Proximate, Mineral and Vitamin Content of Flesh, Blanched and Dried Tomatoes  
(Lycopersicon esculentum)

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ABSTRACT

The experiment was aimed at comparing the effect of preservation methods on proximate, vitamins and mineral composition of fresh, blanched and dried tomatoes. The tomatoes samples were divided into three; fresh, blanched and dried tomatoes. The research was conducted at the Department of Biochemistry, Faculty of Basic Medical Science, Bayero University, Kano, between the month of February 2019 and August 2019. The Proximate Composition was determined using AOAC methods (1975), the Vitamins were determined by (Pearson Chemical methods, 1970), and Minerals using (Atomic Absorption Spectrophotometer). The results of this research revealed the Blanched tomatoes has significant higher (P=.05) percentage moisture (77.58±2.71), however it has the least percentage composition of Crude Protein and Carbohydrate. The fresh tomatoes has the higher composition of crude fibre (17.00±1.87) and crude protein (1.78± 0.13) as compared with the other two samples at (P=.05), while the dried sample has the higher percentage composition of crude fat and Carbohydrate, (8.34±0.84) and (21.77±2.02) at (P=.05) respectively. Vitamin A and lycopene content were found

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to be significantly higher ($P=.05$) in Dried tomatoes, with Vitamin C content of blanched tomatoes been significantly higher ($P=.05$). Mineral analysis indicates that sodium, magnesium, calcium, copper and lead has no significant difference in all the three samples.

**Conclusion:** This study reveals that dried tomatoes are also a good source of Vitamin A, lycopene and other nutrients.

**Keywords:** Tomatoes; minerals; vitamins; lycopene; carbohydrate; fat; fibre.

1. **INTRODUCTION**

Tomato (*Lycopersicon esculentum*) is a fleshy berry regarded as very popular perishable fruit as well as vegetable grown throughout the tropical and temperate regions of the world. The edible part of the fruit is known as the power house of nutrition [1,2]. It makes significant contribution to human nutrition for their content of sugars, acids, vitamins, minerals, lycopene, phytonutrients and other carotenoids [3,4]. It is use as a cathartic for kidney, liver problems and for good digestion [5].

The quality and nutritional value of fresh produce like tomatoes are affected by postharvest handling and storage conditions.

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 [6]. There is an interest in finding ways to improve the shelf life, safe and cost effect methodologies at the same time retain the nutritional quality [7]. Storage and processing technologies have been utilized for centuries to transform perishable fruits and vegetables including tomato into safe and stable products [8]. In some cases, processed food including tomato are said to have same or even higher nutrient content. Among the oldest methods of preservation are drying, refrigeration [9], fermentation as well as the use of use of moist saw-dust [10]. Modern method includes canning, pasteurization, freezing, irradiation and the addition of chemicals [3,5,11] which can sometimes be associated with harmful deleterious effects.

Therefore, the research was aimed at evaluating the effect of home storage and preservation on the physiochemical constituents of tomato in comparison with the fresh counterpart as well as reduce spoilage and maximize profit to farmers. The specific objectives are to determine the proximate composition (carbohydrate, moisture, fibre, protein, ash, fat), mineral (Na, Cu, Ca, Pb, Mg), vitamins (A, C and lycopene) content of fresh, blanched and dried tomatoes.

2. **MATERIALS AND METHODS**

2.1 **Materials**

2.1.1 Sample collection and preparation

A total of three samples of tomatoes were used in this study (fresh, blanched and dried tomatoes). Fresh tomatoes were purchased from Rimi Market, Gwale LGA, Kano State, Nigeria. The blanched tomato was prepared first by washing the fresh tomatoes, after which boiled water ($100^\circ C$) was added to it for 1 min, which were then transferred to ice water for another 1 min, then drained and stored in air tied jars in February 2019. The fresh tomatoes were washed and divided into two parts. One part was blended into paste. While the other was sliced using a sharp knife and was dried in the oven ($82^\circ C$) for 2 hours. After drying, the dried tomatoes were crushed into a powder using a clean mortar and pestle. The powdered sample was then stored at room temperature prior to the research period.

