

## **Effect of Packaging Materials on Storage Stability of Locally Processed Tomato Paste**

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**Abstract:** *The experiment was conducted at the Postharvest Technology laboratory of Department of Agricultural Engineering Ramat Polytechnic, Maiduguri. The study was aimed at determining the effect of packaging materials on storage stability of locally processed tomato paste. The packaging materials were bottle with preservative, bottle without preservative, plastic with preservative, plastic without preservative, tin with preservative and tin without preservative. Ripe and wholesome tomatoes were procured, sorted and prepared into paste. The quantities of evaporated tomato paste filled into bottle, plastic and tin containers was 371.3 g, and 5 ml of vegetable oil was added as preservative and sealed hermetically. Each packaging materials comprised of six oil treated and six untreated samples totally eighteen samples per replicate and replicated three times and arranged in a Complete Randomized Design (CRD) with total number of fifty-four treatments. Physiochemical analysis was carried out at the end of every month to determine percentage level of dry matter, moisture content, crude protein, crude fiber, fat, ash and carbohydrate content of the treatments for three months. ANOVA was used to determine the variations in nutrient composition in the treatments (packaging materials). The results indicated that nutrients in plastic container without oil preservative were significantly ( $p < 0.05$ ) higher compared to the other packaging materials used and therefore it is recommended for preservation of locally processed tomato paste.*

**Keywords:** *Packaging materials, Storage and Tomato paste*

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### **INTRODUCTION**

Tomato (*Lycopersicon esculentum* L.) belongs to the family of solanaceae though the site of domestication is uncertain. Peralta and Spooner (2008), suggested that the South West coast of the tropical South America may be ascribed to be the origin of the crop. This crop has become widely grown around the world because of its importance and value (Adepoju, 2014). Tomatoes are grown in most home gardens and commercially as one of the world most popular vegetables. It requires a relatively cool dry climate for high yield and better produce (Nicola *et al*, 2009). It is adapted to a wide range of climatic conditions from temperate to hot and humid tropical.

Global tomato production was put at 170.8 million tones, with China accounting for 31% of the total, followed by India and United States with 18.7 and 14.5 million tons respectively as the major producers of tomato in the world (FAOSTAT, 2014). Asia and Africa account for about 79% of the global tomato area under production with about 65% of

world output (FAO 2008). Nigeria ranked 16<sup>th</sup> on the global tomato production; it produces 1.8 million tones accounting for 10.79% of Africa and 1.2% of total world production of tomatoes (Weinberger, 2008). Africa as a continent does not provide enough tomatoes to meet the demand of almost every country in Africa due to its highly perishable nature (FAO, 2008).

Tomatoes are considered to be one of the most economically important crops in the world, being ranked first on their nutritional contribution to human diet. Tomato contained nutrients such as vitamin A, vitamin C, potassium, phosphorus, magnesium and calcium (USDA, 2009). It also contained an antioxidant compound called lycopene which are essential to well-balanced human diet and reduces the risk of cancer (Srinivasan, 2010). Tomato cultivation provide tremendous amount of money because they give more yield and it has many advantages over growing other type of crops, such as high yielding potential, short duration crop and suited to different cropping systems (Naika *et al*, 2006).

Packaging is the technology of enclosing or protecting products for distribution, storage, sale and use. It also refers to the process of designing, evaluating, and producing package. Packaging equally describe as a coordinating system of preparing good for transport, warehousing, logistics, sales and end use (Robertson, 2010). Packaging has advantages of assisting in prolonging the shelf life and maintaining quality of tomatoes, it also protects against pathogens, natural predators, and loss of moisture, regulate temperature, provide cushioning effect against deformation and bruising to tomatoes. It helps in reducing the exposure to contaminants in the air and bacteria during handling. Some of the most common packaging materials used for processed tomatoes include; glasses, bottles or jars and tins, cans and polythene. For fresh tomatoes, wooden crates and plastic crates are found to be effective in handling tomatoes.

Locally processed tomatoes are unsafe when used as food because they cause dietary complication like diarrhea and food poisoning. Due to lack of stable storage facilities, locally processed tomatoes can be easily attacked by micro-organisms which causes deterioration of the product, reduce market value and total loss of produce to both producers and consumers.

