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The Physiochemical and Microbiological Quality of Fresh Tomatoes Juice and Tomatoes Paste Sold in Abraka Market

Anie, Oliseloke Clement, Adushoke, Eguonor Loveth
Department of Pharmaceutical Microbiology and Biotechnology,
Faculty of Pharmacy, Delta State University, Nigeria

Egbon, Olukayode Temitope
Department of Pharmaceutical
Microbiology and Biotechnology,
Faculty of Pharmacy, Federal University,
Oye-Ekiti. Nigeria

Enemchukwu Chizobia Mercy
Department of Pharmaceutical Microbiology
and Biotechnology Faculty of Pharmacy
Madonna University Elele
Rivers State

Corresponding Author: Anie, Oliseloke Clement[1]

Abstract:

Background: Vegetables are important items of diet in many countries. Apart from the variety which they add to the menu, they are valuable sources of nutrients especially in rural areas where they contribute substantially to protein, mineral, vitamins, fiber and other nutrients which are usually in short supply in daily diets

Objective: This study sought to comparatively assess the physicochemical and microbial quality of fresh tomato and tomato paste sold in Abraka, Delta State.

Methods: Physicochemical parameters; pH, total soluble solids, acidity, fat content, ash content and moisture content and microbial quality of fresh tomatoes and tomato paste were done using standard analytical methods.

Results: The pH of the fresh tomato was 6.39±0.01 while those of tomato paste was within the range of 5.79±0.01 to 6.06±0.01. Ash of fresh tomato sample was 2.12±0.02% which is higher than those of Sonia, Der and Tat tomato paste were ash value for Toh and Gin tomato paste value were higher than the fresh tomato. The moisture content of tomato paste was within the ranged of 2.01±0.01 - 2.62±0.01% which was lower compared to that of fresh tomato with moisture of 3.57±0.02%. The value of crude fat and fibre in the fresh tomato sample was 3.11±0.01g and 72.35±0.04g while those of tomato paste ranged from 2.76±0.02 - 3.01±0.02g for crude fat and 62.15±0.03 - 126.07±0.01g for crude fibre. Total soluble solid found in the tomato sample was in the range of 1.36±0.01 - 1.39±0.01 for tomato paste while fresh tomato was 1.32±0.02. The acidity of the sample was in the range of 29.44±0.04 - 65.05±0.05 and 19.5±0.10 for both tomato paste and fresh tomato respectively. The microbial load of analyzed fresh tomatoes was 7.4 x10^4 total coliform count and 2.4 x 10^4 and 8.0 x10^4 total fungi count, while tomato paste was5.0 x10^4, 3.6 x 10^4 and 4.1 x 10^4total coliform count and 2.0 x10^4, 1.5 x 10^4, 6.0 x 10^4 and 3.0 x 10^4total fungi count. It was observed that *Micrococcus* sp, *Staphylococcus aureus* and *Citrobacter* sp were present in fresh tomatoes, on the other hand *Citrobacter* sp and *Bacillus subtilis* were present in Tat, *Micrococcus sp* and *Streptococcus sp,* were present in Gin while*Staphylococcus aureus* and *Citrobacter* sp were present in Toh.It was observed that the occurrence of *Citrobacter* sp 31.25% was higher compared to other bacteria isolated while *Streptococcus sp* and *Bacillus subtilis* with 12.5% was the least. *Candida albican* had the highest percentage occurrence of 38.88% while *Aspergillus terreus and Rhizopus sp*with 16.66% was the least among others respectively.

Conclusion: The result of this study revealed that fresh tomatoes constitute a great source of protein when compared to the tomato paste, which is consumed for body building and repair of worn out tissue in human in Nigeria. Improvement in the microbial quality of fresh tomatoes and tomatoes paste is very important and adequate steps must be taken to prevent contamination and spoilage by microorganisms.

