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Phytochemical and Proximate Evaluation of Fresh and Spoilt Fruits of Tomatoes (*Solanum lycopersicum* L.) Sold in Five Major Markets in Benin City, Edo State, Nigeria

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ABSTRACT: Tomatoes contribute to healthy, well-balanced diet. They are rich in minerals, vitamins, essential amino acids, sugar and dietary fibres. It contains much vitamin B and C, iron and phosphorus. Tomato fruits are consumed fresh in salads or cooked in sauces, soup and meat or fish dishes. Phytochemical compounds are desirable compounds in our food because of their antioxidant properties. The study of phytochemical and proximate evaluation of fresh and spoilt tomatoes fruits obtained from five markets in Benin City, Edo State, Nigeria was carried out. This aim to investigate the phytochemical and proximate constituents of both fresh and spoilt tomatoes fruit. A total of 400 tomatoes were randomly purchased from the five markets in Benin City, Edo State, Nigeria. In each market, 40 fresh (firm and undamaged) and 40 spoilt (damaged and spoilt) tomatoes were purchased from 10 different sellers. Samples were separately packaged into different sterile containers, labelled, and transported to the laboratory immediately for phytochemical and proximate analysis. The phytochemical and proximate composition analyses were carried out using the official methods of analysis of analytical chemists laboratory procedures. The result shows a significant difference in value of phytochemical and proximate composition in both fresh and spoilt tomato fruits. The value of crude carbohydrate, crude protein, crude fat, saponin, flavonoids and alkaloids were higher in fresh tomato fruits than spoilt fruit while moisture, crude ash, crude fibre, tannins and polyphenols were higher in spoilt tomato fruits than in fresh fruits. This study has shown that spoilage reduces some important phytochemical and proximate constituents of tomato fruits.

Keywords: Phytochemical, Proximate, Tomato fruit, Fresh, Spoilt

Introduction

Tomatoes, *Solanum lycopersicum* L. contribute to healthy, well-balanced diet. They are rich in minerals, vitamins, essential amino acids, sugar and dietary fibres. Tomato contains much vitamin B and C, iron and phosphorus. Phytochemical content of tomato fruits is dependent on both genetic and environmental factors (Davies *et al.*, 2003; Suarez *et al*., 2008; Ilupeju *et al*., 2015). Tomato fruits are consumed fresh in salads or cooked in sauces, soup and meat or fish dishes. The fruit is a fleshy berry, globular to oblate in shape and 2 – 15 cm in diameter. The immature fruit is green and hairy. Ripe fruits range from yellow, orange to red. It is usually round, smooth or furrowed. Carolus Linnaeus in 1753 placed tomato in the genus *Solanum* as *Solanum lycopersicum* L. while Philip Miller in 1763 who was a contemporary of Linnaeus moved it into a new genus, *Lycopersicum esculentum*. The tomato is a fruit with a berry-like endocarp and delicious flesh. It naturally contains high levels of protein, dietary fibre, vitamins, and minerals. It naturally contains high levels of protein, dietary fibre, vitamins, and minerals. It is the second-most important vegetable on the world in terms of the amount of essential nutrients it adds to the diet (Osemwegie, *et al*., 2010).

Tomatoes are prone to deterioration during storage, shipping, and waiting to be processed. The spoilage of tomato fruits lowers the market value and nutritional quality of the product. Pre- and postharvest illnesses, inappropriate handling, and other circumstances can have an impact on the nutritional value and quality of

newly produced tomato fruits (Tandel and Ansari, 2022). In developing countries, the poverty rate is high and several tomato consumers in this country prefer the spoilt tomato because it's cheaper when compared to the price of the healthy tomato fruits. This study aims to comparatively evaluate the phytochemical and proximate composition of healthy and spoilt tomato fruits.

Materials and methods

Collection of samples: An experimental study was carried out by randomly purchasing tomatoes from different sellers at five major markets (Oba, Ogida, New Benin, Oka and Uselu) in Benin City, Edo State, Nigeria. This purchase was done between August and September. A total of 400 tomatoes were randomly purchased from the five markets in Benin City, Edo State, Nigeria. In each market, 40 fresh (firm and undamaged) and 40 spoilt (damaged and spoilt) tomatoes were purchased from ten sellers and two fresh and two spoilt tomatoes each were purchased from them across the five markets. Samples were separately packaged into different sterile containers, labelled, and transported to the laboratory immediately for phytochemical and proximate analyses.