However, food packaging is an integral and essential part of modern food processing. Effective packaging is a necessity for tomato preservation either fresh or processed. Tomato paste has been in existence for long and it was processed by crushing ripe tomatoes. Fresh tomatoes when properly processed can be preserved for long period and reduce possible spoilage that are caused by agents of deterioration. It also adds value to the produce and makes it available during scarcity and stabilized the high demand of tomatoes and ultimately reduce post-harvest food wastage. Hence, the main objective of this research is to determine the effect of packaging materials on storage stability of locally processed tomato paste. The specific objectives are:

- i. To determine the most effective packaging material for preserving locally processed tomatoes.
- ii. To determine the stability of the locally processed tomato paste.
- iii. To determine the physiochemical changes on the stored tomato paste.

## **MATERIALS AND METHOD**

### ***Experimental site***

The experiment was conducted in 2017 between March to May at the Postharvest laboratory of Ramat Polytechnic Maiduguri, Department of Agricultural Engineering Technology Maiduguri, Borno State, Nigeria. The study area is located in the Sudan Savannah belt on Latitude 11°5' N and Longitude 13°3' E. The city stands on some 230 meters above sea level on relatively undulating plains and occupies an area of 50.778km<sup>2</sup>. Mean annual rainfall of 1300mm is obtainable and temperature can go as high as 45-48°C between the months of March to May.

### ***Experimental procedure***

Some tomato samples were obtained from Gamboru vegetable market Maiduguri, and conveyed to the Post harvest laboratory for processing. The ripe and wholesome tomatoes were sorted and washed thoroughly to remove dirt and contaminants. The washed tomatoes were sliced to convenient size. The excess moisture from the tomato was drained and then the sliced tomato was blended with electrical blender in batches. The blend tomatoes were later evaporated for 4 hours 30 minutes and allow to cool. The treatments consist of four packaging materials (bottles + oil, bottles, plastic + oil, plastic and, tin + oil, tin.) and marked as Bp, Bnp, Pp, Pnp, and Tp, Tnp respectively. The tomato variety used for the experiment was heirloom variety. The empty packaging materials were sterilized and weighed to determine their initial weight before filling with the evaporated tomato paste. The packaging materials were randomly filled with the evaporated tomato paste. The quantity of evaporated tomato paste was poured into bottle, plastic and tin was 371.3 g, and 5 ml of oil was added to preserved samples and sealed hermetically. Each packaging materials comprised of six oil treated and six untreated samples totally eighteen samples per replica and replicated three times and arranged in a Completely Randomized Design (CRD) with total number of fifty-four treatments. At the end of every month two oil treated and two untreated samples from each treatment were randomly selected and taken to laboratory for physio-chemical analysis (nutrient contents determination) for period of three months.

### ***Chemical analysis***

The tomato samples were analyzed for dry matter, crude protein, crude fiber, ether extract (fat), ash, and carbohydrates according to Association of Official Analytic Chemists, (AOAC) method (1990) 15<sup>th</sup> edition.

### ***Dry matter***

The dry matter content of the tomato samples was determined by weighing 50.02 g of the sample into petri dish and placed into oven and heated for 24 hours up to 105°C, then removed and placed in desiccators to cool, and reweighed. The dry matter content was calculated using the formula;

$$DM = \frac{W_2 - W_3}{W_2 - W_1} \times 100 \%$$

Where:

DM = Dry matter

W<sub>2</sub> = weight of petri dish with sample in grams before oven dried

W<sub>3</sub> = weight of petri dish with sample in grams after oven dried

W<sub>1</sub> = weight in grams of empty petri dish.

### **Crude protein**

Crude protein content was analyzed using keljidal tablets, 1 g of the sample was weighed and put into a digestion tube and 1 to 2 keljidal tablets was added, then 10 ml of concentrated sulphuric acid (Conc. H<sub>2</sub>SO<sub>4</sub>) was also added into the tube and digested at 420°C for 4 hours. After cooling, 80 ml of distilled water was added into digested solution. About 50 ml of 40 % caustic soda (NaOH) was also added onto 50 ml of the digested and diluted solution and then placed on heating section of the distillation chamber, again 30 ml of 4 % boric acid, plus bromo cresol green and methyl red as an indicator was put into conical flask and placed underneath the distillation chamber for collection of ammonia, the solution changed from orange to green colour. About 0.1 normal solution of hydrochloric acid (HCl) was measured and poured into the burette. The conical flask containing the solution was titrated until the colour changes from green to pink, then burette reading was recorded. The crude protein was calculated using the formula;

$$\text{Percentage crude protein (CP)} = \frac{A - B \times N \times F \times 6.25}{\text{Mg of samples}} \times 100$$

