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Effect of Oil Marination on Nutrient Content of Fresh Tomato

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Abstract

Tomato is one of the most widely consumed fresh vegetables in the world. This study was conducted to investigate the effect of oil marination on nutrient content of fresh tomatoes. The tomatoes were grouped into three. The group 1 served as the fresh (control), group 2 was the unblanched and group 3 was the blanched tomatoes. Both the groups 2 and 3 were oil immersed and stored for 6 weeks. The vitamins (A, C and E) contents of the fresh marinated tomatoes (75.14mg/100g, 15.14mg/100g and 154.34mg/100g) respectively were significantly (P<0.05) higher than the concentration found in the unblanched and blanched marinated tomatoes. The lycopene content of the fresh oil marinated tomatoes is 21.53mg/100g which was significantly (P<0.05) higher than the unblanched tomatoes (16.64 to 17.81 mg/100g) and the blanched (19.05 to 20.63 mg/100g). The sodium ion concentration on fresh sample is 122.01mg/kg, this value was significantly (P<0.05) higher than that of blanched and unblanched marinated tomatoes. There was no significant difference in the calcium ion and potassium ion concentration of the fresh tomatoes with that of blanched and unblanched samples. The magnesium ion content in the fresh sample was 1.4 mg/kg which was significantly (P<0.05) greater than that of the blanched marinated tomatoes (0.95 to 1.26mg/kg) and the unblanched (0.89 to 1.14mg/kg). The oil marinated tomatoes did not rotten for the entire six weeks under observation. This might be a better way for a long-term preservation of fresh tomatoes.

***Keywords**: Blanch, fresh, nutrient, oil marination, tomato*

Introduction

Tomatoes (*Lycopersicon esculentum*) are important fruits classified as a berry and commonly consumed for its red pigment due to lycopene content which has been reported as a source of antioxidant (Berry, 2004). Tomato fruits are extremely beneficial to human health due to their richness in folate, potassium, vitamin C, carotenoids and flavonoids (Agarwal and Rao, 2007). Blanching is a thermal treatment that is usually performed prior to food processes such as drying, freezing, frying, and canning (Arroqui *et al*., 2003). It is essential to preserve the product quality during the long-term storage because it inactivates enzymes and destroys microorganisms that might contaminate raw vegetables and fruits during production, harvesting and transportation (Cruz *et al.*, 2006; Mukherjee and Chattopadhyay, 2007).

A marination is a technique primarily used for enhancing the flavor, qualities and extending the shelf-life of foods by submerging the foods completely in edible oils or acids thus protecting them from aerobic spoilage organisms (Vallverdu – Queralt *et al*., 2013). Food preservation is aimed at maintaining the original state of food material by treatments, which will prevent its spoilage or deterioration (IFIS, 2005). Food preservation is also an obligation to sustain the wholesomeness of raw agricultural produce given their perishable nature (Andritsos *et al*., 2003). Fresh market tomatoes as obtained from the farm cannot keep fresh beyond five days at ambient conditions especially in the hot tropic regions like Nigeria (Andritsos *et al*., 2003). There is need therefore to advance alternative methods of preserving the shelf-life of tomato fruits that could be simple to adopt and practice at both household and commercial applications especially in areas with no access to electricity. Thu, this study aimed to determine the effect of processing; blanching and oil marination on nutrient content of tomatoes.

Sample Collection

Fresh sample of tomato (*Lycopersicon esculentum*) was purchased from the local market (Kasuwar daji), Sokoto State. The sample was randomized in uniform size, color, ripeness and free from defect or injury and then kept in a clean place.

Sample Preparation

The tomatoes were washed thoroughly under running tap water, rinsed with distilled water and then wiped with an absorbent paper. Nine kilograms of tomatoes were divided into 3 portions. Group1; fresh tomato (control), group 2; unblanched and group 3; blanched tomato. The blanching was done using steam blanching method as described by Xiao *et al.* (2017). Group 2 and 3 were further divided into 4 portions each, and then transferred into 200 ml preheated oil to 60°C. It was allowed to cool then packaged in sterile small bottles and was pasteurized at 90°C for 2 min. The product was stored at room temperature while being analyzed at day 1, 7, 14, 21, 28, 35 and 42 days.

Sample Analysis
Vitamin A, C and E were determined according to method of A.O.A.C (2010).

Determination of Lycopene
A well homogenized tomato juice was used for lycopene estimation; 100 µL of the juice was dispensed into a screw cap tube with the aid of a micropipette. Also blank sample was prepared with 100 µL water, 8 ml of hexane: ethanol: acetone (2:1:1) was also added. The tube was caped and vortexed immediately, then incubated out of bright light. After 10 min, 1.0 ml of water was added to each sample and vortexed again. The sample was allowed to stand for 10 min to allow phases to separate and all air bubbles to disappear. The cuvette was rinsed with the upper layer from the blank samples. It was discarded and fresh blank were used to zero the spectrophotometer at 503 nm. The absorbance was determined at 503 nm.

Determination of pH
The pH meter's electrode was lowered into a buffer solution. The instrument was then calibrated in a buffer of pH 7. The electrode was then removed from the buffer solution, rinsed and placed in the samples and the pH was read and recorded.

