play a great contribution in area with limitation of soil and water and for the poorer and landless people, result indicated that all samples showed significant different in proximate and microbes during storage at room temperature

Keywords: Hydroponics, Tomato paste, Proximate composition, Microbial, Storage

INTRODUCTION

Tomato (*Lycopersiconesculentum*), commonly referred to as vegetable to nutritionist and a fruit to plant scientists is grown throughout the tropical and temperate regions of the world (Okorie*et al.*, 2004). Tomato is an important herbaceous perennial vegetable grown for its edible fruit and as an annual vegetable in temperate regions. This fruit vegetable has the ability to raise the standard quality and acceptance of other diets and are consumed both as raw and/or processed products. Fresh tomatoes are the fifth most popular vegetable consumed in the United States (16.6 pounds per capita) (USDA, 2000). They are a good sourceof vitamins and minerals.It is also high in moisture and cellulose but low in protein.Production and consumption of tomato

around the world has increased tremendously over the past 25 years, a production of about 105 million tons in 2001 from an estimated hectares of 3.9 million was reported for fresh fruits by Ayandiji and Adeniyi (2011).

Hydroponics is a soilless technique for growing crops. It involves the growing of plants in a liquid nutrient solution with or without the use of artificial media (Bruce, 2015). The demand for hydroponically grown produce has rapidly increased in the last few years, it has been recognized as a viable method of producing vegetables for example tomatoes, lettuce, cucumbers and peppers as well as ornamental crops such as herbs, roses, freesia and foliage plants.

Tomatoes are highly perishable and large quantity of tomatoes is wasted due to poor handling/storage facilities. One of the methods used in most household in the preservation of tomato is the processing into tomato paste. The paste also represents the main product from industrial tomato cultivar. Tomatoes have short agricultural season and during the glut season much is transformed into paste and made available during the off-seasons. Due to rapid urbanization and industrialization not only the cultivable land is decreasing but also conventional agricultural practices causing a wide range of negative impacts on the environment. To sustainably feed the world's growing population, methods for growing sufficient food have to evolve. Modification in growth medium is an alternative for sustainable production and to conserve fast depleting land and available water resources (Butler and Oebker, 2006). Thereis sparse information on these hydroponically cultivated tomatoes and especially on the proximate and microbial properties of the paste.This study was aimed at evaluating the quality of the tomato paste with respect to the changes in proximate and microbial assessment during storage. This study can therefore help to manipulate the storage conditions and determine the safety of the pastes.

MATERIALS AND METHODS

Source of Material and Material Handling

Four varieties of tomatoes (Cherry, Plum, UTC and Beefsteak)were purchased from Soilless Farm Laboratory Owiwi, Abeokuta, Ogun State.They were properly packed in polyethylene packaged in carton and finally transported to the laboratory. Evaluation of the samples was carried out under strict and standard conditions in the Department of Food Science and Technology Laboratory of the Federal University of Technology, Minna, Nigeria.

Production of Tomato Paste

The tomatoes were sorted and washed to remove extraneous material and blanched at 90°C for 2 minutes for easy skin removal (peeled). The skins were removed manually followed by milling of the pulp in an attrition mill (untill uniformly smooth mixture)and finally concentratingthe tomato slurry at 100°C.It was sealed in aluminum steam pouch and then pasteurized at 70°C for 15 minutes.The packaged paste was labeled A (UTC), B (Cherry) C (Beefsteak) and D (Plum). These were then kept on shelve at room temperature for shelf studies.

Tomato pastes storage protocol

The tomato paste were stored at room temperature (cooled and dry place) 28°C on shelve and the evaluation of the paste were carried out at fourteen days (14 days) interval.

Proximate Analysis

The moisture, ash, fat and crude protein content of the various tomato pastes was determined using standard method described by AOAC (2010).