Keywords:- *Tomatoes, physicochemical, fresh, Abraka and parameters.*

I. INTRODUCTION

In many parts of the world vegetables has been seen as an important item of diet and tomato is one of the most commonly cultivated and consumed vegetable fruit. Aside the variety which these vegetables add to food menu, they are also known to be valuable source of nutrients. One medium sized tomato provides 40% of the Recommended Daily Allowance (RDA) of vitamin C (ascorbic acid), 20% of the RDA of vitamin A, substantial amounts of potassium, dietary fibre, calcium, and lesser amounts of iron, magnesium, thiamine, riboflavin, and niacin, yet contains only about 35 calories (Tigist *et al*., 2013; Adekalu *et al*., 2016). Medicinal plant has been defined by World Health Organization (WHO) consultative group as any plant which in one or more of its organs contains substances that can be used for therapeutic purposes or which are precursors for the synthesis of useful drugs Anie *etal* 2015; Ibezim *etal* 2011). Tomatoes rank first as it contributes relatively to human

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nutrition when compared to 39 major fruits and vegetables in the Africa. Tomato (*Solanumlycopersicum*) belongs to family Solanaceae which is widely used fresh and as well as in the preparation of different food products (Suri *et al*., 2017). Tomatoes have a lower shelf life and cannot be stored for longer period of time. To resolve this, tomato is processed into fruit paste, thus extending its shelf life.

For several decades, a significant number of compounds has been identified from tomato fruit when subjected to metabolite analysis, these compounds represent diverse biosynthetic pathways and covering an array of traits (from volatile to highly polar to nonpolar). Some of these biochemicals identified comprises of sugars, amino acids, organic acids, fatty acids, hormones, phenolics, alkaloids, and terpenes including carotenoids and various volatile compounds (Kim *et al*., 2019). Previous researches have indicated that non-edible parts of the tomato contain a higher content of antimicrobial compounds than edible parts. For instance, tomato leaves include a higher content of antimicrobial metabolites such as chlorogenic acid, caffeic acid, vanillic acid, β-phellandrene, sabinene, α-terpinene, dehydro-tomatine, and α-tomatine than tomato fruits (Kim *et al*., 2014).

Tomatoes several biochemical components, such as Steroidal alkaloid: Green and unripe parts contain steroid glycosides, in form of glycoalkaloids. Total contents of steroid alkaloids differ from 0.1 up to 0.5 %. It is found in highest amount in fruits and seeds. In the genus Solanum they are important, both ecologically and commercially. The main steroid alkaloids are Solanin and Solasodine. Both consist of an aglycone and are connected mostly with 3 sugar parts like a chain. So they are called solatrioses. The content of solasodine found in young leaves (Kobayashi *et al*., 2012). Steroidal saponines: In most species steroid saponins were found, additionally. Their sapogenines are diosgenin, hispigenin, neochlorogenin, solagenin, tigogenin, yamogenin. From *S. lycopersicum* following saponins are isolated, such as solanigrosides 2-7, degalactotigonin. On human tumour cell line their cytotoxicity is tested. Only degalactogonin is toxic with IC50 values 0.25. 4.49µM. In some other Solanum species, like *S. malacoxylon* and *S. verbascifolium* glycosides of dihydrocalciferol could be detected (Kobayashi *et al*., 2012). Flavonoids: Leaves of *S. lycopersicum* contain flavonones such as Neringenin, Calconaringenin and flvonols such as Rutin, Quercetin, Kaempferol, α-tocopherol, polyphenols. Leaves also contain hydroxycinnamic acid such as Caffeic acid, Ferulic acid, Coumeric acid (Kobayashi *et al*., 2012).Carotenoids (Such as Lycopene (in red tomato), Lutein, Zexanthin, and β-carotene. 5. Glycoside and fatty acid derivative: Fruit and leaves contains Esculoside A, 1.9-oxo-octadecadienoic acid 2007; Kobayashi *et al*., 2012).