Data Analysis
The results are presented as mean ± standard deviation of mean of triplicate. Difference between Means are considered significant at $p<0.05$ using Dunnett One-way analysis of variance (ANOVA). This was carried out using SPSS version 16 statistical package.

Results

Pro-vitamin A
Figure 1 shows the effect of storage time on pro-vitamin A concentrations of fresh and oil marinated tomatoes. The fresh (control) has a mean value of 75.14 mg/100g. The vitamin A content of the blanched sample ranges from 70.66 mg/100g to 66.30 mg/100g. While that of unblanched sample ranges from 68.35 mg/100g to 47.73 mg/100g. There is a significant difference between the blanched and the unblanched with that of the control at $P<0.05$. The vitamin A content of oil marinated blanched and unblanched tomato decreases as the week's progresses.

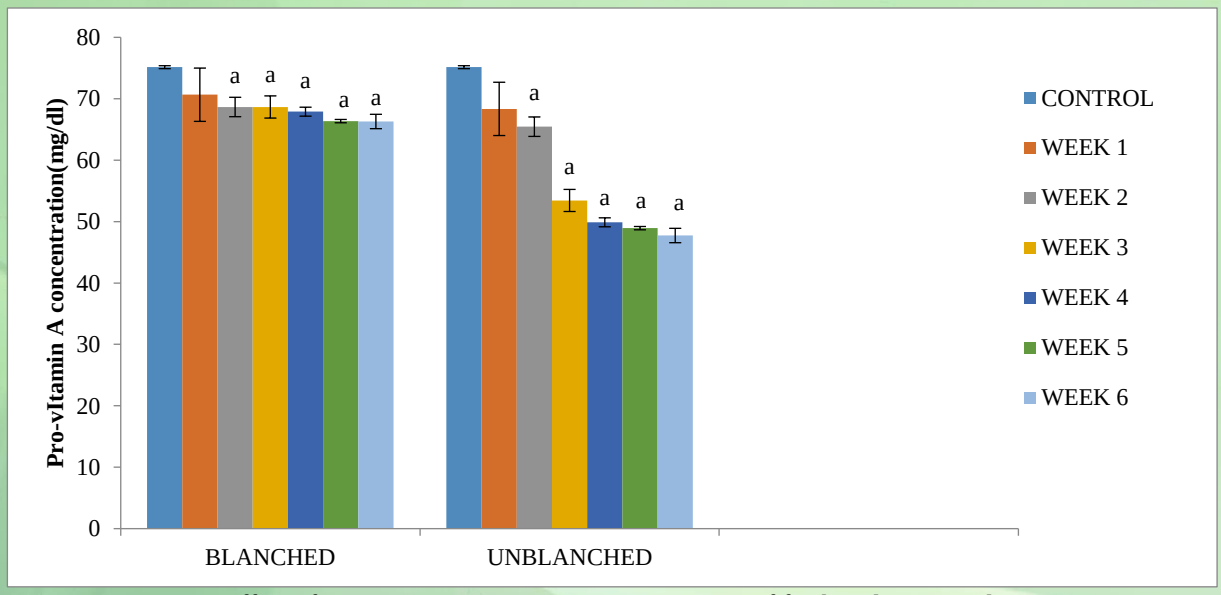

Figure 1: Effect of storage time on vitamin a concentration of fresh and marinated tomatoes.
Key: a = indicates significant difference with control

Vitamin C
The effect of storage time on vitamin C concentrations of fresh and marinated tomato are presented in figure 2. The fresh (control) has the highest vitamin C content (15.14mg/100g) while that of blanched ranges from 13.47 mg/100g to 11.43 mg/100g and unblanched ranges from 11.22 mg/100g to 9.82 mg/100g. There was a slight decrease in the vitamin C content of marinated tomatoes as the weeks progresses. There was a significant difference between the blanched and the unblanched with that of the control at $P<0.05$.

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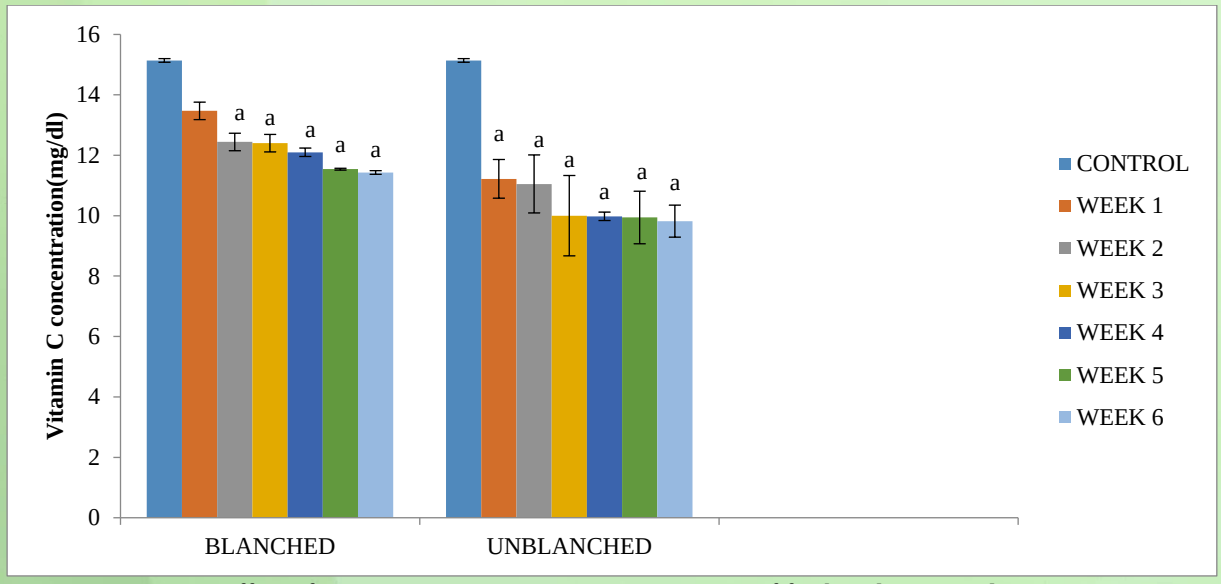