Determination of the phytochemical constituent of the tomato samples

Alkaloids: One gram of the sample was dispersed in 10% acetic acid solution in ethanol to form a ratio of 1:10 (10%). The mixture was allowed to stand for four hours at 28 °C. It was then filtered via Whatman No. 42 grade filter paper. The filtrate was concentrated to one quarter of its original volume by evaporation and treated with drop wise addition of concentrated aqueous ammonium hydroxide (NH_4OH) until the alkaloid was precipitated. The alkaloid precipitated was received in a weighed filter paper, wash with 1 % ammonia solution and dried in the oven at 80 °C alkaloid content was calculated and expressed as a percentage of the weight of sample analyzed.

Flavonoids: Each of the sample weighing 0.5 g was boiled in 50 ml HCl solution for 30 min under reflux. It was allowed to cool and then filtered through Whatman No. 42 filter paper. 2 ml of the volume of the extract was treated with equal volume of ethyl acetate starting with a drop. The flavonoid precipitate was recovered by filtration using filter paper. The resulting weight difference gave the weight of flavonoid in the sample

Tannins: Each of the sample weighing 0.2 g of finely ground sample was measured into a 50 ml beaker then 20 ml 0f 50% methanol was added, covered with paraffin and placed in a water bag at 77- 80 °C for1 h. The mixture was stirred with a glass rod to prevent lumping. The extract was quantitatively filtered using a double layered Whatman No. 1 filter paper into a 100 ml volumetric flask using 50% methanol to rinse. Distilled water was added to make up the 100 ml mark of the volumetric flask and thoroughly mixed. One ml of sample extract was pipette into 50 ml volumetric flask, 20 ml distilled water, 2.5 ml Folin-Denis reagent and 10 ml of 17% Na_2CO_3 were added and mixed properly. Distilled water was added to make up the 50 ml mark on the volumetric flask and was thoroughly mixed. It was allowed to stand for 20 mins until when a bluish-green colouration developed. Standard tannic acid solutions of range 0 – 10 ppm (were treated similarly as 1 ml of sample above. The absorbances of the tannic acid standard solution as well as sample were read after colour development on a spectronic 21D Spectrophotometer at a wavelength of 760 nm.

Percentage tannin was calculated using the formula below:

$$Tannin\ (\%) = \frac{Absorbance\ of\ sample\ \times Average\ gradient\ \times Dilution\ factor}{Weight\ of\ sample\ \times 10,000}$$

Saponin: One gram of finely ground sample was weighed into a 250 ml beaker and 100 ml isobutyl alcohol was added. The mixture was shaken on a UDY shaker for 5 h to ensure uniform mixing. Thereafter, the mixture was filtered through a Whatman No. 1 filter paper into a 100 ml beaker and 20 ml 0f 40% saturated solution of magnesium carbonate ($MgCO_3$) were added. The mixture obtained with saturated $MgCO_3$ was again filtered through a Whatman No. 1 filter paper to obtain a clear colourless solution. Then 1 ml of the colourless solution was pipetted into 50 ml volumetric flask and 2 ml of 5% Iron (III) chloride ($FeCl_3$) solution was added. Distilled water was then added to make up the 50 ml volumetric flask. It was allowed to stand for 30 mins for blood red colour to develop. This was followed by the preparation of 0 – 10 mg/l standard saponin solutions from saponin stock solution. The standard solutions were treated similarly with 2 ml of 5% FeCl solution for all samples. The absorbances values of the sample as well as standard saponin solutions were read after colour development on a spectronic 21D Spectrophotometer at a wavelength of 380 nm.

Percentage saponin was calculated using the formula below:

$$Saponin\ (\%) = \frac{Absorbance\ of\ sample\ \times Average\ gradient\ \times Dilution\ factor}{Weight\ of\ sample\ \times 10,000}$$

Phenols: Two hundred ml of extracted sample, in triplicate, were added to 1 ml of 0.2 N Folin-Ciocalteau reagent and 0.8 ml of 7.5% sodium carbonate solution, mixed well and allowed to stand for 30 min at room

temperature. Absorption at 765 nm was read using a Shimadzu 300 UV-Vis spectrophotometer (Shimadzu UV-1601). Quantification was based on the standard curve generated with 100 – 400 mg/l of gallic acid.