Plants produce many organic compounds and substances which are valuable in prevention and in the treatment of various diseases (Anie *etal* 2011) .A review of literature show that tomatos have enormous medicinal benefits, these includes: (a) the fresh fruits juice used being used to induce vomiting in children in case of food poisoning, and also in stopping excessive blessing from wounds. It is used externally in Greece to treat furuncles. In Italy, it is used to cure scorpion and other insect bites. In Mexico, it is used externally as febrifuge whereas in Philippines, the fresh fruit is used to treat edema by pregnant women. Fresh fruit is used by Americans orally for kidney and liver problems, as a cathartic and also to keep good digestion . Tomatoes has also shown to significantly reduce total LDL cholesterol levels, promote prostate, lungs and stomach health (Etminan *et al*. 2004; National Cancer Institute Initiative, 2006). Tomatoes has also shown relevance in the reduction in the risk of heart disease (Sanjiv and Rao, 2000), improve vision and prevent night blindness especially in cases where diabetes is implicated (Lazarus *et al*., 2004; Ganesan *et al*., 2012).

The main objective of the study is to examine comparatively the physicochemical and microbial quality of fresh tomatoes and tomato paste sold in Abraka, Delta State.

II. MATERIALS AND METHODS

A. Materials

Materials and equipment used are: glassware, glass rods, bijou bottles, microscopic slides, sterile swab sticks, porcelain dishes, sterile hand gloves, cotton wool, cork borer, forceps, autoclave, aluminum foil, spirit lamp, wire loop, spatula, sterile 5 ml and 2 ml syringes, pre-coated TLC plate, filter paper (Whatmann No 1.), test tube rack, muslin cloth, white laboratory coat and agar bottles, digital weighing balance (KERO BLG 300), rotary evaporator, binocular light microscope (OLYMPUS), refrigerator (Haier Thermocol®, Model: HRF-250E), refrigerator, autoclave, hot air oven (Leader® Model: GP/50/CLAD/250/HYD), Nutrient agar, nutrient broth, citrate agar, Sabouraud dextrose agar, methanol, methylated spirit, distilled water, sterile water, chloroform, ethyl acetate, n-hexane, Lugol's iodine, crystal violet, safranine, immersion oil, Mayer reagents, Dragendorf reagent, Fehling solution, NaOH, H_2SO_4, HCl, glacial acetic acid, olive oil. Solvent purchased were of analytical grade and were used without further purification.

B. Sample Collection

Fresh tomatoes and five (5) tomato paste with these codes (TOh, Tat, Gin, Der and Son) were purchased from Abraka main market in Abraka, Delta State. The local tomato that was used as the control sample was also purchased from the Abraka market in Abraka, Delta State, Nigeria. All samples were taken to the laboratory immediately after purchase. The fresh tomatoes used were ensured spoilage free at the point of collection.

C. Sample Preservation

The samples were preserved in the refrigerator at 4ºC after opening the paste while the fresh tomatoes were crushed and also stored in the refrigerator. This was meant to generally slow down biological activities and reduce chemical reaction.

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III. METHODS

The materials used for this study were sterilized by appropriate methods to free them from microbial contamination.

A. Physicochemical Parameters

Stored samples were immediately analyzed within a period of 2-3 hours. Parameters of the fresh and paste sample evaluated include; pH, total soluble solids, acidity, fat content, ash content, moisture content and total reducing sugar using standard analytical method with little modifications.

B. Determination of pH

The pH value was measured with a pH meter (Mettler Toledo, Switzerland) according to AOAC (2004). 10 g of the sample (fresh and paste) was taken from the jars, homogenised with a blender and strained. 10 mL of the juice was used for pH measurement using Jenway 3310 pH meter which have been previously calibrated with buffers of 4 and 9. (Okafo *etal* 2019)

C. Determination of Total soluble solids

Total soluble solids, primarily sucrose, fructose and glucose, were measured. Brix is reported as "degrees Brix" and is equivalent to a percentage. The determination was carried out on both fresh and paste samples on monthly interval for each treatment using Abbe refractometer which has been calibrated with distilled water at 27°C. The results were expressed in %Brix. (FAO, 2005; Mamo *et al*., 2014).