Where:

A = ml of acid used for titrating the samples

B = ml of acid used for titrating blank sample (O)

N = Normality of acid used for titration

F = Factor = 14.007

6.25 = Constant

100 = Conversion to percentage

### **Crude fiber**

Crude fiber was determined by weighing 2 g of the sample then placed in a round bottom flask, and 50 ml of tri-chloroacetic acid reagent (TCA) was added to the mixture and boiled with refluxed for 40 minutes. Filter paper was used to filter the residue and then removed and cooled to a room temperature. The residue obtained was washed four times with hot water and once with petroleum ether then filter paper plus the sample were folded together and dried at 30°C-60°C in an oven for 24 hours, reweighed and then ash at 650°C, cooled and finally reweighed.

Formula;

$$\text{Percentage crude fiber (CF)} = \frac{\text{Difference in weighing}}{\text{Mg of samples}} \times 100$$

Weight of sample on dried matter (DM) bases 1

**Ash**

To determine the ash content, 1g of the tomato sample was weighed into crucible and dried at 105°C for 24 hours then cooled in desiccators for 15 minutes and reweighed, it was then charred at 600°C in muffle furnace for 2-3 hours, then cooled in desiccators for 15 minutes and reweighed.

Formula;

$$\text{Percentage Ash} = \frac{\text{Loss in weight}}{\text{Initial weight}} \times \frac{100}{1}$$

**Carbohydrate**

Percentage carbohydrate content was determined by computing indirectly by difference using the formula;

$$\text{Percentage Carbohydrate} = 100 - (\% \text{ MC} + \% \text{ ash} + \% \text{ CP} + \% \text{ CF}).$$

Where:

% = Percentage, CP = Crude protein, MC = Moisture content, CF = Crude fiber.

**Data analysis**

Data collected were subjected to analysis of variance (ANOVA) using STATISTIX 8.0 computer package. Duncan’s New Multiple Range Test (DMRT) was used to separate the significance means.

**RESULTS AND DISCUSSION**

Table 1: Effect of packaging materials and oil on dry matter and moisture content of locally processed tomato paste after three months of storage

Treatments	0 month	1 <sup>st</sup> month	2 <sup>nd</sup> month	3 <sup>rd</sup> month
Dry matter (%)				
Bottle (P)	14.90	19.85 <sup>d</sup>	23.55 <sup>d</sup>	23.67 <sup>a</sup>
Bottle (NP)	14.90	18.27 <sup>e</sup>	18.82 <sup>b</sup>	19.67 <sup>c</sup>
Plastic (P)	14.90	20.63 <sup>cd</sup>	30.71 <sup>a</sup>	21.29 <sup>b</sup>
Plastic (NP)	14.90	28.63 <sup>a</sup>	29.89 <sup>a</sup>	22.78 <sup>a</sup>
Tin (P)	14.90	26.72 <sup>b</sup>	27.28 <sup>c</sup>	18.7 <sup>c</sup>
Tin (NP)	14.90	21.47 <sup>c</sup>	27.78	19.78 <sup>c</sup>
SE± (F-test)		0.4530	0.2859	0.3487
Significant		*	*	*
Moisture content (%)				
Bottle (P)	85.10	81.41 <sup>a</sup>	76.45 <sup>a</sup>	76.45 <sup>c</sup>

Bottle (NP)	85.10	81.10 <sup>ab</sup>	71.17 <sup>c</sup>	80.29 <sup>ab</sup>
Plastic (P)	85.10	79.69 <sup>bc</sup>	69.21 <sup>d</sup>	79.71 <sup>b</sup>
Plastic (NP)	85.10	53.53 <sup>e</sup>	70.11 <sup>d</sup>	77.22 <sup>c</sup>
Tin (P)	85.10	73.27 <sup>d</sup>	72.11 <sup>b</sup>	81.26 <sup>a</sup>
Tin (NP)	85.10	78.52 <sup>c</sup>	72.21 <sup>b</sup>	80.33 <sup>ab</sup>
SE± (F-test)		0.4761	0.3064	0.3792
Significance	*	*	*	*

Means within a column followed by similar letter(s) are not significantly different at 5% probability level according to Duncan's Multiple Range Test (DMRT). \*= Significant at 5% probability level.