2.1.2 Equipment

The equipment and instrument used in this research are as follows; Glass dishes, crucibles, electric shaker, beakers, filter, oven, desiccator, furnace, volumetric flask, test tubes, measuring cylinder, soxhlet apparatus, digestion apparatus, atomic absorption spectrophotometer, pipette, burette, spectrophotometer, separating funnel, aliquot bottles and conical flask.

2.1.3 Reagents

Some of the reagents used in this research are as follows; sulfuric acid, distilled water, sodium hydroxide, petroleum ether, kjeldahl catalyst mixture, boric acid, methyl red indicator, ethanol, aceton, nitric acid, hydrochloride acid, potassium hydroxide, hexane, xylene and phosphotungstic acid reagent.
2.2 Methods

2.2.1 Proximate analysis

2.2.1.1 Determination of moisture content

A clear, dried aluminum dish was weighed \(W_1\). Grounded sample of 5 g was weighed into each of the dish \(W_2\). The dish was shaken gently to ensure uniform distribution of sample. The dish containing sample was placed in the oven at 100°C for 2 hours, then the dish was move to a desiccator and allowed to cool. The dish containing a dried sample was weighed, \(W_3\) [12].

Calculation

\[
\text{% moisture} = \left(\frac{W_2 - W_3}{W_2 - W_1}\right) \times 100
\]

Where: \(W_1\) = weight of empty aluminium dish, \(W_2\) = weight of aluminium dish and sample before drying, \(W_3\) = final weight of dish and sample after drying.

2.2.1.2 Determination of ash content

A crucible, which have been dried for at least 2 hours at 100°C from oven to desiccator, cooled and its weight was recorded \((W_1)\). 5 g of sample was weighed into the crucible \((W_2)\). The samples were ashed in furnace at 600°C for 2 hours. Crucible was removed from furnace and allowed to cool in a desiccator and weighed, \(W_3\) [12].

Calculation

\[
\text{% Ash (dry basis)} = \left(\frac{W_3 - W_1}{W_2 - W_1}\right) \times 100
\]

Where: \(W_1\) = weight of empty crucible, \(W_2\) = weight of crucible and sample before ashing, \(W_3\) = weight of crucible and ash all in grams.

2.2.1.3 Determination of crude fibre

Sample of 2 g was weighed \((W_1)\) and transferred into filter paper, supported on a filter cone in a 60°C funnel. It was then extracted with three 25 cm\(^3\) portions of ether and vacuum was applied until sample was dried. The extracted sample was transferred quantitatively by brushing into a 600 cm\(^3\) beaker of the fibre digestion apparatus. Sulfuric acid \((200 \text{ cm}^3)\) of 1.25% solution was added. A beaker was then placed on digestion apparatus with pre-adjusted heater and boiled exactly 30 minutes. The beaker was rotated periodically to keep solids from adhering to sides.

The beaker was removed and the content was filtered through California Buckner funnel. The beaker was rinsed with 50-75 cm\(^3\) of boiling water and washed through funnel. This was repeated with three 50 cm\(^3\) portions of water and sucked dry. The residue was returned to beaker by blowing through funnel, 200 cm\(^3\) of boiling 1.25% sodium hydroxide \((\text{NaOH})\) solution was added. It was then returned to heat and boiled for 30 minutes. The beaker was removed and filtered and removed as mentioned earlier. It was then washed with 25 cm\(^3\) of boiling 1.25% sulfuric acid solution followed by 50 cm\(^3\) portion of water and 25 cm\(^3\) of alcohol respectively. The fibre mat and residue were dried at 130°C for 2 hours. It was then cooled in a desiccator and weighed \((W_3)\). It was then ignitned at 600°C to constant weight for about 30 minutes. It was then cooled in desiccator and weighed, \(W_3\) [12].

