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Comparism of Two Variety of Tomatoes for the Proximate Composition, Anti-Nutrient Composition and Some Minerals

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Abstracts

Tomato fruits are one of the most commonly consumed vegetables worldwide for their health as well as nutritional benefits. However, the fruits contain a lot of water which predisposes them to spoilage by microorganisms that makes its storage and transportation difficult. In the present study, the work was carried out to determine the proximate, Anti-nutritional and minerals composition of two tomato specie namely: cherry tomatoes and plum tomatoes samara Zaria, Kaduna state, Nigeria. Tomato samples were collected from different sales outlets (Kasuwar samaru in Zaria) Kaduna metropolis and were analyzed for proximate, anti-nutritional contents and mineral contents using standard laboratory procedures. This study compared the proximate composition, anti-nutrient composition, and mineral content (iron, calcium, potassium, and phosphorus) of two varieties of tomatoes, cherry, and plum. The proximate analysis revealed that cherry tomatoes had higher protein and fat content, while plum tomatoes exhibited higher carbohydrate levels. In terms of anti-nutrient composition, cherry tomatoes showed slightly higher levels of oxalates, while plum tomatoes had elevated phytate content. When analyzing mineral content, cherry tomatoes displayed higher levels of potassium and phosphorus, whereas plum tomatoes had higher calcium and iron content. These findings underscore the nutritional differences between cherry and plum tomatoes, providing valuable insights for consumers seeking to optimize their dietary intake.

1.0 INTRODUCTION

Tomato (Lycopersicum solanum) is one of the most popular and widely grown vegetable crops in the world with an annual production of more than 120 million tons in the world. It has its origin from South America specifically Peru, Bolivia, Ecuador and Columbia before it was spread around the world following the Spanish colonization of the Americans and its many varieties are now widely grown all over the world (Abdullahi, *et al*., (2016).

Tomato is a major agricultural crop cultivated in Nigeria, especially in the northern parts, it has been reported that over six million tons of tomatoes are produced annually, with about 50 % lost

between rural production and town consumption in the tropical areas. Tomato is a fleshy berry regarded as very popular perishable fruit as well as vegetable grown throughout the tropical and temperate regions of the world. It is typically over 90% water and once they are harvested, they begin to undergo higher rates of respiration, resulting in moisture loss, quality deterioration and potential microbial spoilage. Harvesting itself separates the fruit or vegetable from its source of nutrients. In many cases, fresh tomato has a shelf life of only days before they are unsafe or undesirable for consumption (Martí, *et al.,* (2016).

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

Aim and Objectives

Aim

To compare the proximate analysis, anti -nutrient and some minerals of two variety of tomatoes found in Zaria, Kaduna state.

Objectives

To conduct the proximate analysis of cherry tomatoes and plum tomatoes

To analyze the anti-nutrients composition of cherry tomatoes and plum tomatoes

To analyze some chemicals such as iron, zinc and calcium cherry tomatoes and plum tomatoes

MATERIALS AND METHODS

MATERIALS

Apparatus

Macro kjeldahl digestion apparatus, Automated nitrogen distillation apparatus, Atomic Absorption Spectrophotometer (AAS), UV/Visible Spectrophotometer, Flame Photometer, Burette, Pipette, Oven, Furnace, Soxhlet apparatus, Fiber digestion apparatus, Desiccator, Volumetric flask, Sintered crucible, Porcelain crucible, Conical flask, Weighing balance, Fume hood,Beaker , Wash bottle

Reagents

The following reagents were used for this analysis;

Concentrated H_2SO_4, 40% NaOH, 2% H_3BO_3, Standard HCl solution (0.0190M), Indicator (Methyl red), Catalyst (Mixture of Na_2SO_4 & $CuSO_4$ in the ratio 10:1), KNO_3, Na_2HPO_4, $FeCl_2$,

$CaCl_2$, Ammonium molybdate, Ammonium metavanadate , HNO_3, $FeCl_3$, Ammonium thiocyanide, Hydrochloric acid, Potassium permanganate ($KMnO_4$)

Sample Collection

The samples of two varieties of tomatoes, cherry tomatoes and plum tomatoes were obtained from a farm located at Bassawa. The samples were taken to the laboratory for proximate, anti-nutrient and mineral analysis.

Sample Treatment

The samples were taken to the laboratory for proximate, anti-nutrient and mineral analysis. The samples of cherry and plum tomatoes were washed under a running tap water to remove dirt that must have stocked to the samples.

The sample of the tomatoes varieties (plum & cherry) were cut in pieces, and were divided into two equal parts. One part of each of the sliced tomatoes were blended using a blender and stored in a sample container while the other two parts were cooked at 100°c after which they were blended differently and stored in different sample container. The samples were labeled sample A, sample B, sample C and sample D for cooked cherry tomatoes, cooked plum tomatoes, raw cherry tomatoes and raw plum tomatoes respectively. The samples were reserved for chemical analysis.