Figure 2: Effect of storage time on vitamin C concentration of fresh and marinated tomatoes.
Key: a= indicates significant difference with control

Vitamin E

The effect of storage time on vitamin E concentrations of fresh and marinated tomato are presented in figure 3. The fresh (control) has the highest vitamin E content (154.34 mg/100g) while that of blanched ranges from 152.34 mg/100g to 148.45 mg/100g and unblanched ranges from 150.34 mg/100g to 147.21 mg/100g. There was a significant decrease in the vitamin E content of marinated tomatoes as the weeks progresses. There was no significant difference between the blanched and the unblanched with that of the control at $P<0.05$.

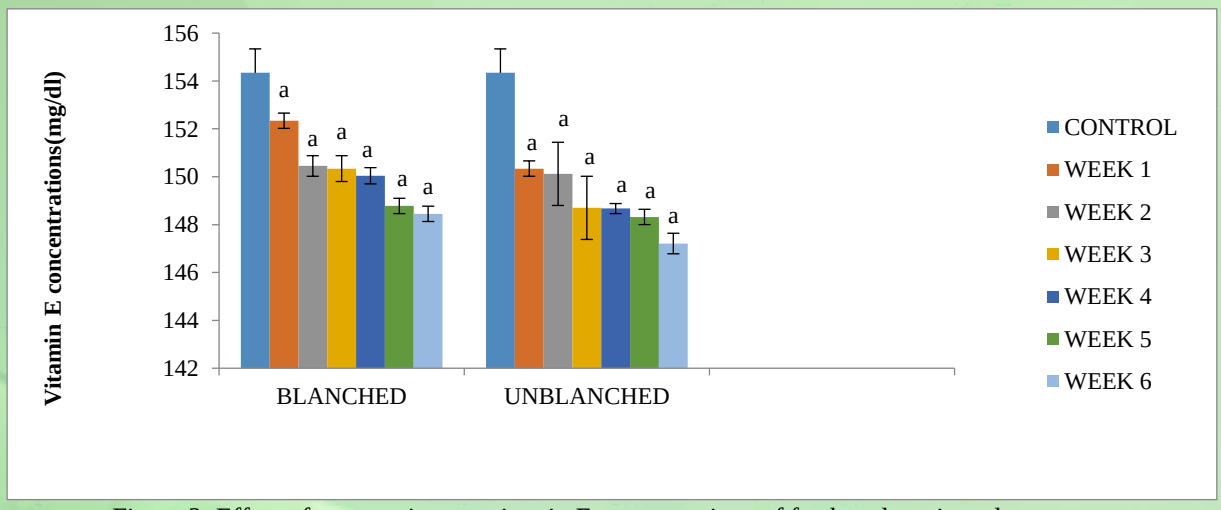

Figure 3: Effect of storage time on vitamin E concentrations of fresh and marinated tomatoes.
Key: a= indicates significant difference with control

Mineral Elements

Sodium Ion (Na^+)

Figure 4 presents the effect of storage time on sodium ion concentration of control (fresh), blanched and unblanched samples. The control has a mean value of 122mg/kg Na^+. The blanched sample has a mean value for week 1 to 6 110.33 mg/kg Na^+ which depreciated slightly across the 6 weeks to a final mean value of 98.33 mg/kg Na^+. Consequently, the unblanched sample has a mean value of 98.66 mg/kg Na^+ in week 1 which is significantly different with the control, but it was appreciably maintained across the 6 weeks.