Calculation

\[
\text{%Crude fibre} = \left(\frac{W_2 - W_3}{W_1}\right) \times 100
\]

2.2.1.4 Determination crude protein

Sample \((0.2 \text{ g})\) was weighed out into digestion tube, Sulphuric acid \((15 \text{ cm}^3)\) of was added. The tube was swirled gently until the sample and the acid were thoroughly mixed. Kjeldahl catalyst mixture of 5 g was added. The solution was heated curiously until it was clear. The temperature was raised and the solution was heated to boil for 2 hours after the solution was cleared. The solution was allowed to cool and it was transferred into 100 cm\(^3\) volumetric flask and diluted to volume with distilled water and mixed thoroughly. This ends the digestion process. For the distillation, 10 cm\(^3\) of 2% boric acid was measured into a 100 cm\(^3\) Erlenmeyer flask then 1-2 drops of mixed indicator was added. Aliquot \((10 \text{ cm}^3)\) of the digest was transferred into a distillation apparatus. Sodium hydroxide \((15 \text{ cm}^3)\) was added into the mixture. The nitrogen distilled into boric acid/indicator flask for at least 10-15 minutes, the condenser tip was then rinsed with distilled water. The distillate was then titrated with 0.025N \(\text{H}_2\text{SO}_4\) to a pink end point and the burette reading was taken [12].

Calculation

\[
\text{% Nitrogen} = \frac{\text{Titre value} \times 0.000056 \times 100 \times 6.25}{\text{Sample weight}}
\]

2.2.1.5 Determination crude fat

Samples \((3.0 \text{ g})\) were wrapped in a clean defatted filter paper and recorded as \((W_1)\),
placed inside an extractor. Petroleum ether (300 cm³) was measured into extraction flask and was connected to the condenser and heated on hot plate for about 3 hours. The heat vaporized the solvent which pass up the arm and was condensed onto the sample. The condensed solvent falls drop by drop to extract the fat content. When it reached the level of siphon height, the condenser containing the wash fat flows down into the extraction flask, it was then re-evaporated leaving the extracted fat behind and this process was repeated until six siphoning were taken. The flask was then removed and the solvent was evaporated. The samples were heated to dryness and transferred in a desiccator to cooled and new weighed is recorded as W₂ [12].

Calculation

\[ \% \text{Fat} = \frac{W_1 - W_2}{W_1} \times 100 \]

2.2.1.6 Determination of carbohydrate

Carbohydrate as nitrogen free extract (NFE) was calculated by difference [12].

\[ \text{NFE} = 100 - (\text{crude protein} + \text{crude fiber} + \text{moisture} + \text{ash} + \text{crude fat}) \]

2.2.2 Mineral element determination

**Digestion:** The ash residues was digested using 5 cm³ of concentrated Nitric acid and then filtered using a filter paper in to 100 cm³ volumetric flask and was diluted to the mark with distilled water. It was then transferred in to sampling bottle, ready for analyses. The procedure was repeated for all other samples.

**Atomic Absorption Spectrophotometer (AAS):** 5 cm³ of 1N Nitric acid (HNO₃) solution was added to the ash contained in the crucible. Evaporation to dryness on a hot plate at a low heat under ventilation was then followed. The sample was then returned to furnace and heated at 400°C for 10 minutes and a perfectly white ash was obtained. The sample was again cooled on top of an asbestos sheet before the addition of 10 cm³ of 1N HCL and then the solution was filtered into 50cm³ volumetric flask. The crucible and the filter paper were washed with additional 10 ml portion of 0.1N HCL three times and the volume was made up to 100 cm³ with distilled water. The filtrate was then stored the determination of sodium, potassium, calcium, magnesium and iron by flame photometry [12].