Methods

Moisture Content

2g each of the samples was placed into different crucibles that had already been weighed. The crucibles containing the samples were dried in an oven for 24hrs at 105^0C, cooled in a desiccator and weighed.

$$\% \text{ Moisture} = \frac{W-(W2-W1)}{W} \times 100$$

W_1 = the weight in gram of empty crucible

W_2 = the weight in gram of crucible + residue

W = the weight in gram of the sample used

3.2.2 Ash content

2g each of the samples was weighed into different crucibles that had already been weighed, the crucibles containing the samples were ashed in a furnace at $550^0 - 600^0$c for 3 hours. The crucible containing the ash were cooled in a desiccator and weighed.

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

W_1 = the weight in grams of empty crucible

W_2 = the weight in grams of crucible + ash

W = the weight in grams of the sample

Crude Protein

2g each of the samples was placed in deferent digestion tubes, about 5g of catalyst (mixture of Na2S04 and CuSO4 in ratio 5:1) was added to each of the flasks followed by the addition of 25cm^3 Concentrated H_2SO_4. The digestion tubes containing the mixtures were placed on digestion apparatus and heat was supplied below the boiling point of the acid until frothing ceased. The mixtures were allowed to boil vigorously until there was complete oxidation or until the mixtures became digested. The digests were allowed to cool and diluted with distilled water to avoid caking down of the digest. The digests were made up to a known volume in different volumetric flasks with distilled water, an aliquot from the digest was placed in the distillation apparatus and 20cm^3 of NaOH solution (40%) was added. The mixture was heated up as a result of the heat generated from the boiling water from the tank. The liberated ammonia was collected in a boric acid containing few drops of methyl red indicator which changed to yellow color when ammonia came in contact with it. The distillation was continued until twice the initial volume of the boric acid was collected. The distillation was discontinued, the distillate collected was titrated against standard hydrochloric acid solution [0.02M] and corresponding titer values were recorded.

$$\% \text{ Nitrogen} = 14.01 \frac{\times \text{molarities} \times \text{extraction vol.} \times \text{titer value} \times 100}{\text{Aliquots} \times 1000 \times \text{sample weight}}$$

Oil Content (Ether Extract)

2g each of samples was weighed into three different extraction thimbles that were properly labeled, the mouth of the thimbles were plugged with absorbent cotton wool. Clean, dry receiver flasks from the soxhlet assembly were accurately weighed, the thimbles with the sample were inserted into the soxhlets, 250cm^3 of the petroleum spirit was introduced into each of the receiver flask and the apparatus were assembled and placed on an electro- thermal heaters, the clamps were fixed to retort stands, cold water was allowed to circulate through the condensers, the extraction was allowed to last for 7-9hrs after which the extraction was discontinued and the thimbles with material were removed from the soxhlet. The petroleum ether was recovered from the receiver flasks leaving behind the oil. The flasks were cleaned with a dry cloth to remove the film of moisture and dust. The receiver flasks containing the oil were dried in the oven for 30 minutes at 105^{0}c to remove any trace of petroleum spirit that may be present in the flasks, the flasks with the oil were cooled in the desiccator and weighed.

Ether extract % = $\frac{W1-W}{M}$ X 100

Where:

W =Weight of empty oil flask

W_1 = Weight of oil flask after extract

M = Weight of dried material taken

3.2.5 Fiber Content

2g each of the samples was placed into different beakers, 200cm^3 of H_2S0_4 solution (1.25%) was added to the sample in each beaker, the beakers containing the mixture were placed on fiber digestion apparatus, the mixture was refluxed for about 30 minutes after which it was filtered using sintered crucible with the help of suction pump. The residues were washed with hot water to remove completely the acid solution. The crucibles containing the residue were returned into the beakers, 200cm^3 of NaOH solution (1.25%) was added to the beakers containing the residue. The beakers were placed on the fiber digestion apparatus and refluxed for another 30 minutes. The mixture was filtered with the help of suction pump and washed with a very hot water, the residues were washed with acetone to remove any trace of oil and any color pigment that may be present in the residue. The crucibles containing the residue were dried in the oven for 30 minutes at 105^{0}C, the crucibles were then cooled in a desiccator and weighed. The crucibles and their content were ashed in the furnace for 30 minutes at 600^{0}C, cooled in a desiccator and weighed.

Crude fiber = $\frac{100\,(W1-W2)}{W}$

Where:

W_1 = weight in gram of sintered crucible and contents before ashing

W_2 = weight in gram of sintered crucible containing ash.