The results in table 1 shows the effect of packaging materials and oil preservation on dry matter and moisture content of locally processed tomato paste after three months of storage. The initial percentage dry matter content of the tomato paste was 14.9%. In the first month of storage significant ( $p < 0.05$ ) variation was recorded on the effect of packaging materials on the dry matter content of the tomato paste. Plastic container without oil preservative recorded the highest (28.63%) dry matter followed by tin container with oil preservative (26.72%). The lowest dry matter content was recorded with the bottle container with oil preservative (19.85%). In the second month of storage plastic container with oil preservative recorded the highest (30.71%) dry matter and there are statistically at par with plastic without oil preservative. The least dry matter was obtained with bottle with oil preservative (23.55%). At third month after storage, highest (23.67%) dry matter was recorded with bottle package with oil preservation followed by plastic package without oil preservation. The lowest dry matter was observed with bottle without oil preservative and tin with oil preservative recording 19.67% and 18.7% respectively. The dry matter content increases from the initial month to the second month of storage but drops at third month, these was because decrease in moisture content of the tomato paste. The longer the time of storage the higher the dry matter content due to reduction in moisture content of the product.

The initial moisture content of the tomato paste after processing was 85.1%, significant ( $p < 0.05$ ) difference was recorded on the effect of packaging materials on moisture content of processed tomato and oil preservation. At first month of storage period, the moisture content decreases from 85.1% to 81.41% in bottle container with oil preservative which also indicates highest level of moisture content compared to other packaging materials. The lowest (53.33%) moisture content was recorded with plastic container without oil preservative. At second month of storage period highest (76.45%) moisture content was recorded with bottle and oil preservative followed by tin container with oil preservative and tin container without oil preservative, while lowest (69.21%) moisture content was found with the plastic container with oil preservative. Moisture content of the stored product at third month was found to be high (81.26%) with tin with oil preservative, followed by tin with preservative recording 80.33%, while the lowest (76.45%) moisture content was recorded with bottle container with oil preservative. This results were in agreement with the findings of Famurew (2013), on his work storage stability of tomato paste package in plastic bottle and polythene stored.

Table 2: Effect of packaging materials and oil on crude protein and fat of locally processed tomato paste after three months of storage

Treatments	0 month	1 <sup>st</sup> month	2 <sup>nd</sup> month	3 <sup>rd</sup> month
Crude protein (%)				
Bottle (P)	8.66	7.62 <sup>a</sup>	7.87 <sup>b</sup>	6.95 <sup>c</sup>
Bottle (NP)	8.66	6.83 <sup>a</sup>	9.01 <sup>a</sup>	9.23 <sup>a</sup>
Plastic (P)	8.66	7.58 <sup>b</sup>	2.33 <sup>d</sup>	8.13 <sup>b</sup>
Plastic (NP)	8.66	5.36 <sup>b</sup>	7.33 <sup>bc</sup>	9.49 <sup>a</sup>
Tin (P)	8.66	5.05 <sup>b</sup>	7.70 <sup>bc</sup>	6.05 <sup>d</sup>
TIN (NP)	8.66	5.58 <sup>b</sup>	6.62 <sup>c</sup>	5.59 <sup>d</sup>
SE±(F-Test)		0.2886	0.3438	0.2622
Significance		*	*	*
Fat (%)				
Bottle (P)	1.0	2.33 <sup>c</sup>	1.00 <sup>d</sup>	2.33 <sup>b</sup>
Bottle (NP)	1.0	4.66 <sup>b</sup>	4.00 <sup>b</sup>	1.00 <sup>d</sup>
Plastic (P)	1.0	2.00 <sup>c</sup>	2.33 <sup>c</sup>	1.60 <sup>c</sup>
Plastic (NP)	1.0	9.66 <sup>a</sup>	7.33 <sup>a</sup>	4.66 <sup>a</sup>
Tin (P)	1.0	2.00 <sup>c</sup>	1.66 <sup>cd</sup>	2.00 <sup>bc</sup>
\TIN (NP)	1.0	2.66 <sup>c</sup>	2.00 <sup>c</sup>	5.00 <sup>a</sup>
SE±(F-Test)		0.2722	0.2277	0.2018
Significance		*	*	*

Means within a column followed by similar letter(s) are not significantly different at 5% probability level according to Duncan’s Multiple Range Test (DMRT).