D. Determination of Acidity

Citric acid and a small amount of malic and tartaric acid were added in samples for its tartness and unique taste. The amount of acid present in the samples was reported as the percent citric acid. A titration with sodium hydroxide was used to calculate the value (FAO, 2005; Mamo *et al*., 2014).

$$\text{Titrable acidity (\%)} = \frac{T.V \times Factor}{W}$$

Type equation here.Where TV = Titer value of the sample in ml.;

W = quantity of the sample taken for the test in ml.

Factor for - Citric acid: 0.0064 (Citrus fruit), Malic acid: 0.0067, Tartaric acid: 0.0075

E. Determination of Ash Content

Determination of ash content was based on AOAC (2004) method. Sliced tomatoes of about (2) g were weighed into a crucible. The crucible was heated first on a heating mantle till all the material was completely charred, followed by incineration in a muffle furnace at 550°C for 1 - 3 hours. The crucible was then cooled in a desiccator and weighed.

F. Determination of Fat Content

The fat content was determined by the continuous solvent extraction method using a Soxhlet extractor (AOAC, 2004). One gram (1g) of each sample was wrapped with a pre-weighed Whatman filter paper No 40. The wrapped sample was placed in a Soxhlet column flask mounted unto a weighed oil extraction flask containing about 300 ml of petroleum ether (40- 60°C boiling point). The wrapped sample was defatted twice and the fat content determined by weight difference of each sample and expressed as a percentage of each sample weight.

G. Determination of Crude Fibre

This was determined by the method of AOAC (2004). Five gram (5g) of each sample was defatted (as in fat determination) and the defatted sample boiled in 200 ml of 1.25% H_2SO_4 solution under reflux for thirty minutes. After that, the sample was washed with enough hot water using a twofold muslin cloth to trap the particles. The washed sample was carefully transferred into a weighed porcelain crucible and dried for an hour on an oven set at 105°C, cooled in a desiccator and reweighed. The loss in weight after drying was calculated as the crude fibre content and expressed as a percentage of the sample weight.

H. Determination of Moisture Content

Moisture content of the sample was determined using method described by AOAC (2004). 5 g of the fresh and paste tomato samples were taken and transferred into a porcelain crucible, after which they were oven dried at a temperature of 105°C for 1 hr. The difference in the weight of the samples was recorded in percentage as the moisture content.

I. Isolation of Microbes from the Study Samples

Triplicate sample sources were processed in the study through which a mean reading was taken. Serial dilution of each sample was carried out to get 10^{-4} dilution. 0.1ml was then transferred to a sterile plate.

The sterilized medium of nutrient agar (NA) and the sabourand dextrose agar (SDA) generally used during the study were poured in the plate already containing the diluents as appropriate using the method known as pour plate technique. This was then swirled evenly to make the mixture homogenized and left for few minute(s) to allow it to solidify. The inoculated plates were labeled properly for easy identification, and then the plate was incubated for 37ºC for 24 hours for bacterial culture and 25 -27ºC for 24 hours and 48 hours for fungal growth (Enwa *etal* 2016; Anie 2018; Onyekaba *etal* 2011)

J. Laboratory identification of fungi

a) Yeast identification
Different colonial types were purified by transferring into sterile potato dextrose plate. Each pure colonial isolate was inoculated into a sterile potato dextrose agar slants and stored in refrigerator.

b) Colonial Morphology
The vegetative cells of the pure culture of the yeast isolates were streaked on sterile potato dextrose agar plate. The plates were incubated at 30ºC for 48 hours.