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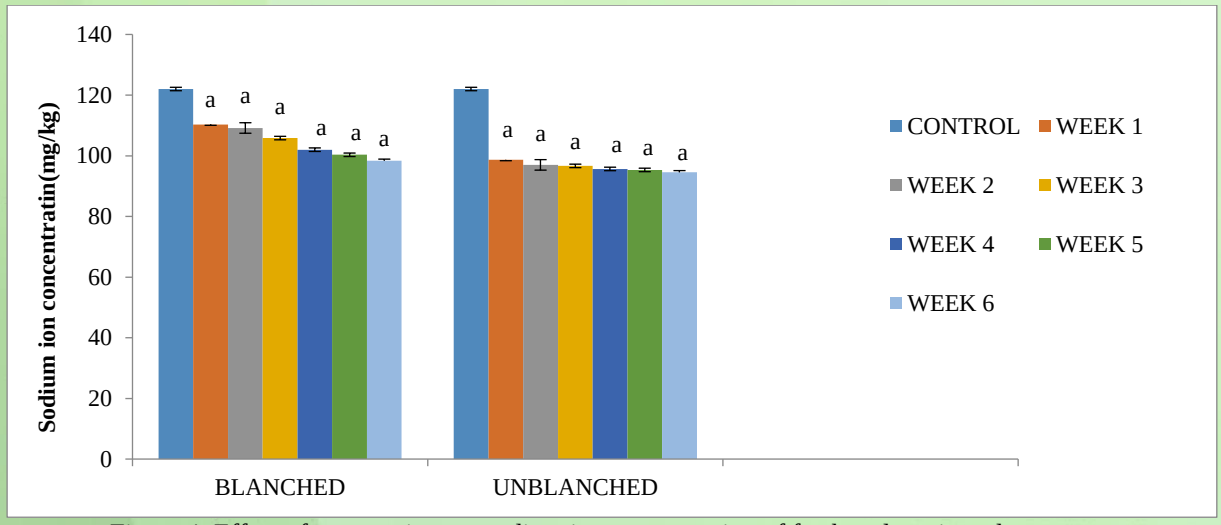

Figure 4: Effect of storage time on sodium ion concentration of fresh and marinated tomatoes.
Key: a= indicates significant difference with control

Potassium Ion (K^+)

Figure 5 explains the effect of storage time on potassium ion concentrations of control, blanched and unblanched samples. The control has a mean value of 590.31 mg/kg K^+. In the blanched sample, K^+ concentration depreciated significantly across the 6 weeks from 585.34 mg/kg in week 1 to 574.78 mg/kg in week 6. While the unblanched sample also has a significance difference with the control ranging from a mean value 583.00 mg/kg in week 1 to 570.34 mg/kg in week6.

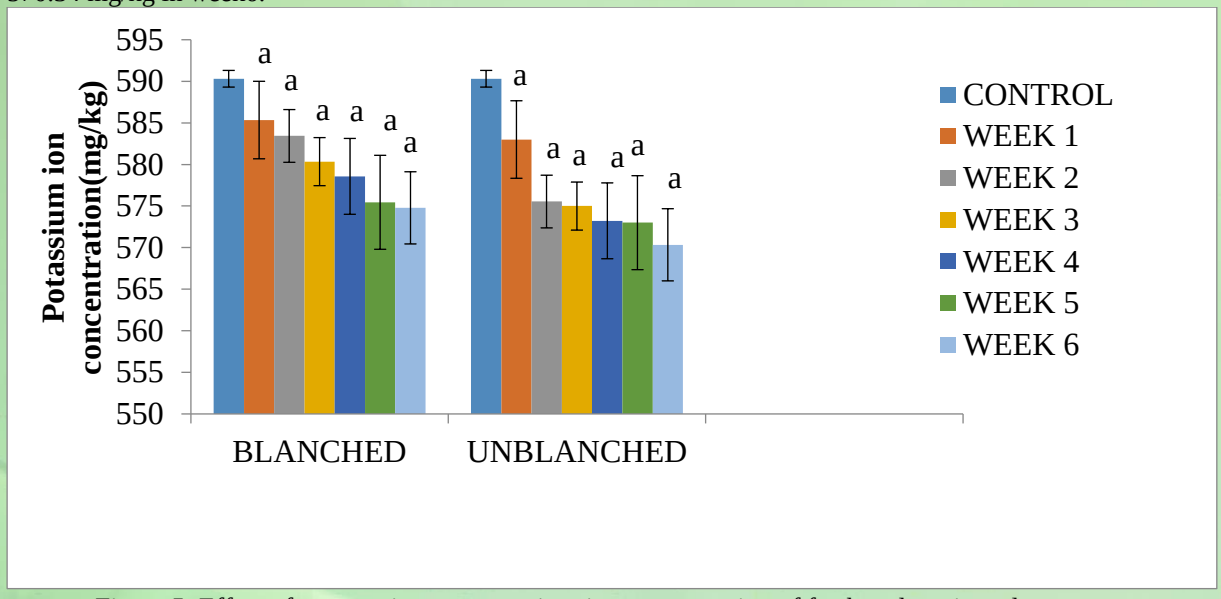

Figure 5: Effect of storage time on potassium ion concentration of fresh and marinated tomatoes.
Key: a= indicates significant difference with control

Calcium Ion (Ca^{2+})

Figure 6 shows the effect of storage time on calcium ion concentrations of control, blanched and unblanched samples. The control has a mean value of 1.11mg/kg Ca^{2+}. The blanched sample has a mean value of 1.00 mg/kg Ca^{2+} for week 1 which slightly depreciated across the 6 weeks to a mean value of 0.90 mg/kg Ca^{2+} for week 6. In the unblanched sample, where is no significance differences across the 6 weeks but it also depreciated from the control from a value of 1.02 mg/kg for week 1 to 0.90 mg/kg Ca^{2+} for week 6.