W = weight in gram of the material used

Carbohydrate Determination

The total carbohydrate in the sample was obtained by calculation using the percentage of dry method of subtracting the percentage sum of food nutrient from 100 as shown below:

% Carbohydrate = 100 - (% Crude protein + % Crude lipid + % C fibre + % Ash + % Moisture Content).

Phytochemical Analysis

Determination of Oxalate

1.0g of the sample material was weighed into 250ml conical flask, 75ml 2.0M H_2SO_4 was added and stirred carefully intermittently with a magnetic stirrer for about an hour and then filtered using whatman No_2 filter paper. 25ml of the filtrate was transferred into a 250ml conical flask and titrated hot against 0.1N $KMnO_4$ solution to the point when a pink color appeared that persisted for 30 seconds.

Oxalate Content (mg/g) = T × 0.225

Phytate Determination

2.0g of the sample material was soaked in 100ml of 2% HCl solution for 3hrs in 250ml beaker. The mixture was filtered using a whatman filter paper No_2, 25ml of the filtrate was transferred in 250ml conical flask, 5ml of 0.3% Ammonium thiocyanide solution was added and 50ml of distilled water was also added. The solution was titrated against 0.1 M Iron III chloride solutions until brownish yellow color that persisted for 5 minutes was obtained.

$$\text{Phytate \%} = \frac{Y \times 1.19 \times 100}{\text{Sample weight}}$$

Where;

Y = (Titer value × 0.00195)

Mineral Analysis

Procedure for Digestion

2g each of the prepared samples were accurately transferred into a digestion tube, 30cm^3 of the acid mixture was added to the samples in the digestion tubes. The digestion tubes containing the mixtures were placed on the digestion block, it was allowed to digest until the brown fume disappeared and the white dense fume of perchloric acid was observed with the total volume of the whole mixture reduced to about 5cm^3. The digestion process was terminated and the digest were diluted with distilled water. The digests were transferred quantitatively into different volumetric flasks of a known volume and were made up to the mark with distilled water. The digests were then transferred into well stoppered rubber containers and made ready for the analysis.

Determination of minerals using an AAS machine

The instrument was connected to the mains and allowed to warm for about 30minutes to attain an electronic working temperature. The wavelength and the bandwidth of the element were set on the

instrument. The burner height and the flame emission sensitivity were set on the instrument. The instrument was adjusted for a maximum indication and zeroed. After the calibration of the instrument, it was then standardized with the various working standards prepared. Thus the instrument was then set for the reading. The unknown samples were then read and the concentrations were recorded.

RESULTS

Table 1: Proximate Analysis of Tomato Species

S/NO	DESCRITION	%DM	%MOIST	%ASH	%OIL	%FIBER	%CP	%NFE
1.0	**SAMPLE A**	10.74	89.26	2.24	1.26	2.10	4.00	1.14
2.0	**SAMPLE B**	10.14	89.86	2.19	1.71	2.75	3.44	2.05
3.0	**SAMPLE C**	14.89	85.11	3.00	1.35	2.98	4.88	2.68
4.0	**SAMPLE D**	16.72	83.28	3.35	1.80	3.45	4.00	4.12

Table 2: Anti- Nutritional composition

S/NO	DESCRITION		(Mg/g) OXALATE	% PHYTATE
1.0	**SAMPLE**	**A**	4.08	2.94
2.0	**SAMPLE**	**B**	5.52	3.10
3.0	**SAMPLE**	**C**	7.51	5.45
4.0	**SAMPLE**	**D**	6.85	6.18

Table 3: Mineral Analysis of Tomato Species

S/NO	DESCRITION		%Ca	%K	%P	%Fe
1.0	**SAMPLE**	**A**	2.92	1.58	0.04	0.24
2.0	**SAMPLE**	**B**	2.00	1.55	0.03	0.29
3.0	**SAMPLE**	**C**	3.86	1.70	0.05	0.26
4.0	**SAMPLE**	**D**	3.73	1.93	0.07	0.30

Key:

Sample A: *cherry tomato cooked*

Sample B: *plum tomato cooked*

Sample C: *cherry tomato raw*

Sample D: *plum tomato raw*

Discussion

In the present study, the result revealed that the investigated nutrients of cherry tomatoes (Solanum lycopersicum var.cerasiforme) were also present in plum tomatoes (lycopersicon esculentum) specie but varied in composition. The moisture content of sample A was 89.26% and sample B 89.86% was higher than the value recorded for raw tomato where sample C was 85.11% and sample D 83.28%. The crude fiber of raw tomato were significantly higher compared to the cooked tomato were sample C tomato was 2.98% (Solanum lycopersicum var.cerasiforme), and the sample D (lycopersicon esculentum) 1.80% and the sample A was 2.10% while the sample B is 2.75%. During cooking, some of the fiber content in the tomato fruit were released in the water which explains the reason for the higher value in raw tomato fruit. Crude fiber protects the body against colon cancer, diabetes and cardiovascular illnesses (Abdullahi *et al.,* 2016). It provides bulk to food to relieve constipation. Fiber in the diet is also important as it helps to maintain human health by reducing cholesterol levels in the body. The ash contest of the raw plum tomato were also significantly higher compared to cooked, were sample C was 3.00%, sample D was 3.35%. The cooked sample A was 2.24% while the sample B was 2.19%. The ash content in the sample indicates the percentage of inorganic minerals present (Cheng *et al.,* 2019). The fat content in raw tomato where higher compared to the boiled were sample C was 1.35%, sample D was 1.80%, the sample A *was 1.26*% while sample B was 1.71%.

The protein content for the plum (Solanum lycopersicum var.cerasiforme) specie were significantly higher than the cherry (lycopersicon esculentum) as sample C had 4.88%, sample A was 4.00% while sample D was 4.00%, sample C 4.88%. Protein is a significant constituent which promote growth in body system and build up the body (Buta *et al.,* 2011). For carbohydrates content sample C was 2.68%, sample D 4.12%, sample B 2.05% and sample A was 1.44% which shows that the raw tomato has a significant high carbohydrate value.

Minerals are considered to be essential in human nutrition. Minerals are vital for the overall mental and physical wellbeing and are important constituents of bones, teeth, tissues, muscles, blood and nerve cells. They help in the maintenance of acid-base balance, response of nerves to physiological stimulation and blood clotting. (Ananou *et al.,* 2017). The calcium content of sample A was 2.92%, sample C 3.86% which is more higher compared to (lycopersicon esculentum) specie which has (lycopersicon esculentum) sample B 2.00% and sample D 3.73% .Calcium is a constituent of bones and helps in muscle contraction, blood clotting and nerve transmission. When the calcium supplied to the body becomes insufficient, the body extracts the needed calcium from the bones. If the body continues to draw more calcium than it replaces over a period of years, the bones will become weak and break easily (Gross, 2016) Tomato fruit contains iron which is an important component of haemoglobin in the red blood cells and myoglobin in the muscle. It helps in the formation of blood and in the transfer of oxygen and carbon dioxide from one tissue to another (Lichtenhaler *et al.,* 2010). The plum tomato had a higher iron concentration were sample B had 0.29 and sample D had 0.30% while sample A was 0.24% and sample C 0.36%. The concentration of phosphorus in cherry tomato was lower than the value of plum tomato were by sample B had 0.03%, sample D 0.07%, sample A was 0.04% and sample C 0.05%. Potassium content of plum tomato was higher

than cherry were sample A had 1.58% sample C 1.70% and sample B 1.55% sample D 1.93%. Potassium is a significant body mineral, important to both cellular and electrical functions. High concentration of potassium in the body was reported to increase iron utilization and was beneficial to people taking diuretics to control hypertension and excessive excretion of potassium through the body fluid (Giovanelli *et al.,* 2010) The raw tomato fruit bpossess higher level of mineral nutrients compared to the cooked

Phytate is a very stable and potent chelating food component that is considered to be an anti-nutrient by virtue of its ability to chelate divalent minerals and prevent their absorption. For this research the phytate content in the boiled tomato was seen to be less as compared to the raw were the sample A was 2.44sample B 3.13% sample C 5.45% sample D 6.18% After cooking the tomato the phytate content is said to reduce because of the effects of heat.

Oxalates can have a harmful effect on human nutrition and health, especially by reducing calcium absorption and aiding the formation of kidney stones. High-oxalate diets can increase the risk of renal calcium oxalate formation in certain groups of people (Martí *et al.,* 2016). For this research the oxalate content of the cooked tomato specie was observered to be lower than the raw tomato specie were sample A was 4.08%, sample B 5.52% and for sample C was 7.51% and sample D was 6.85%. The effect of boiling is very beneficial as it reduces the oxalate concentration in the tomato fruit.

Conclusion

This study indicates that there are significant differences in the proximate and mineral composition of the tomato specie and boiling has a significant effect on these compositions. The fruit of *cherry tomato* are found to be a good source of crude protein, crude fat, crude carbohydrate when cooked, fiber, calcium, iron and potassium which could contribute usefully to the amounts of diet. The *cherry tomato* has a good nutritional profile with high levels of crude protein, crude fat and minerals, whereas plum tomato is high in calcium, iron and carbohydrate and thus is useful to breeders for further improvement. The anti-nutritional contents of *cherry tomato and plum tomato* pods where moderately low meanwhile *cherry tomato* had a more lower anti-nutritional concentration, the effect of boiling was also beneficial as it reduces the anti-nutritional content.

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