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The shapes, color, edge and the growth elevation were examined CLSI,(2015; Anie *etal* 2019).

c) Germ tube Test
0.5ml of humzin serum was measured into a small test tube, a sterile wire loop was used to inoculate the serum using a 18-72hrs broth of yeast and incubated for 2-3 hrs. A drop of the serum – yeast culture was transferred to a glass slide using a Pasteur pipette and covered with a cover glass. This was view under a microscope using an X10 and X40 objective lens with the condenser as diaphragm close sufficiently to have good contrast. Sprouting growth that looks like germ tube as recorded as positive(CLSI, 2015; Anie *etal* 2019).

d) Biochemical test
The following biochemical tests were done; Gram-staining, coagulase, oxidase, fermentation, urease, lead acetate/H_2S test, citrate utilization, motility, MR - VP (Methyl Red - Voges Proskauer), catalase, and indole test.(Enwa *etal* 2015; Anie *etal* 2017)

IV. RESULTS

The comparison of the physiochemical property and microbiological quality of fresh tomatoes and tomatoes paste were analyzed and results presented in the Tables below. Table1: presents the result of the physicochemical parameters of samples of tomato paste and fresh tomatoes analyzed. The pH of the sample was within the range of 5.79±0.01 to 6.39±0.01. Ash and moisture content of tomato paste and fresh tomato samples ranged from 1.10±0.01 to 4.37±0.011% and 2.01±0.01 to 3.57±0.02% respectively. The value of crude fat and fibre in the sample analyzed were in the range of 2.76±0.02 to 3.11±0.01 g and 62.15±0.03 to 126.07 g respectively. Total soluble solid found in the tomato sample was in the range of 1.32±0.02 to 1.39±0.0l while the acidity of the sample was in the range of 19.5±0.10 to 65.05±0.05.

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Parameters	Toh	Gin	Son	Der	Tat	Fresh tomato
pH	5.91±0.01	5.79±0.01	5.99±0.01	5.95±0.01	6.06±0.01	6.39±0.01
Ash content (%)	4.37±0.11	2.91±0.03	1.10±0.01	1.51±0.01	1.92±0.02	2.12±0.02
Moisture content (%)	2.01±0.01	2.49±0.01	2.46±0.02	2.58±0.00	2.62±0.01	3.57±0.02
Crude fat (g)	2.98±0.01	2.82±0.02	2.76±0.02	2.83±0.01	3.01±0.02	3.11±0.01
Crude fibre (g)	74.41±0.01	65.31±0.01	62.15±0.03	75.01±0.00	126.07±0.01	72.35±0.04
Acidity	29.55±0.15	37.33±0.03	29.44±0.04	49.05±0.05	65.05±0.05	19.5±0.1
TSS	1.38±0.01	1.39±0.01	1.36±0.01	1.36±0.01	1.36±0.01	1.32±0.02

Table 1: Physicochemical Parameters of Tomatoes Sample

Key: TSS = total soluble solid

		Fresh tomatoes
24 hrs	**TCC**	7.4 x10^4
	TFC	2.4 x10^4
48 hrs	**TFC**	8.0 x10^4

Table 2: Total Coliform and Fungal Counts (cfu/g) of Fresh Tomatoes sold in Abraka Main Market

Key:
TCC = total coliform count
TFC = total fungal count
NG = no growth

Assessment of total coliform and fungal counts of fresh tomatoes and tomatoes paste was done using microbiological standard methods and result presented in Table 2 and 3 respectively.The microbial load of analyzed fresh tomatoes was 7.4 x10^4 cfu/g after 24 hours. The values were higher compared to those of the tomato paste sample with values of 5.0 x 10^4, 3.6 x 10^4 and 4.1 x 10^4 cfu/g for Tat, Gin and Toh tomato paste whereas Der and Son tomato paste showed no bacterial growth. Total fungi count of fresh tomatoes after 24hrs has value of 2.4 x 10^4 and 8.0 x 10^4 after 48 hrs these values were quite higher when compared to those of the tomato paste with total fungi count of 2.0 x 10^4 cfu/g for Gino after 24 hrs and 1.5 x 10^4, 6.0 x 10^4 and 3.0 x 10^4 cfu/g for Tat, Gin and Toh tomato paste respectively, while Der and Sonia tomato pastes showed no fungi growth.