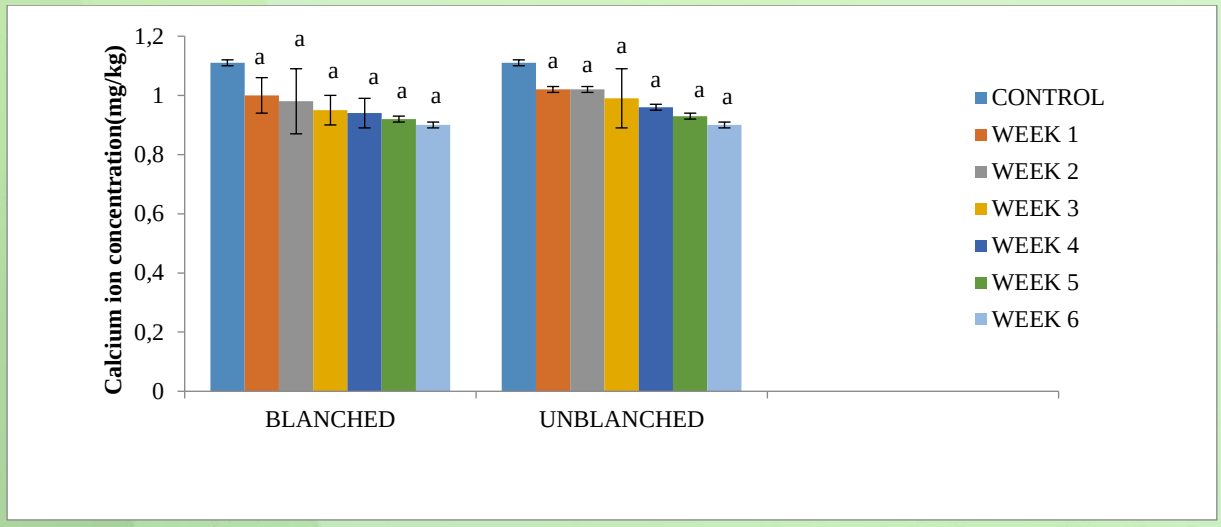

Figure 6: Effect of storage time on calcium ion concentration of fresh and marinated tomatoes.
Key: a= indicates significant difference with control

Magnesium Ion (Mg^{2+})

Figure 7 presents the effect of storage time on Magnesium ion concentrations of fresh and oil marinated blanched and unblanched samples. The fresh (control) has a mean value of 1.4 mg/kg Mg^{2+} while the blanched sample has a mean value of 1.26 mg/kg Mg^{2+} for week 1 and 0.95 mg/kg Mg^{2+} for week 6. A significance difference was seen in the unblanched sample from 1.13 mg/kg for week 1 to 0.89 mg/kg Mg^{2+} for week 6.

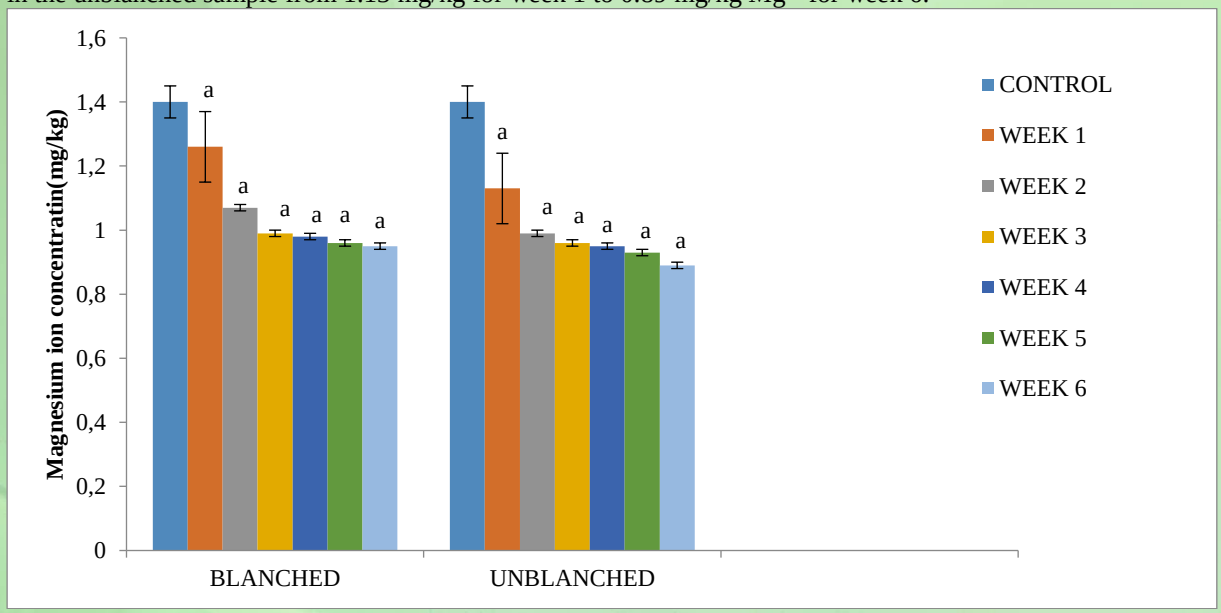

Figure 7: Effect of storage time on magnesium ion concentration of fresh and marinated tomatoes.
Key: a= indicates significant difference with control

Phosphorus Ions

Figure 8 shows the effect of storage time on phosphorus ion concentrations of fresh and oil marinade tomatoes. The control has a mean value of 4.76 mg/kg of Phosphorus ions. In the blanched sample, the phosphorus concentration reduced from 4.41 mg/kg in week 1 to 3.83 mg/kg in week 6. While the unblanched sample has a significance difference between the weeks. A large depreciation was observed from week 3 to week 6.

