COMPARATIVE ANALYSIS OF TWO DIFFERENT PROCESSING METHODS OF TOMATO (*Lycopersicum Solanum*) PASTE IN FEDERAL COLLEGE OF FORESTRY, JOS, PLATEAU STATE, NIGERIA.

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Abstract

The research was conducted to compare the nutritional value of locally processed tomato and industrially processed tomato pastes at the Federal College of Forestry, Jos, Plateau State, Nigeria for a period of eight (8) months. The parameters accessed were crude fat, crude fibre, carbohydrates, ash content, moisture content, vitamin C and pH value. The data obtained were subjected to analysis of variance (ANOVA) and mean separation done using Tukey's method at 5% level of probability. The result obtained from proximate analysis shows that the industrial tomato paste has the highest mean percentage moisture content (25.44%) followed by locally processed tomato paste (7.27%) while the fresh tomato paste has the least percentage (5.19%). The crude protein of the industrial paste was found to be 0.22, the local having 0.19 and the fresh with 0.09. The industrial paste has 6.68% crude fat, fresh tomato paste 3.3% while the local paste has 0.23%. The crude fibre content of the industrial paste was 0.72 that of the local paste 0.53 while the fresh tomato paste has 0.45. On the Ash content, the locally processed paste is 0.72 followed by the fresh tomato paste with -0.41 and the industrial paste having –2.85. The carbohydrate content of the fresh tomato paste was found to be 91.43, with 91.20 and 69.84 for local and industrial pastes respectively. The local paste has 12.23% vitamin C, 11.09% for industrial paste and 10.56% for the fresh tomato paste. The result from the analyses shows that there is significant difference between the industrial tomato paste and the locally processed tomato paste. This indicates that the locally processed tomato paste can withstand long shelve life and still maintains its nutrient value.

Keywords: Tomato, Assessment, Proximate, Tomato Paste, Vitamin

Introduction

Tomato (Lycopersicum solanum) is one of the most popular and widely grown vegetable crops in the world. It has its origin from South America specifically Peru, Bolivia, Ecuador and Columbia (Dunn et al., 2006) before it was spread around the world following the Spanish colonization of the Americans and its many varieties are now widely grown all over the world (James, 2010).

Tomato is one of the most popular and widely consumed vegetables grown worldwide with an annual production of more than 120 million tons in the world (Andrew, 2000). Tomato is a major agricultural crop cultivated in Nigeria, especially in the northern parts, it has been reported that over six million tones of tomatoes are produced annually, with about 50 % lost between rural production and town consumption in the tropical areas (Adenike, 2012).

Tomato is a fleshy berry regarded as very popular perishable fruit as well as vegetable grown throughout the tropical and temperate regions of the world (Joy et al., 2007). It is typically over 90% water and once they are harvested, they begin to undergo higher rates of respiration, resulting in moisture loss, quality deterioration and potential microbial spoilage. Harvesting itself separates the fruit or vegetable from its source of nutrients. In many cases, fresh tomato has a shelf life of only days before they are unsafe or undesirable for consumption.

Post harvest activities greatly influence the level of losses and the quality of produce. These are grading, packaging, pre-cooling, storage and transportation. An efficient marketing system is essential for sustained agricultural development. It affects both producers' income and consumers' welfare. There are several factors which influence the efficiency of tomato marketing including perishability, seasonality, quality, prices and location of the products (Ahmad, 2008).

Storage and processing technologies have been utilized for centuries to transform perishable fruits and vegetables including tomato into safe, delicious and stable products. In some cases, processed food including tomato are said to have same or even higher nutrient content (Ismail et al., 2016).

Food preservation is the process of treating and handling food to stop or slow down spoilage (loss of quantity, edibility or nutritional value) and thus, allow for longer storage time (Ananou et al., 2007).

Tomatoes are not only a good source of Vitamin A and C but they are also a good source of other vitamins and minerals. Tomatoes contain higher levels of minerals, Phosphorus and Potassium, they also contain folate and high levels of the antioxidants beta-carotene and lycopene. One medium tomato have 552mcg of beta carotene and 3,165mcg of lycopene which can help boost the immune system by fighting the damaging effects of substances called free radicals (Mann, 2010).

Tomato is low in saturated fat, cholesterol and sodium. Tomatoes can be eaten raw, with salad or mixed with meat, pulse and vegetable dishes. Slices of red tomatoes are used for garnishing. Cooking or processing of tomato (e.g. tomato paste, ketchup, tomato soup, and tomato sauce) maintains its lycopene content. Test also shows that eating tomatoes has more benefits (with all of its other ingredients) than taking lycopene alone (USDA, 2005).

Tomato has a limited shelf life at ambient conditions and is highly perishable this makes its preservation inevitable. Sun drying is one of the most common methods of preservation in Nigeria due to its vest availability all the year round. A large percentage of the tomatoes produced in the northern part of Nigeria are usually sun dried on the bear ground to avoid wastages which results in an unattractive dried tomato chips (Adenike, 2012)

Preservation and storage of tomato is difficult especially in Nigeria because of the prevailing situation of poor transportation networks coupled with high temperatures that enhances decay during storage (Ibironke, 2013). There is the need to find ways of improving the shelf life of tomato in a Safe and low cost manner. The objective of the study is to compare and analyse two different processing methods of tomato paste.