Sample	24hrs		48hrs
Samples	**TCC**	**TFC**	**TFC**
Der	NG	NG	NG
Tat	5.0x10^4	NG	1.5 x10^4
Gin	3.6x10^4	2 x10^4	6. x10^4
Son	NG	NG	NG
Toh	4.1x10^4	NG	3 x10^4

Table 3: Total Coliform and Fungal Counts (cfu/g) of Tomatoes Paste sold in Abraka Main Market

Key:
TCC = total coliform count
TFC = total fungal count
NG = no growth

Cultural Characteristics	Morphological Characteristics	BIOCHEMICAL TESTS															Identity
		Gram	Coatgulase	Catalase	Indole	Citrate	Oxidase	Glucose ferm	Lactose	Sucrose ferm	Lead acetate	H_2S Prod	Gas Prod	Urease	Motility	MR	
Colonies were slightly raised on agar plate	Cocci in cluster	+	+	+	-	+	-	+	+	-	-	-	+	+	-	-	*Staphylococcus aureus*
Colonies were, white, flat, entire on nutrient agar.	Rod	+	-	+	-	-	-	-	+	+	-	-	-	-	+	-	*Bacillus subtilis*
Orange, smooth edges & convex colonies	Rod	-	-	+	-	+	-	+	-	+	+	-	+	-	+	+	*Citrobacter sp*
Colonies were, yellow, entire on nutrient agar.	Cocci	+	-	+	-	-	-	-	+	-	-	-	-	-	-	-	*Micrococcus sp*
Creamy, smooth edges and convex colonies	Cocci in chain	-	-	+	-	-	-	+	+	-	-	-	+	+	-	+	*Streptococcus sp*

Table 4: Biochemical Test Characterization

Key:
+ positive
- negative

The characterization and identification of biochemical test of isolated organisms was *Micrococcus sp, Streptococcus sp, Bacillus subtilis, Staphylococcus aureus* and *Citrobacter* spas shown in Table 4.

Bacterial and fungi isolates from fresh tomatoes and tomatoes paste as presented in Table 5. It was observed that *Micrococcus* sp, *Staphylococcus aureus* and *Citrobacter* sp were present in fresh tomatoes, on the other hand *Citrobacter* sp and *Bacillus subtilis* were present in Tat, *Micrococcus sp* and *Streptococcus sp,* were present in Gin while *Staphylococcus aureus* and *Citrobacter* sp were present in Toh(Table 5). Similarly, it was observed that *Rhizopus* sp, *A. terreus* and *Mucor* sp were present in tat, on the other hand *A. terreus* and *Mucor* sp were present in fresh tomatoes and Toh, *Rhizopus sp* and *Candida albican,* were present in Gin (Table 5).

Samples	Fresh tomatoes	Tat	Gin	Toh
Bacterial				
Citrobacter sp	+	+	-	+
Staphylococcus aureus	+	-	-	+
Bacillus subtilis	-	+	-	-
Micococcus sp	+	-	+	-
Streptococcus sp	-	-	+	-
Fungal				
A. terreus	+	+	-	+
Mucor	+	+	-	+
Rhizopus	-	+	+	-
Candida albican	-	-	+	-

Table 5: Microbial isolates from fresh tomatoes and tomatoes paste

The percentage incidence of microbial isolated from the samples as presented in Table 6. It was observed that the occurrence of *Citrobacter* sp 31.25% was higher compared to other bacteria isolated while *Streptococcus sp* and *Bacillus subtilis* with 12.5% was the least. *Candidaalbican* had the highest percentage occurrence of 38.88% while *Aspergillus terreus and Rhizopus sp* with 16.66% was the least among others respectively.