Microbiological Analysis

The microbial analysis was carried out on each sample for microbiological safety and all the media used were prepared aseptically in the laboratory following their manufacturers' descriptions. These includedpeptone water (PW), nutrient agar and potato dextrose agar. The media were weighed into different conical flasks and corked after the addition of distilled water. The media and tubes were autoclaved at a temperature of 121°C for15 minutes using an autoclave (FSSAI, 2012). The cap of each of the sample bottles were opened aseptically and the necks of the bottles were flamed lightly before and after collecting the samples. Exactly 1mL from each of the samples was transferred into six different test tubes containing 9mL of peptone water each. From the first dilution, 1mL of each sample was taken into a test tube. One mL was taken and transferred to the second test tube and shaken, the process was repeated until the last test tube labeled sixth. Thereafter, 20mL of the molten sterile agar was transferred into a sterile petri dish and swirled gently for homogeneity. The molten agar was allowed to solidify andtransferred into the incubator for 24hours at 37°C for the bacterial enumeration. While fungi plates containing potato dextrose agar were transferred to the fungi hood and incubated at room temperature (28°C) for 48h. The resulting growth of the cultures was counted as colony forming unit per mile (CFU/mL)

Statistical Analysis

Data obtained for bacterial load was tabulated using Microsoft Excel (MS Excel 2010, Microsoft Corporation). Statistical analyses were doneon proximate data using Statistical Package for the Social Sciences (SPSS version 16.0). One way ANOVA using Duncan Multiple Range (DMR) test were usedat 95%probability.

RESULTS AND DISCUSSION

The results of the proximate analysis are shown on Table 1.The results revealed that the moisture content ranged from 79.24% to 84.63%.The moisture content was higher than other parameters analyzed irrespective of storage period and this is in agreement with the findings of Agbemafle*et al.* (2015). As the storage period progress the quality of the protein is maintained except on the forty two days (42 Days) there is slightly significant difference and sample C recorded lowest protein with 4.96%. The crude protein content of all the varieties during storage ranged between 4.99 – 6.88% higher than 1.0% - 1.1% as reported by USDA (2005). The differences may be as a result of varietal influence, environmental conditions and other agronomical practices during production (Agbemafle*et al*, 2015).The ash content of a food substance depicts the total crude minerals which ranged from 1.17% to 2.98% with sample A having the highest value. The ash content values are above the range of 0.47% - 0.98% reported by Agbemafle*et al.* (2015). As the storage time progress the four samples are

significantly different in ash content and could be as a result of its ability to absorb minerals from the medium or through nutrient manipulation as the tomatoes was said to be hydroponics and was not in agreement with the findings of Agbemafle*et al.* (2015). The four varieties had crude fat ranging from 0.33 – 0.55%, however, significantly higher than 0.20% reported by Idah*et al.* (2010). Agronomical activities during production may also account for dissimilarity.

The microbial quality of tomato paste is shown on Table 2. The bacteria count of the paste showed that the bacteria load of sample C ($2.50x10^6$ cfu/mL)had the lowest bacteria count when compared to the rest of the sampleswhile sample A had the highest bacteria load of $8.50x10^6$cfu/mL. The low bacteria load of sample C gives a comparative advantage over others as it will stay longer maintaining its quality. However, for the fungi count no growth was observed in the four samples on 0 and 14 days of storage. No significant change was observed in 28 days except that sample A had growth to be $1.15x10^6$cfu/mLand on the 42 days sample A has $1.55x10^6$ cfu/mL and sample recorded $1.25x10^6$ cfu/mL. Bacteria load for sample C at 14 days was$4.05x10^6$cfu/mLwhile sample A had $8.15x10^6$ cfu/mLand at 28 days $4.45x10^6$ cfu/mLfor sample C and $9.15x10^6$ cfu/mLand $8.55x10^6$ cfu/mLfor samples B and A, respectively.These microbial profiles may be related to several interactive behaviours influenced by temperature, acidity and oxygen content. During the course of the microbial study, swollen pouches were observed for all the tomato paste after 6 weeks (42 days), and the study was terminated.