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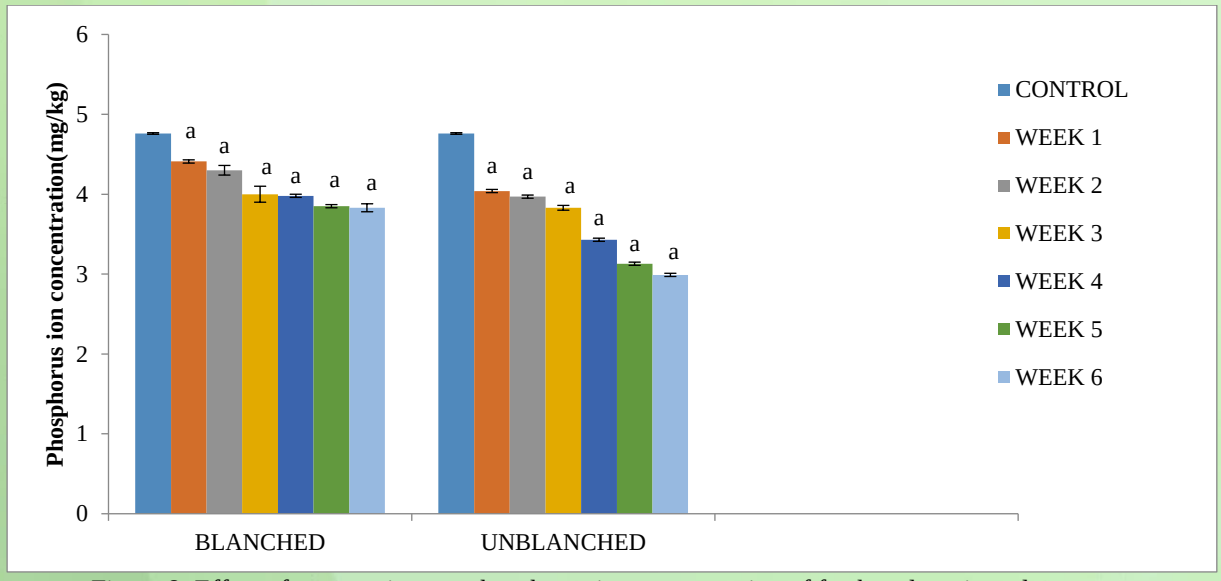

Figure 8: Effect of storage time on phosphorus ion concentration of fresh and marinated tomatoes
Key: a= indicates significant difference with control

Lycopene Concentrations

The effect of storage time on lycopene content of fresh and oil marinated tomato was presented in figure 9. The fresh (control) has the highest lycopene content (21.53 mg/100g), while that of blanched ranges from 20.63 mg/100g to 19.05 mg/100g and unblanched ranges from 17.81 mg/100g to 16.64 mg/100g. There was a decrease in the lycopene content of marinated tomatoes as the weeks progresses. There is a significant difference between the blanched and unblanched oil marinated tomatoes with the control at $P<0.05$.