\*= Significant at 5% probability level.

The results in table 2, represent the effect of packaging materials and oil preservation on crude protein and fat content of locally processed tomato paste after three months of storage. The initial percentage crude protein content of tomato paste was 8.66%. In the first month of storage period significant ( $p < 0.05$ ) variation was recorded on the effect of packaging materials on crude protein content of the tomato paste, bottle container with oil preservative recorded the highest (7.62%) crude protein followed by plastic container with oil preservative (7.58%). Tin container with preservative recorded the lowest crude protein (5.05%). In the second month of storage, bottle container without oil preservative recorded the highest (9.01%) crude protein content followed by bottle container with oil preservative (7.87%), while plastic container with preservative (2.33%) recorded the lowest content of crude protein. In the third month plastic container without oil preservation recorded the highest (9.49%) crude protein content followed by bottle container without preservation (9.23%) and tin container without preservative recorded the least crude protein (5.59%).

The initial fat content of the tomato paste at the initial month was 1.0%, significant ( $p < 0.05$ ) effect was recorded on the effect of packaging materials on fat content of processed tomato and oil preservation. At the end of first month plastic container without oil preservative recorded the highest (9.66%) fat content this shows that the fat content

increase by 10 folds, then followed by bottle container without preservative with 4.66% and the lowest (2.0%) fat content was recorded by both plastic container and tin container with oil preservative. In the second month, plastic container without oil preservative recorded highest (7.33%) fat content followed by bottle container without oil preservative (4.0%), and bottle container with oil preservative recorded the lowest (1.0%) fat content, while in the third month, tin container without oil preservative recorded the highest (5.0%) fat content, while plastic container without oil preservative followed (4.66%) and bottle without oil preservative recorded the least (1.0%) fat content. This coincided with the work of Ibadapo (2013), on storage stability of tomato paste package in bottle and polythene stored.

Table 3: Effect of packaging materials and oil on crude protein and fat of locally processed tomato paste after three months of storage

Treatments	0 month	1 <sup>st</sup> month	2 <sup>nd</sup> month	3 <sup>rd</sup> month
Crude fiber (%)				
Bottle (P)	20.0	18.66 <sup>c</sup>	16.66 <sup>e</sup>	24.33 <sup>e</sup>
Bottle (NP)	20.0	24.66 <sup>b</sup>	22.00 <sup>a</sup>	21.66 <sup>c</sup>
Plastic (P)	20.00	27.00 <sup>a</sup>	20.00 <sup>b</sup>	22.66 <sup>c</sup>
Plastic (NP)	20.00	23.66 <sup>b</sup>	22.00 <sup>a</sup>	26.33 <sup>a</sup>
Tin (P)	20.00	23.66 <sup>b</sup>	17.66 <sup>d</sup>	22.00 <sup>c</sup>
TIN (NP)	20.00	24.33 <sup>b</sup>	19.00 <sup>c</sup>	24.00 <sup>b</sup>
SE±(F-Test)		0.4082	0.2509	0.3801
Significance		*	*	*
Ash (%)				
Bottle (P)	5.0	2.00 <sup>c</sup>	3.33 <sup>c</sup>	3.33 <sup>ab</sup>
Bottle (NP)	5.0	2.66 <sup>b</sup>	3.33 <sup>c</sup>	3.00 <sup>ab</sup>
Plastic (P)	5.0	3.0a <sup>b</sup>	3.33 <sup>c</sup>	3.00 <sup>ab</sup>
Plastic (NP)	5.0	1.00 <sup>d</sup>	4.66 <sup>b</sup>	2.66 <sup>b</sup>
Tin (P)	5.0	3.33 <sup>a</sup>	5.00 <sup>b</sup>	3.33 <sup>ab</sup>
TIN (NP)	5.0	2.00 <sup>c</sup>	6.33 <sup>a</sup>	3.66 <sup>a</sup>
SE±(F-Test)		0.1826	0.3801	0.2789
Significance		*	*	*

Means within a column followed by similar letter(s) are not significantly different at 5% probability level according to Duncan’s Multiple Range Test (DMRT). \*= Significant at 5% probability level.