### 2.2.3 Vitamins determination

#### 2.2.3.1 Vitamin C determination

Accurately 5g of ground sample was dissolved in 500 cm³ of volumetric flask and made up of to the mark and filtered 50 cm³ of this was then pipette into a 100 cm³ volumetric flask. 25 cm³ of 20% metaphosphoric acid was then added and made of distilled water. 10cm³ of the solution was then pipetted into a flask and 2.5 cm³ of acetone was then added. This was titrated with indophenol solution until a faint pink colour persisted for 15 seconds [13].

Calculation

\[ \text{Vitamin C (mg/100cm³)} = \frac{\text{Sample titre (T)}}{\text{Standard titre (S)}} \times \text{Conc. of standard} \]

#### 2.2.3.2 Vitamin A determination

Into a conical flask containing 25 cm³ of 95% of ethanol, 5 g of sample was placed and maintained at a temperature of about 60-80°C in a water bath for about 20 minutes with periodic shaking. The extract was decanted, allowed to cool and its volume was measured by means of measuring cylinder and recorded as initial volume (V₁). The ethanol concentration of the sample was brought to 85% by adding 7.5 cm³ of distilled water. It was further cooled into a container of ice water for about 5 minutes. Into a separating funnel, 12.5 cm³ of petroleum ether (pet ether) were poured and cooled; ethanol extract was added to it. The funnel was swirled gently to obtain a homogenous mixture and latter allowed standing until separate layer were obtained. The bottom layer was run into a beaker while the top layer was collected in 250 cm³ conical flask. The bottom layer was returned to the separating funnel and re-extracted with some of the pet-ether for five to six times until the ethanol extract become fairly yellow. The entire pet-ether extract was collected into 250 cm³ conical flask and returned into the separating funnel for re-extraction with 25 cm³ of 85% ethanol. The final extract (the clear layer) was measured and poured into sample bottle for further analysis.

The absorbance of the extracts was measured using spectrophotometer (spectronic 20). The spectrophotometer was set up to a wavelength of 436 nm and cuvette-containing pet-ether (blank) was used to calibrate to zero point. Sample of each extract was placed in a cuvette and
readings were taken when the figure become steady. The operation was repeated five to six times for each sample and average values were recorded. After the concentration of á-carotene was calculated, the vitamin A (Retinol) was calculated by using the following. Note 6 µg of á-carotene is equivalent to 1µg of retinol equivalent [13].

Calculation

\[ C_x = (A_1 - A_2) \times 22.23 \]

2.2.3.3 Determination of lycopene

Weighed sample of 5.0 g was transferred into 250 cm³ beaker. Subsequently, 50 cm³ hexane-acetone-ethanol mixture (2:1:1 v/v/v) was added into the beaker and shaken for 15 minutes on an electric shaker. Thereafter, 3cm³ of distilled water was added and the sample was shaken for another 5 minutes. The solution was transferred into 250 cm³ separating funnel and allowed to stand for 5 minutes to enable phase separation thereafter the upper layer (hexane) was then collected into an amber screw capped vial. An aliquot of the hexane extract was then transferred into a 1cm³ quartz cuvette and the absorbance taken at 503nm against the solvent-blank using JENWAY (6405) UV Visible spectrophotometer. The lycopene content of each sample was then estimated [14].

Calculation

\[ \text{Lycopene (mg/kg fresh wt)} = \frac{A_{503} \times 137.4}{5.0 \times 172} \]

Where 537 g/mol is the molecular weight of lycopene, 8 ml is the volume of mixed solvent, 0.55 is the volume ratio of the upper layer to the mixed solvents, 5g is the weight of tomato added, and 172 Mm is the extinction coefficient for lycopene in hexane. If 100Ul of tomato juice is analyzed but the volume of mixed solvent used is something other than 8ml, then the lycopene concentration can be calculated by:

\[ \text{Lycopene (mg/kg fresh wt)} = A_{503} \times 17.17 \times V \]

2.3 Statistical Analysis

Statistical Package for the Social Sciences (SPSS) was used for analysis of the results. The results were presented as Mean ± standard deviation. Where \( P=.05 \) was considered to be highly significant.