Table 1: Effect of storage on the proximate composition of the various tomato paste

Samples	Period (days)	Moisture	Protein (%)	Ash	Fat
A	0	80.26±0.01^b	6.60±0.01^b	2.71±0.01^a	0.49±0.01^a
B		80.74±0.02^a	5.16±0.01^c	1.21±0.01^c	0.49±0.01^a
C		80.12±0.08^b	4.99±0.01^d	1.98±0.01^b	0.43±0.01^b
D		79.24±0.66^c	6.81±0.01^a	1.17±0.01^c	0.48±0.01^a
A	14	80.39±0.01^b	6.23±0.01^b	2.85±0.01^a	0.56±0.01^a
B		80.85±0.01^a	5.13±0.01^c	1.34±0.01^d	0.54±0.01^b
C		80.19±0.01^c	5.05±0.07^c	1.49±0.01^b	0.43±0.01^d
D		80.43±0.01^b	6.88±0.01^a	1.39±0.01^c	0.47±0.01^c

A		81.63±0.01^{c}	6.18±0.01^{a}	2.98±0.01^{a}	0.34±0.01^{d}
B	28	81.74±0.01^{b}	5.10±0.01^{c}	1.72±0.01^{b}	0.51±0.01^{a}
C		82.46±0.01^{a}	5.04±0.00^{d}	1.42±0.01^{d}	0.39±0.01^{c}
D		80.47±0.01^{d}	6.17±0.00^{a}	1.55±0.00^{c}	0.41±0.01^{b}
A		84.63±0.01^{a}	6.11±0.00^{a}	2.74±0.00^{a}	0.33±0.00^{d}
B	42	84.12±0.01^{a}	5.94±0.00^{b}	2.05±0.01^{b}	0.47±0.00^{a}
C		84.41±0.01^{a}	4.96±0.01^{d}	1.98±0.00^{c}	0.36±0.00^{c}
D		83.62±0.01^{b}	5.17±0.00^{c}	1.72±0.00^{d}	0.38±0.00^{b}

Mean with the same superscript in the same column are not significantly different at (p<0.05). NG= No growth, A= UTC tomatopaste, B= Cherry tomatopaste, C= (Beefsteak) tomatopaste, D= Plum tomato paste.

Table 2: Effect of storage period on the microbial loadof the various tomato pastes

Samples	**Period Days**	**Bacteria (cfu/mL)**	**Fungi (cfu/mL)**
A		8.50± 0.07^{a}	NG
B	0	6.00 ± 0.00^{c}	NG
C		2.50 ± 0.07^{d}	NG
D		7.50 ± 0.07^{b}	NG
A		8.15 ± 0.07^{a}	NG
B	14	7.10 ± 0.14^{b}	NG
C		4.05 ± 0.07^{d}	NG
D		6.05 ± 0.07^{c}	NG
A		8.55 ± 0.00^{b}	1.15 ± 0.07^{a}
B	28	9.15 ± 0.07^{a}	NG

C		4.45 ± 0.07^{d}	NG
D		7.55 ± 0.00^{c}	NG
A		13.30 ± 0.00^{a}	1.55 ± 0.07^{a}
B	42	10.65 ± 0.07^{b}	NG
C		5.15 ± 0.07^{d}	1.25 ± 0.07^{c}
D		8.90 ± 0.00^{c}	NG

Mean with the same superscript in the same column are not significantly different at (p<0.05). NG= No growth, A= UTC tomato paste, B= Cherry tomato paste, C= Beefsteak tomato paste, D= Plum tomato paste,

CONCLUSION

In recent years hydroponics is seen as a promising strategy for growing different crops. As it is possible to grow short duration crop like vegetables round the year in very limited spaces with low labour, so hydroponics can play a great contribution in area with limitation of soil and water and for the poorer and landless people.The results showed that tomato paste can be produced from varieties of hydroponics tomato as they all contain moisture, protein, ash and fat and sample C has a comparative advantage over samples A, B and D in microbial analysis as it contained the lowest count of microbes and it will stay longer maintaining it quality.Further work should be carried out on the safety accumulations of metals and generally the nutritional advantages compared with the conventional products.

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