The results in table 3 indicates the effect of packaging materials and oil preservation on crude fiber and ash content of locally processed tomato paste after three month of storage. The initial percentage crude fiber at zero month was (20.0%). In the first month of storage significant (p<0.05) variation was recorded on the effect of packaging materials on crude fiber content of the tomato paste. Plastic container with oil preservative recorded the highest (27.0%) crude fiber indicating an increase of 7%, then followed by bottle container without oil preservative (24.66%). The lowest crude fiber content was recorded with the

bottle container with oil preservative (18.66%). In the second month both bottle and plastic without oil preservative recorded the highest (22.0%) crude fiber content, while plastic container with oil preservative followed with (20.0%) and the lowest crude fiber content was recorded with bottle container with oil preservative (16.66%). At the end of the third month highest (26.66%) crude fiber was recorded with plastic container without oil preservative followed by bottle container with oil preservative while bottle container without oil preservative recorded lowest (21.66%) of crude fiber content.

The initial ash content of the tomato paste at zero month after processing was (5%). Significant ( $p < 0.05$ ) effect was recorded on the influence of packaging materials on ash content of locally processed tomato and oil preservation. In the first month of storage period, the ash content decreases from 5.0% to 3.33% in tin container with oil preservative which also indicates the highest level of ash content compared to other packaging materials, followed by plastic container with oil preservative (3.0%) and the lowest (1.0%) ash content was recorded with plastic container without oil preservatives. While at the second month of storage period the ash content increases to 6.33% with tin-container without oil preservative while bottle container without oil preservative, bottle container with oil preservative and plastic container with oil preservative all reflected decrease (3.33%) in ash content. Ash content of the stored tomato paste in the third month of storage also dropped (3.66%) with tin container without oil preservative, followed by both tin-container with oil preservative and bottle container with oil preservative with 3.33% ash content, and plastic container without oil preservative recorded the lowest (2.66%) ash content. This results were in support of findings of Smith and Hul (2004), on food processing.

Table 4: Effect of packaging materials and oil on carbohydrate content of locally processed tomato paste after three months of storage

Treatments	0 month	1 <sup>st</sup> month	2 <sup>nd</sup> month	3 <sup>rd</sup> month
	Carbohydrate (%)			
Bottle (P)	18.76	30.62 <sup>c</sup>	31.94 <sup>c</sup>	14.27 <sup>c</sup>
Bottle (NP)	18.76	38.83 <sup>b</sup>	34.28 <sup>b</sup>	14.12 <sup>c</sup>
Plastic (P)	18.76	39.58 <sup>b</sup>	34.98 <sup>b</sup>	20.47 <sup>a</sup>
Plastic (NP)	18.76	41.69 <sup>a</sup>	40.64 <sup>a</sup>	16.34 <sup>b</sup>
Tin (P)	18.76	34.05 <sup>c</sup>	31.94 <sup>c</sup>	12.98 <sup>d</sup>
TIN (NP)	18.76	34.58 <sup>c</sup>	34.28 <sup>b</sup>	13.60 <sup>cd</sup>
SE±(F-Test)		0.3552	0.3702	0.2837
Significance		*	*	*

Means within a column followed by similar letter(s) are not significantly different at 5% probability level according to Duncan's Multiple Range Test (DMRT). \*= Significant at 5% probability level.

The results in table 4, represent the effect of packaging materials and oil preservative on carbohydrate content of locally processed tomato paste after three months of storage. The initial percentage carbohydrate content at 0 month was 18.76%. At the end of the first month, significant ( $p < 0.05$ ) variation was recorded on the effect of packaging materials on carbohydrate content of tomato paste. Plastic container without oil preservative recorded

the highest (41.69%) carbohydrate content indicating significant increase by more than two folds followed by plastic container with oil preservative recording 39.58%. The lowest (30.62%) carbohydrate content was recorded with bottle container with oil preservatives. At the end of second month, the highest (40.64%) carbohydrate content was recorded with plastic container without oil preservative followed by plastic container with oil preservative and bottle and tin container with oil preservative recorded the least (31.94%) carbohydrate content each. At the end of third month, highest (20.47%) carbohydrate content was recorded with plastic container with oil preservative and followed by plastic container without oil preservative 16.34%. The least (12.98%) carbohydrate content was recorded with tin container with oil preservative. The results were in support with the findings of Okorie and Okoro (2004), on their work on the quality properties of tomatoes as influence by processing with preservative and storage recording similar range of carbohydrate content after processing and storing tomato paste.