3. RESULTS AND DISCUSSION

3.1 Results

3.1.1 Proximate composition

There was significant difference \((P=.05)\) in all the parameters analyzed with the exception of the Ash content (Table 1). Fresh tomatoes has significant \((P=.05)\) higher levels of crude fiber and protein \((17.01±1.87a^* \text{ and } 1.78±0.13a^*)\) respectively. Carbohydrate and crude fat were found to be significantly high \((P=.05)\) in the dried sample \((8.34±0.84b,c^* \text{ and } 21.77±2.02b,c^*)\) respectively. The blanched tomato had the significant higher \((P=.05)\) moisture content \((77.58±2.71a,c^*)\), with dried tomatoes having the least moisture content \((62.71±2.36b,c^*)\).

3.1.2 Mineral compositional analysis

There was no significant difference in the levels of mineral elements determined from the fresh, blanched and dried tomatoes (Table 2).

3.1.3 Vitamin composition

The result for vitamin composition is presented in Table 3. Blanched tomatoes had significant level \((P=.05)\) of vitamin C content when compared with the other samples. Dried tomatoes has significant \((P=.05)\) high levels of vitamin A and lycopene content \((4.72±0.03a,b^* \text{ and } 7.72±0.26b^*)\) respectively when compared with the other samples.

Table 1. Percentage proximate composition of fresh, blanched and dried tomatoes

<table>
<thead>
<tr>
<th>Sample</th>
<th>Moisture</th>
<th>Ash</th>
<th>CF</th>
<th>CP</th>
<th>Crude fat</th>
<th>CHO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh</td>
<td>68.03 ± 3.05a,b</td>
<td>0.86 ± 1.15</td>
<td>17.01 ± 1.87a</td>
<td>1.78 ± 0.13a</td>
<td>2.36 ± 0.67a</td>
<td>9.94 ± 3.41</td>
</tr>
<tr>
<td>Blanch</td>
<td>77.58 ± 2.71a,c</td>
<td>0.92 ± 1.31</td>
<td>12.77 ± 2.76b</td>
<td>1.16 ± 0.23a</td>
<td>3.90 ± 0.99b</td>
<td>3.70 ± 2.01a,b</td>
</tr>
<tr>
<td>Dried</td>
<td>62.71 ± 2.35b,c</td>
<td>0.16 ± 0.41</td>
<td>5.60 ± 1.09b</td>
<td>1.40 ± 0.23</td>
<td>8.34 ± 0.84b,c</td>
<td>21.77±2.02a,b</td>
</tr>
</tbody>
</table>

Values are presented as Mean ± Standard deviation, \(n=3\). Values bearing the same superscript in the same column are significantly different \((P=.05)\). CF= Crude fibre, CP= Crude protein, CHO=Carbohydrate
Table 2. Mineral composition of fresh, blanched and dried tomatoes (ppm)

<table>
<thead>
<tr>
<th>Samples</th>
<th>Sodium (Na)</th>
<th>Magnesium (Mg)</th>
<th>Lead (Pb)</th>
<th>Calcium (Ca)</th>
<th>Copper (Cu)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh</td>
<td>1.25 ± 0.50</td>
<td>2.50 ± 1.29</td>
<td>2.00 ± 0.82</td>
<td>2.00 ± 0.82</td>
<td>2.00 ± 0.82</td>
</tr>
<tr>
<td>Blanched</td>
<td>1.75 ± 0.96</td>
<td>2.00 ± 0.82</td>
<td>1.25 ± 0.50</td>
<td>1.25 ± 0.50</td>
<td>2.50 ± 1.29</td>
</tr>
<tr>
<td>Dried</td>
<td>2.50 ± 1.29</td>
<td>1.75 ± 0.96</td>
<td>2.00 ± 0.82</td>
<td>1.75 ± 0.96</td>
<td>2.50 ± 1.29</td>
</tr>
</tbody>
</table>