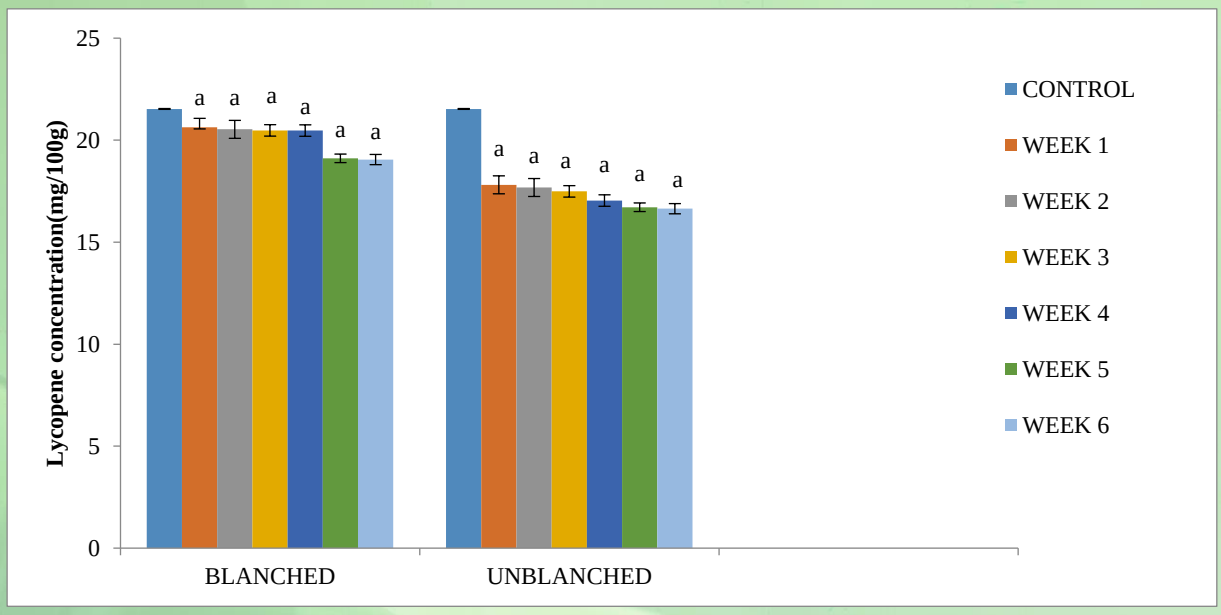

Figure 9: Effect of storage time on lycopene concentration of fresh and marinated tomatoes.
Key: a= indicates significant difference with control

pH Determination

Figure 10 presents the effect of storage time on the pH of fresh and oil marinated tomatoes. The control has a pH of 3.86 while the blanched sample has a pH of range from 3.88 to 4.12. While the pH of unblanched samples ranges from 3.88 to 4.10. There was an increase in the pH of marinated tomatoes as the weeks progresses. There is a significant difference between the blanched / unblanched with that of the control at $P<0.05$.

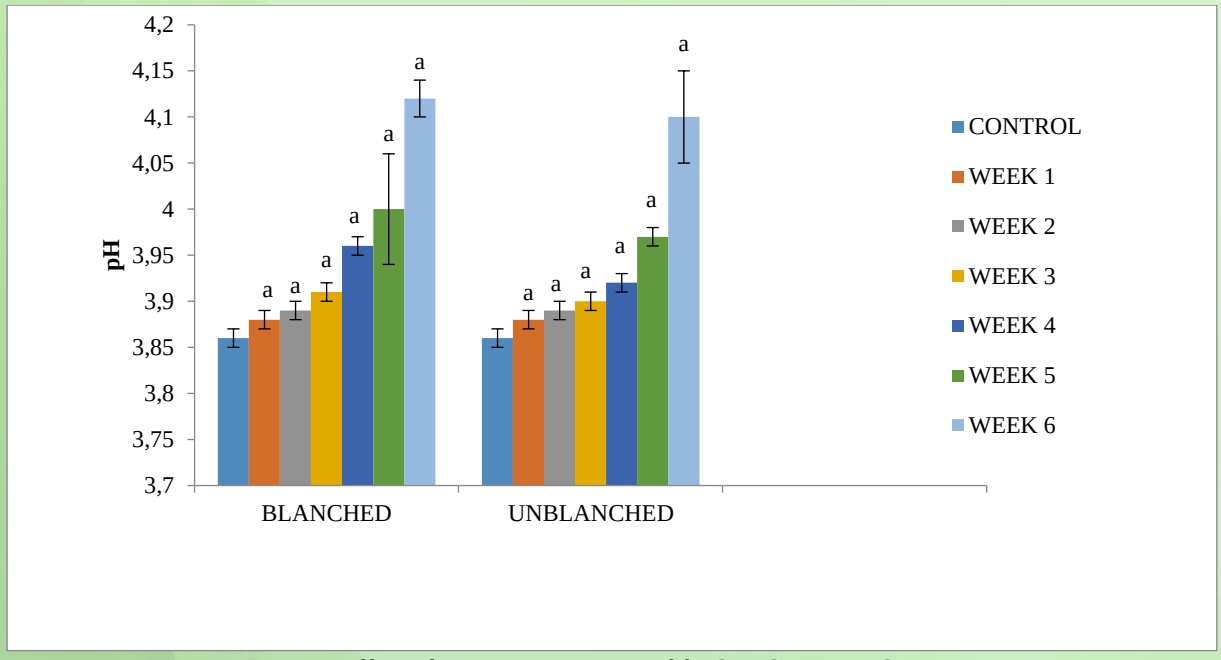

Figure 10: Effect of storage time on pH of fresh and marinated tomatoes.
Key: a = indicates significant difference with control

Discussion

Tomatoes are highly perishable and subject to surface and internal damage. There should be proper temperature and pH management during storage. Tomatoes, flavor should be preserved as much as possible. Hence, any means employed to preserve tomatoes should be able to maintain its flavor. In this study, the method used to preserve tomatoes proved to be very successful. This is because the tomatoes did not rotten for the entire 6 weeks of storage. The air-tight container was able to keep the tomatoes intact. Furthermore, fresh and marinated tomatoes (blanched and unblanched) were analyzed for their contents of major nutrients, vitamins, pH and essential minerals.

Effects of Pre-and post-processing treatments on vitamin contents of oil marinated tomatoes

The different levels of the three vitamins (A, C and E) were presented in Figure (1, 2 and 3) respectively. The significance difference in pro-vitamin A content between the blanched and unblanched samples might be due to the pre-processing undergone by the blanched sample. The pro-vitamin A content was above the RDA values (Institute of Medicine, 2005). Thus, may be a good source in supplementing the daily requirements. It is important to note that vitamin A is a good source for normal vision, gene expression, growth and immune function (Lukaski, 2004).