### **Summary**

The research was aimed at determining the effect of packaging materials on storage stability of locally processed tomato paste using different packaging materials (bottle, plastic and tin) with vegetable oil as preservative agent and stored for periods of 3 months. At the end of every month, samples were collected from all the treatments and analyzed for nutrient composition, the results of the experiment shows that dry matter, crude protein, fat, crude fiber and carbohydrate were high with plastic container as packaging materials recorded 28.6, 9.49, 9.66, 26.33 and 41.69 % respectively. It indicates bottle container (packaging material) retain the lowest dry matter, moisture content, fat, crude fiber, ash and carbohydrate having 23.5, 76.4, 1.0, 18.6, 3.33 and 30.62 % respectively. The results show that the plastic container indicates superiority compared to other packaging materials used.

### **CONCLUSION**

The results of the experiment represent that plastic packaging materials without oil preservative provided the most convenient environment for preservation of locally processed tomato paste because it retained almost all the important nutrient in their highest levels compared to other packaging materials used (bottle, and tin). Consequently, tin packaging material was found to be less effective in preserving locally processed tomatoes because, it was not sealed hermetically like other packaging materials (bottles and plastic) which lead to infection by microorganism, thereby creating favorable conditions for the survival of microorganisms.

### **RECOMMENDATION**

Based on the findings of this research work, it is therefore recommended that;

- i. The plastics packaging container can be used as packaging materials for storage of locally processed tomato paste for the period of three months, because it retains the most important nutrients in their highest form within the period stored.
- ii. It is also recommended that the period of storage should be extended to ascertain the stability of locally processed tomato paste.

- iii. Further researchers should try other tomatoes varieties using other packaging materials to establish the extent of storing locally processed tomatoes. Furthermore, pH and rancidity tests of the tomato should be determine being an important storage parameter.

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### **References**

- Adepoju A.O. (2014). Postharvest losses and welfare of tomato farmers' in Ogbomoso, Osun State, Nigeria: *Journal of store products and postharvest Research*. Vol.5(2) pp 8-13.
- AOAC (2007). Official methods of analysis of Food composition, additives, Natural contaminants (Vol.2) in Helrich K.(Ed) Arlington.
- AOAC (1990). Association of Official Agricultural Chemists.15<sup>th</sup>Edn, Association of Official Analytic Chemists, Washington, DC.
- Arjenaki, O. O, Moghaddam, P. A, and Motlagh, A.M (2013). "Online tomato sorting based on shape, maturity, size, and surface defects using machine vision." *Turkish Journal of Agriculture and Forestry*, Vol 37, no.1 PP 62-68.
- Ayo, A., and L.C Eckerte (2007). Processing tomato production in California UC Vegetable Research and information center. Carner Newsletter of the Berkeley Farmers Market (2009). Ecology Center. (Online).<http://WWW.ecologycenter.org/bfm/newsletter/200508>. pdf.
- Edlin, D. J (2009). Heirloom and hybrid tomato yield and quality in organic and conventional production systems. *Journal of Botany Science*. Pp 62- 83, 0855-3864.
- Famurew J.A. (2013). Storage stability of tomato paste package in plastic bottle and polythene stored; *International Journal of Applied Science and Technology*. Vol 3. NO 6. Pp 34-37
- Food and Agricultural Organisation Statistics (FAOSTAT, 2014). Global tomato production; Rome FOA.
- Food and Agricultural Organization Of United Nation (FAO 2008) Production Year book: Rome, Italy.
- Food and Agricultural Organization (FAO, 2011): Global and national tomato production, (Trade for fresh tomato code 0702000). Tomato product consumption.
- Gould, W. A (2012) *Tomato production, processing and technology*: 3<sup>rd</sup>ed; Wood head Publishing Limited. Pp 2-158.
- Guichard, S., Bertin, N., Leednardi, C and Gary (2011). Tomato crate and carton fluxes. *Agronomy* 21;385-392.
- Hagland, A., Johansson, L., Garedal, L. and J. Dlouhy, (2006). Sensory cultivated with Ecological fertilizing system in; hagland (ed). Sensory carrots, tomato, and wheat influences of growing systems. Uppsala University.
- Hayes, L., C, Moretti and Huber, A. G (2006). Effect of Storage condition on tomato. *Journal of Biological science*, Vol 8; no 2, pp 490-493.