Values are presented as Mean ± Standard deviation, n=3

Table 3. Vitamin Content of Fresh, Blanched and Dried Tomatoes (µg)

<table>
<thead>
<tr>
<th>Samples</th>
<th>Vitamin A</th>
<th>Vitamin C</th>
<th>Lycopene</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh</td>
<td>3.84 ± 0.49&lt;sup&gt;a&lt;/sup&gt;</td>
<td>7.06 ± 0.05&lt;sup&gt;b&lt;/sup&gt;</td>
<td>7.57 ± 0.20&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Blanched</td>
<td>3.41 ± 0.01&lt;sup&gt;b&lt;/sup&gt;</td>
<td>11.37 ± 0.04&lt;sup&gt;b,c&lt;/sup&gt;</td>
<td>3.09 ± 0.01&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Dried</td>
<td>4.72 ± 0.03&lt;sup&gt;a,b&lt;/sup&gt;</td>
<td>10.70 ± 0.01&lt;sup&gt;b,c&lt;/sup&gt;</td>
<td>7.72 ± 0.26&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Values are presented as Mean ± Standard deviation, n=3. Values bearing the same superscript in the same column are significantly different at P=.05

3.2 Discussion

During processing, there is large fluctuation in the nutrient contents of fruit and vegetables, as it could increase or decrease the bioavailability of some nutrients. The most important post-harvest factors are temperature, atmospheric composition and physical stress [6,15].

Blanched tomato was found to have the highest moisture content than the fresh and dried samples. The result of the present study agreed with the report of [16]. However, high moisture content might makes it more susceptible to deterioration. Pretreatment of tomato before drying improves the quality of the dried tomato and increases its drying rate. The result of the crude protein content in the present study was significantly higher than the content observed in a previous study [17]. This variation could be as a result of treatment, temperature and time which might result in protein denaturation [18].

Mineral contents in fruits and vegetables are very important in providing adequate nutritional needs of the consumers [19]. Emerging research underscores the relationship between consuming tomatoes and tomato products with reduced risk of certain cancers, heart disease, ultraviolet light–induced skin damage, osteoporosis, and other conditions due to the availability of these minerals [20,21].

The result of vitamin A and lycopene content obtained from this study revealed that dried tomato have higher content than those found in fresh and blanched tomato samples. This result was slightly different from the result observed by [22] who found higher lycopene and vitamin C contents in non-blanched tomatoes. The high contents might be as a result of the processing, which according to some studies makes vitamins in fruits and vegetables more bioavailable. In fact, heating can be responsible for increasing in-vivo carotenoid bioavailability by promoting the degradation of carotenoid-associated proteinaceous structures [23] In addition, [24] asserted that lycopene bioavailability in processed tomato products is higher than that in unprocessed fresh tomatoes. These results are consistent with studies on blanching which show the highest average losses of vitamin C for tomatoes, spinach, broccoli and relatively lower amounts for legumes [25]. Studies have shown that destruction of ascorbic acid is directly related with temperature and air [26,27]. Some researches support the common perception that fresh vegetables are often best for optimal vitamin C content, as long as the fresh product undergoes minimal storage at either room or refrigerated temperatures [27]. Blanching and drying process is not as destructive to ascorbic acid, but continued storage and subsequent cooking of fruit and vegetable products result in significant degradation of the vitamins [28].

4. CONCLUSION

Based on this finding, tomatoes can be a significant source of dietary lycopene, vitamin A, C, calcium and fiber. People often regard dried foods as less nutritious but this research reveals that it might not always be true for tomatoes. In addition to the specific nutritional benefits of tomato consumption, encouraging greater tomato and tomato product consumption may be a simple and effective strategy for increasing overall vitamins and lycopene intake.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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