Materials and Methods

Study Site

The experiment was conducted at the biology laboratory of Federal College of Forestry, Jos in Plateau State, Nigeria located at the city center of Jos North local government area, north – west of Plateau State. It is a region of the middle belt of Nigeria and falls between latitude 7^o and 11^o N, longitude 7^o and 25^{o}E within the Guinea savannah with mean annual rainfall of 1460mm and temperature between 10^o and 32^{o}C (Pam, 2009).

Materials

The materials for this research work include fresh tomato (UTC variety), jar bottles, spoon, kerosene, firewood, coal pot, charcoal, pot, blender, newspaper and bucket.

Methods

The fresh tomato was sourced from a local farmer in Naraguta village in Jos North L.G.A. Different methods were used for the experiment which includes heating with different heat sources like firewood, kerosene stove and charcoal.

Step I: fresh and healthy tomatoes were selected

Step II: Removing seeds and water by cutting the tomatoes into two halves longitudinally and then squeezing the seeds and water out

Step III: Grinding the tomato using blender

Step IV: Continuous boiling was done until thick enough by stirring continuously to prevent sticking around the container

Step V: The jar bottles were washed, cleaned and dried before filling them with the tomato paste

Step VI: Boiling the jar bottles in a pot containing water for about 15 minutes.

The locally processed tomato paste was stored in the biology laboratory because the temperature of the room is controlled and for safety. The temperature was taken daily and the mean calculated to be 18^{o}C.

The tomato paste was stored from 17th September, 2013 to 17th July, 2014 while constantly checking to see if there are any physical changes (colour and microbial activity).

Methods of Data Analysis

Proximate analysis was used to test the nutritional value of the products (processed and unprocessed fresh tomato) and the result was subjected to Analysis of Variance (ANOVA) using Tukey's method to separate the means.

Moisture content

Samples, 5g each were minced and thoroughly mixed into a petridish and the weight noted (W2). These samples were evaporated in a forced draft oven set at 105^{o}C for about 24 hours when a constant weight was obtained. The final weight (W1) was taken after cooling the samples in dessicators.

$$\% \text{ moisture content } (\%OM) = \frac{W1 - W2}{\text{Weight of Sample}} \times 100$$

Crude Protein Determination

2g each of the samples were weighed into Kjeldhel digestion flask and 7g of potassium sulphate , 0.35g of mercury (II) oxide, 12ml of sulphuric acid added to each of the flasks. These samples were digested at 420^{o}C in the Kjeldhel digesting unit for 45 minutes until the colour of the mixtures became clear yellow.

During digestion, the tubes were covered with knobs attached to a water refluxing unit to prevent the loose of ammonia through volatilization. The mixtures were cooled and 75ml of distilled water added to each of the flasks. This was followed by the addition of 50ml of alkaline solution (350g NaOH + 60g $Na_2S_2O_7$ in 1 liter of aqueous solution). Finally the mixtures were distilled in a kjeldhel distilling unit and 150ml of the distillate collected in a conical flask containing 25ml of Boric acid solution. A blank (without sample) was also made using the same procedure.

The distillates were titrated against standard hydrochloric acid and the liters noted.

$$\% \text{ Crude protein } (\%CP) = \frac{(\text{Titre} - \text{Blank}) \times \text{Normality} \times 14.01 \times 6.25}{\text{Weight of Sample} \times 10}$$

Crude Fibre Determination

3g each of the samples were defatted with light petroleum ether (60^{o}C BP) for 1 hour. 2g of the samples (W1) was weighed into 250ml round bottom quick fit flask and 100ml of crude fiber reagent (mixture of 500ml glacial acetate acid, 20g trichloroacetic acid, 50ml Nitric acid, 450ml distilled water) added and refluxed with occasional shaking for 50 minutes on a heating mantle. The mixtures were cooled and filtered with a Buchner funnel. The residues were rinsed with methylated spirit and hot water. These were then carefully transferred into silica crucible and dried in an oven at 105oC overnight.

After drying, the samples were cooled in a desiccator and weights taken (W2). Finally, the samples were tasked into a muffle furnace at a temperature of 600^{o}C for 6 hours, cooled and weighed (W3).

$$\% \text{ Crude Fibre (CF)} = \frac{W2 - W3}{W1} \times 100$$

Ash Determination

Crucibles were heated at 150°C for 30 minutes, cooled in a dessicator and weighed (W1). 5g (W2) each of well mixed samples was taken into the weighed crucibles and heated in a muffled furnace at 600°C for 6 hours. The crucibles were cooled in a dessicator after ashing and weighed (W3).

$$\% \text{ Ash} = \frac{W3 - W1}{W2} \times 100$$

Determination of Fat/Lipid

3g (W2) each of well mixed samples was weighed into soxtec thimble and 75ml of distilled grade pet ether 60 – 80 taken into pre-weighed flask (W2). The thimbles attached to the extraction component were lowered into the extraction cups and extraction took place for 60 minutes, after which the thimbles containing the samples were raised up another 60 minutes. The thimbles were removed afin a rinsing position and rinser, rinsing and the refluxing taps closed for the recovery of the solvent. The cups were dried in the oven for 5 minutes, cooled in a dessicator and weighed (W3).