- Ibidapo, P.O. (2013). Storage stability of tomato paste package in plastic bottle and polythene stored; *International Journal of Applied Science and Technology*. Vol 3, No 6. Pp. 34-37.
- Kader, A. A. (2007). Effect of Postharvest handling procedures on tomato quality. *Acta horticulture*, 190:209-222.
- Marzena A. C. (2014). Appraisal of artificial screening techniques of tomato to accurately reflect field performance of the late blight resistance.
- Naika, S., Van Lidt, J. J, Goffai, M., Hilmi, M. Van Dam, B. (2006). Cultivation tomato production, Processing and Marketing. In: Van Dam B(ed) Digigrati, Wageningen, The Netherlands.
- Nicolas, T. G. Fontana, E. (2009). Tomato Production System and their application to the tropics. *Acta Horticulture* 821:27-33.
- Ojo, M. A and Ibrahim, O. A. (2009). Profitability and Production Function of Small Scale irrigated tomato production in Niger State: Nigeria. *Continental Journal of Agriculture Economics* 3:16 -22.
- Okorie, S.U., Nwanekezi, E.C. and Okoro .C.C. (2004). The quality properties of tomatoes as influence by processing with a preservative and storage. *Nigerian food Journal* vol. 22 (2004) Pp. 195-197.
- Parker, R. (2013). The effect of harvesting stage fruit quality and shelf life of four tomato cultivation (*Lycopersicon esculentum* mill), *Agriculture and biology Journal of North America* Vol 4, NO 3 Pp 252-259.
- Peet , M. M. (2009). Fruit cracking in tomato. *Horticulture technology* 2: 216-223
- Paralta, I.E and Spooner, D.M (2007). Early cultivation of tomato (Solanaceae). Genetic improvement of Solanaceous crops. Vol. 2. Ed field. NH. Science publishers pg. 1-27
- Paralta, I.E. and Spooner, D. M. (2009). Granule bound starch synthesis gene phylogeny of wild tomato. *American journal of botany* 88:1888-1902.
- Prasad, P. and Kochnar, A. (2014). Active packaging in food industry: a review, *journal of environmental science, toxicology and food technology*, vol.8 no. 5, Pp. 1-7.
- Roberton, G. (2010). Food packaging and shelf life: a practical guide Taylor and Francis. Boca raton; USA.
- Rozin, P. (2009). Food is fundamental, fun, frightening and far reaching. *Social research*. 66: 9-30.
- Sacco, A. (2008). Genetic mechanisms underlying tomato quality traits. University of deglisudi II. Pp 1-16.
- Samaratunga, H. (2011). Varietals trails of fresh tomato training report of the 5<sup>th</sup> regional training program in vegetable production and research Thailand.
- Satti, S.M.E, and Al-yhyai, R.A, (2007). Partitioning of mineral elements in processing tomato in response to saline nutrients: *Journal of Plant Nutrition and Soil Science* 165:191-197. seminiskeny:retrievedfrom: <http://www.freshplaza.com/news>.
- Srinivasan, R. (2010). Safer tomato production methods. A field guide for soil fertility and post management AVRDC-the world vegetable center sharva Taiwan AVRDC. Publication no. 10-740. Pp 97.
- Smith, J.S. Hul, Y.H. (2004). Food processing and application Black well publishing. United states Department of Agriculture (2009). Tomatoes (red, ripe, raw, year round average) nutrient values and weigth for edible portion

- (NBD <http://www.nal.usda.gov/fnic/foodcomp/cgi/list-nutedit.pl> (accessed December, 2009). 31<sup>st</sup>
- USDA National Nutrient Data Base for Standard Reference (2004). 23-reports by single nutrients. *Research journal for biology, agriculture and health care*. ISSN 2224-3208 (paper).
- Warnache, A. (2007): Vegetable seeds handbook. Regina seeds seminis. Printed by bizone ltd. Nairobi Kenya, 23-25.
- Watson, B. (2010). *Taylor's guide to heirloom vegetables*. Houghton Mifflin co; New York. Pp.343.
- Winter, D. M and Rushbook, L. (2012). Literature review of the English rural economy. Center for rural research: university of Exeter.
- Znidarcic, O. (2006). *History of the tomato in Italy*; Columbia University Press, Scholarly history.