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Microorganisms	No. of isolates	% rate
Bacterial		
Citrobacter sp	5	31.25
Staphylococcus aureus	4	25.09
Bacillus subtilis	2	12.5
Micococcus sp	3	18.75
Streptococcus sp	2	12.5
Fungal		
A. terreus	3	16.66
Mucor	5	27.77
Rhizopus	3	16.66
Candida albican	7	38.88

Table 6: Percentage occurrence of microbial isolates from fresh tomatoes and tomatoes paste samples

V. DISCUSSION

The pH of *L. esculentum* is generally acidic and values obtained during the study period ranges between 5.79±0.01 to 6.06±0.01 for tomato paste while that of the fresh tomato was reported to have pH value of 6.39±0.01. The increase might be attributed to changes in the level of some acids notably citric acid. The finding of this study is in agreement with the result obtained by Tigist *et al.*, (2013). The values of the fresh tomato juice is within the limit for maximum level of pH (6 – 7) for fresh tomatoes juice while that of the tomato paste is slightly higher than the maximum level of pH stipulated by Centre for Food Safety and Applied Nutrition for canned. The high level of the pH in the tomato paste might be ascribed to the storage process of the paste which might cause an increase in the pH level of the tomato paste. Although pH below 4.5 is considered a good indicator as it halts the growth of some microorganisms that may cause deterioration therefore good quality maintenance. The level of moisture present in the tomato paste sample were found to be very low thus indicating a high shelf-life of the tomato paste while that of the fresh tomato was slightly higher but was still within the permissible limit of moisture in food sample which will prevent the growth of microbes on storage when dried. The values obtained for TSS in tomato paste samples were within the range of 1.36±0.01 to 1.39±0.01% while that of the fresh tomato juice has TSS value of 1.32±0.02%. The finding of this study is consistent with that reported by Adekalu *et al.* (2016) who reported values ranging from 1.93±0.05 to 3.80±0.10% and 4 to 6% for fresh and processed tomato samples. The decrease in TSS values during the storage period might be attributed to slower rate of hydrolysis of carbohydrates probably occasioned by the medium of preservation. More so, since TSS is a sum of sugars, some acids and some minor components microorganisms might use some of the components as substrates for growth. The result of physicochemical assessment of tomato samples in this study for ash content, crude fibre and crude fat are in agreement with Adekalu (2014). Foods/produce preserved by this employed in this study remains stable and safe even without refrigeration, higher in sensory and nutritive value due to gentle process applied as reported by Mrema (2008).

The total coliform and fungal count of fresh tomatoes juice and tomatoes paste sample showed that there were variations at different samples. The microbial load observed in the fresh tomatoes and tomatoes paste samples indicated that the fresh tomatoes and tomatoes paste was contaminated with microbes of medical importance. The microbial load of analyzed fresh tomatojuice was higher in values compared to tomato paste. Whereas the microbial load of Gino tomatoes paste among the analyzed tomatoes paste was higher compared to other tomatoes paste at 24hrs. This could be due to the fact that tomatoes contain nutrient that can support the growth of microorganisms as well as the storage condition. This is in agreement with the report of Romero *et al.* (2014) that noted the use of unhygienic environment and water for the preparation of food type as responsible for the contamination of foods. This finding is also in line with the study conducted by (Chukwu *et al.* 2008) who isolated various isolates of bacterial and fungal from tomato fruits. Tomatoes basically contains all the nutrients necessary for microbial growth and metabolism, making it susceptible to microbial contamination. On the other hand, the absence of microbial growth observed in the tomatoes paste could be attributed to the heating and processing of the tomatoes paste.

The observed results in microbial load in 24 hours have been due to storage methods and environmental condition. However, the observed increased after 48 hours could have been due to the fact that the method of preservation could not hold down microbial load beyond 48 hours. Usually preservation through refrigeration relies mainly on supply of electrical energy by PHCN which is either non-existent or epileptic most of the time this may have made the preservation methods ineffective. This result agrees with the report of Kurtzman (2006) who reported that freshly prepared food and vegetable product could be contaminated with a diversity of microbes uncontrolled and with the use of unsterile water. However, this could also have been as a result of the exposure of the tomatoes to the atmosphere during the period of storage or microbes from handlers. This is in agreement with the report of Chime*et al.* (2017).