The significant high vitamin C content of the fresh (control) sample might be due to the fact that it did not undergo any pre -or-post processing treatments as the blanched sample. This explains the significant different between the blanched and unblanched samples in the vitamin C content. The low vitamin C content in the blanched sample was due to heating applied to the sample during pre-processing. Vitamin C is sensitive to thermal treatments. Similar results were found in the study of Mehmood *et al.* (2008) where ascorbic acid content was decreased with storage time in apple juice preserved with potassium sorbate and sodium benzoate. Preservation of ascorbic acid content during storage is a difficult task since it undergoes oxidation. The significant changes in the vitamin C content of blanched and unblanched oil marinated tomatoes might also be due to high temperature during the pre-processing treatments. According to Smith and Hull (2004), increase temperature normally results in high loss of ascorbic acid.

The significant high vitamin E content of the fresh (control) might be due to not undergoing pre-processing treatments of this sample. Subsequently there is no significant difference between the blanched and unblanched vitamin E content. The values recorded for these samples are within the recommended daily allowance for vitamin E which is 15mg/100g. This vitamin was known as a powerful antioxidant that assisted the cells against damage by free radical there by maintaining the normal function of red blood cells and muscles (Lukaski, 2004)

Effects of Pre-and post-processing treatment on mineral elements of oil marinated tomatoes

The minerals under study comprised of five major mineral elements (Ca, Mg, P, Na and K). Generally, fruits are not good sources of calcium. In this study it was found that in both blanched and unblanched marinated tomatoes

there was no significant amount of calcium detected. Generally, the daily allowance for calcium was 1000mg/day for adults and 700mg/day for children. According to Institute of Medicine (2005) it was reported that foods providing 20% or more of the daily values are considered to be high source of nutrients. Therefore, a supplementary source for calcium is necessary to augment this wide gap. Roth and Townsend (2003) reported that calcium and phosphorus are very important in the formation of strong bones and teeth, for growth, normal nerve and muscle action and in cell metabolism.

The phosphorus level was very low when compared to the RDA which is 700mg/day for adults and 1250mg/day for children between the ages of 9 and 18 years, because bone development and formation are rapid at this stage of life (Roth and Townsend, 2003). Consequently, the samples may not be good source of phosphorus. Tomatoes fruits are not good sources of phosphorous as reported by Gopalan *et al.* (2003).

Sodium content was found to be low. The required daily allowance for sodium was 1200mg for children and 2300mg for adult (Institute of Medicine, 2005). Thus, this sample cannot meet the daily allowance and must be supplemented from other dietary sources.

The potassium ion concentrations for control were relatively higher than the blanched and unblanched marinated tomatoes. This concentration was very low compared to recommended daily allowance which is 4700 mg/day for both male and female adults and children between the age of 9 and 13 years are recommended to ingest 4500mg/day, while the daily intake for pregnant women is 4700 mg/day and that of breast feeding women was 5100 mg/day respectively (Institute of Medicine, 2005). In this study, Mg^{2+} was found to be lower both in the fresh and also the oil marinated tomatoes compared to the recommended daily allowance which is 320 mg/day (Institute of Medicine, 2005).

Effect of Pre-and post-processing treatments on lycopene content of oil marinated tomatoes

The average lycopene content of a fresh tomato has been reported at 30 mg/100g (Konuru, 2005). In this study, lycopene was found to have a low content. This variation might be as a result of environmental factors (temperature, light, growing season and location) and the agricultural techniques used in lycopene accumulation (Duman *et al*., 2003; Toor *et al.*, 2006). The lower concentration of lycopene might be due to oxidation, as the main cause of lycopene degradation is oxidation which depend on temperature, moisture and so on (Smith and Hull, 2004). Lycopene content decreased the during storage period for all samples across the weeks for the very reason stated earlier. Lycopene is a powerful antioxidant in maintaining the strength, thickness and fluidity of cell membranes (Jackson, 2007). Lycopene lost is accelerated by high processing temperature. During hot break, the hotter the break temperature the greater the loss of lycopene, even when operating under a vacuum (Toor *et al.*, 2006). Since the tomato was blanched under a high temperature, degradation of lycopene might have occurred. Smith and Hull (2004) reported that heat concentration of tomato pulp can result up to 57% loss of lycopene.

Effect of Pre-and post-processing treatment on pH of oil marinated tomatoes

There was a significant increase in pH of blanched oil marinated tomatoes after week three and a significant increase in pH of unblanched oil marinated tomatoes after week four, this might be as a result of microbial load. High acidity makes the sample resistant to microbial spoilage, decrease in acidity as storage time progresses makes it liable to microbial spoilage (Smith and Hull, 2004). Similarly, the pH values obtained in figure 10 was found to be similar with the report made by Okoronkwo *et al.* (2016).

Conclusion

In this study, the effect of oil marination on nutrient content of fresh tomatoes was studied. Tomato was successfully processed and preserved by oil marination. Although, both the blanched and unblanched oil marinated tomatoes have significant reduction in lycopene, vitamins and mineral elements, except for calcium and potassium ions which were not significantly different from the control samples.

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