Determination of the proximate values of the tomato samples: These analyses were carried out to determine the percentage moisture content, percentage ash content, crude fibre, crude fat, crude protein and crude carbohydrate. They were determined using the official methods of analysis (AOAC, 2000). The above was determined using the formulas below;

Percentage moisture content:

$$\%\ moisture = \frac{W_1 - W_2}{weight\ of\ sample} \times 100$$

W_1 = weight of crucible + sample; W_2 = weight of crucible + oven dried sample

Percentage ash content:

$$\%\ ash = \frac{weight\ of\ ash}{original\ weight\ of\ sample} \times 100$$

Crude fibre:

$$\%\ Fibre = \frac{W_1 - W_2}{weight\ of\ sample} \times 100$$

W_1 = weight of crucible + sample; W_2 = weight of crucible + oven dried sample

Crude fat:

$$\%\ fat = \frac{W_1 - W_0}{weight\ of\ sample\ taken} \times 100$$

W_1 = weight of oven dried flask + oil/fat; W_0 = weight of dried Soxhlet flask

Results and Discussion

The results of phytochemical and proximate composition are presented in Tables 1 and 2. The results shows that there was a significant difference in the phytochemical and proximate composition of fresh and spoilt tomato fruits obtained from the five markets in Benin City. The percentage concentration of Moisture, crude ash and crude fibre was higher in spoilt tomato fruits when compared with the fresh fruit. Also, the percentage content of crude carbohydrate, crude protein and crude fat was higher in fresh tomato fruits when compared with the spoilt tomato fruit. The phytochemical constituents of fresh and spoilt tomato fruits varied significantly. Tannins and polyphenols where higher in spoilt tomato fruits while saponin, flavonoids and alkaloids were higher in fresh tomato fruits. These significant differences may be due to activities of microbes in the process of decomposition. Ikuomola *et al*. (2015); Garuba *et al*. (2018); Ismail *et al*. (2016) also reported varying values for moisture, ash, carbohydrates, protein, lipid and fibre contents in spoilt and fresh tomato (Table 1).

Table 1: Proximate composition (%) of fresh and spoilt tomato fruits obtained from five markets in Benin City, Edo State (%)

Source (Market)	Moisture		Crude carbohydrate		Crude protein		Crude fat		Crude ash		Crude fibre	
	Fresh	Spoilt	Fresh	Spoilt	Fresh	Spoilt	Fresh	Spoilt	Fresh	Spoilt	Fresh	Spoilt
Ogida	81.20	90.10	13.30	10.20	3.30	2.40	1.50	0.30	3.50	5.30	2.80	4.10
Uselu	75.40	82.00	13.80	8.90	3.16	1.80	2.20	0.70	3.00	4.60	2.60	3.90
Oba	72.40	84.00	15.00	12.50	3.80	1.60	2.10	1.10	2.30	5.00	2.70	4.30
New Benin	92.60	95.10	2.50	0.90	1.70	1.20	1.20	0.40	0.80	2.20	2.60	5.30
Oka	86.80	91.30	10.50	4.8	2.70	1.60	2.60	1.90	3.40	5.30	3.00	6.10

Fruits and vegetables are very important and have high dietary and nutritional qualities. The importance of these fruits with its nutritional and other dietary factors cannot be over emphasized. Its spoilage often results to wastage of economic resources as well as food poisoning, especially, when consumed. Phytochemical compounds are desirable compounds in food because of their antioxidant properties. Flavonoids are not only among common antioxidants in nature, but also those with the highest antioxidant potency *in vitro* (Miller *et al*., 1996). Water in addition to hydrating the body serves also as a thermoregulator and also functions in the fluid balance (Popkin *et al.,* 2010). The low level of ash in fresh tomato fruit may be accrued to the high level of moisture present in the tomato sample (Abdullahi *et al*., 2016). Dietary fibre is a component of food that is indigestible and enhances peristatic movement of bowels. It prevents colon cancer as well as constipation.

Table 2: Phytochemical composition (mg) of fresh and spoilt tomato fruits obtained from five markets in Benin City, Edo State (mg)

Source (Market)	**Tannins**		**Saponin**		**Flavonoids**		**Polyphenols**		**Alkaloids**	
	Fresh	**Spoilt**	**Fresh**	**Spoilt**	**Fresh**	**Spoilt**	**Fresh**	**Spoilt**	**Fresh**	**Spoilt**
Ogida	1.10	1.20	3.30	2.30	7.20	4.50	2.60	3.20	5.10	3.40
Uselu	0.91	1.11	3.32	2.13	7.52	5.10	2.63	3.81	4.80	2.90
Oba	1.12	1.30	3.42	2.43	6.87	3.92	2.45	3.43	5.31	3.70
New Benin	1.00	1.31	3.00	2.10	7.32	4.76	2.57	3.21	5.11	3.23
Oka	1.10	1.34	3.15	2.33	7.23	4.38	2.58	3.12	4.93	3.26

Tomato is a wonder fruit with numerous phytochemicals as well as nutrients indispensable to humans hence there should be public enlightenment on the potential health hazards bedeviling consumption of cheaper spoiled tomato fruits.

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