The presence of bacterial and fungal species with their characterization in the samples which is presented in Table 3 and 4, indicated that the fresh tomatoes juice and some tomatoes paste contain microorganisms. This may be as a result of the exposure of the tomatoes to unhygienic condition during preparation, lack of good preservation method and standard equipment for processing the product. The presence of these microorganisms may also be attributed to micro flora and/ or due to spoilage

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microorganisms present in the tomatoes after preparation.In a similar study by Wogu and Ofuase (2014), several genera of bacterial and fungal were identified as being associated with the spoilage of tomato fruits. Ghosh (2009) reported fungi to be the major source of spoilage of most of the tomato samples accessed than bacteria. The result was in consonance with the report of Chukwura and Majekwu, (2002) who stated that microbiological analysis of tomatoes samples could indicate contamination of tomatoes samples with various bacterial species including *Staphylococcus aureus*, and some enteric bacteria through the use of water and preservation methods. Ghosh (2009)also affirm that tomatoes preserved with a certain amount of salt, permit the growth of *Staphylococcus aureus* whereas, the presence of some members of the family of *Enterobacteriacea* is due to contamination from intestine of slaughtered animals.

The presence of *Staphylococcus* species agrees with the report of cross contamination from tomatoes handlers during processing,since it is normal flora of the skin, raw tomatoes is usually carried on the body by vendors in Nigeria due to lack of education, As reported by Onuorah and Orji (2015), the large water content in tomato fruit makes it highly susceptible to spoilage by microorganisms such as fungal, which may produce mycotoxins with public health risks. There is also the report that said that the presence of *aspergillus*, *Citorbater* and *Micrococcus* sp probably may arise from the use of non –portable water during washing of raw tomatoes. The tomatoes and tomatoes paste also showed presence of *Mucors* and *Bacillus subtilis*, which usually occurs in soil, vegetation and surfaces of plants, humans and animals (Field 2002). Generally, the major sources of microbial contamination of tomatoes and tomatoes paste appear to be handling by vendors and the use of contaminated water and equipment. Therefore, control of tomatoes contamination can be achieved if aseptic techniques are employed during preparation.

Association of bacterial and fungal isolates from fresh tomatoes juice and tomatoes paste as presented in Table 5, indicated that diverse microbes are present in the different tomatoes and tomatoes paste samples due to the level of contamination (Table 5). However fresh tomatoes need to be pasteurize in a very hot water before use for consumption, as prescribed by CDC, (2006) who stated that fresh tomatoes for consumption is not free from microorganisms due to contamination from the environment and processing if not properly pasteurized. The vendors sell with their bare hands and also simultaneously handle currency as they take money from the buyers, a common practice implicated in introducing pathogens into the food (Bello *et al*., 2016).

Prevalence rate of bacterial isolates from the samples revealed that *Citrobacter* sp and *Candida albican* was the most frequently isolated organism from both fresh and paste tomatoes, followed by *Streptococcus sp* and *Bacillus subtilis, Aspergillus terreus and Rhizopus sp* was the least among others respectively. This could be due to the method of handling as these organisms are reported to be associated with skin, the environment and water. The presence of other organisms could be due to the fact that they gained entry into the samples from the environment. This is in agreement with the work of Martins (2006) who said that the prevalence of some pathogen in food substance could be due to method of preparation and handling.

VI. CONCLUSION

Fresh tomato juice constitutes a great source of protein which is consumed for body building and repair of worn out tissue in human in Nigeria. Improvement in the microbial quality of fresh tomatoes and tomatoes paste is very important and adequate steps must be taken to prevent contamination and spoilage by microorganisms. The low moisture content of the tomatoes samples prevents an enabling environment for the proliferation of the microbial load and hence its spoilage and potential to become less health risk human spoilage.

The organisms isolated from the tomatoes paste indicate that the standard of preparation and preservation is poor over the years and facilities used for preparation are not sterile. Aseptic techniques should be adequately employed in the food industries so as to reduce microbial load of its products for safe consumption and thus prevent food-borne diseases or infections.

VII. RECOMMENDATION

Unhygienic situation of handlers might lead to the contamination of ready-to-eat foods and this might eventually affect the health of the consumers. Therefore, standard personal hygiene should be observed by food handlers and adequate preparation of these said foods is recommended.

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