$$\% \text{ fat} = \frac{\text{Weight of oil extract}}{\text{Weight of Sample}} \times 100$$

Carbohydrate

% Carbohydrate = 100 – (% Protein + % Fat + % Crude fibre + % Ash + % moisture)

Vitamin C Determination

The titer blank before adding the Dicpip (Dichlorophenol indo reagent) was poured into a pipette until it turns blue and vitamin C content was taken.

$$\% \text{ Vitamin C} = \frac{\text{Titer blank} - \text{Fresh sample}}{\text{Weight of sample}}$$

RESULTS AND DISCUSSIONS

Table 1: P^H Value Determination

Samples	P^H
Fresh Tomatoes	4.57
Locally Processed Paste	4.62
Industrial Paste	4.82

The result from table 1 shows that the P^H value of the industrial paste has the highest percentage of 4.82, followed by locally processed paste with 4.62 and the fresh tomato paste having the least with 4.57. The high value of P^H for the industrial tomato paste was due to the addition of other spices and ingredients, coupled with high heat (Gann, et al., 1999).

Table 2: Proximate Analysis of Industrial Tomato Paste, Locally Processed Tomato Paste and Fresh Tomato

S/N	**Nutritional Parameters**	**Industrial Paste** (%)	**Locally Processed Paste** (%)	**Fresh Tomato Paste** (%)	SE±
1	Moisture Content	25.44c	7.27b	5.19a	0.042**
2	Crude Protein	0.22c	0.19b	0.09a	0.006**
3	Crude Fat	6.68c	0.23a	3.30b	0.053**
4	Crude Fiber	0.72b	0.53a	0.45a	0.043**
5	Ash Content	-2.85a	0.72c	-0.41b	0.026**
6	Carbohydrate	69.84a	91.20b	91.43c	0.043**
7	Vitamin C	11.09b	12.23c	10.50a	0.029**
	Gross Energy	111.10	112.20	110.60	

Means that do not share the same letters are significantly different ($p \leq 0.05$) using Tukey Method

** = Level of significant at 0.001% level of probability

SE= Standard Error

The result presented in table 2 indicates that the highest mean moisture content (25.40) was obtained from industrial tomato paste followed by locally processed tomato paste (7.26) and fresh tomato paste having the least (5.18) mean moisture content. Variety used and method of processing as reported by USDA (2009) could be the reason why the industrial tomato paste has higher moisture content than the other two (locally processed and fresh tomato) processing methods. Ismail et al. (2016) on comparing canned tomatoes and fresh one, indicates that the fresh tomato has much higher moisture content than the canned tomatoes. Several factors could account for such a difference. Since the main purpose of canning is to preserve the quality content, then reducing the water reduces the risk of microbial growth. Also, to increase the solid content so that consumers can buy more solid matter. Geographical differences could be another factor. The moisture content of the fresh tomato is in conformity with the finding of Romain (2001) and Harry (1994).

The crude protein content of industrial tomato paste is 0.21, locally processed tomato paste has 0.18 while fresh tomato has 0.09. For crude fat, the highest value of 6.70 was observed from the industrial tomato paste, 3.30 for fresh tomato and 0.20 for locally processed tomato paste. The result was similar to Ismail, et al. (2016) who revealed that canned tomato has the highest value of fat with a significant difference. This might be that the producing company uses tomato with higher fat content. A crude fiber value of 0.70 was obtained from industrial paste, 0.50 for locally processed tomato paste and 0.40 for the fresh tomato. The highest ash content value (0.70) was obtained from locally processed tomato paste followed by fresh tomato (-0.40) with industrial tomato paste having the least (-2.88) value. This result was contrary to Ismail et al. (2016) who opined that the ash content of fresh tomato was found to have the lowest ash content with significant difference compared to the canned tomatoes ($p \leq 0.05$). This might be as a result of the salt added to the canned tomatoes which might increase the ash content. The high water content might also contribute to the low level of ash.

A carbohydrate value of 91.43 was obtained from fresh tomato, 91.16 from locally processed tomato and 69.87 from industrial tomato paste. Vitamin C content of 12.20 was seen for locally processed tomato, 11.10 for industrial paste and 10.60 for the fresh tomato. The result of this finding shows a higher carbohydrate content of fresh tomato than that reported by Saywell and Robertson in Ismail et al. (2016). However it is lower than that reported by Romain and Harry (2001). The carbohydrate content of canned tomato was found to be much higher than that reported by Mike.

Conclusion

People often regard industrial foods as less nutritious than fresh foods; this study shows that this is not always true for tomato. Of the three sets of the tomato samples, the locally processed tomato paste was found to last longer and its chemical constituents showed minimal change over the period of study. This is thus recommended as the best of the method used for processing of the tomatoes. Nevertheless, fresh tomato can also serve the same function even though it has lower vitamin C content.

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