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Comparative Analysis of Nutritional and Phytochemical Properties of Fresh Tomato, Sundried Tomato and Processed Tomato Paste

Ibitomi O. O.[1], Adefila E. I.[2], Adeyemi C. O.[1], Olaniyi S. S.[3] and Abubakar A.[1]

[1]Department of Biochemical and Chemical Sciences, Federal Polytechnic Offa, Kwara State.
[2]Department of Industrial Chemistry, Kogi State University Kabba, Kogi State.
[3]Department of Science Laboratory Technology, Federal Polytechnic Offa, Kwara State.

Abstract

Tomatoes, *Solanum lycopersicum*, is a significant component of the human diet and the second-highest vegetable consumed and produced in West Africa. It offers a plethora of nutritional and medicinal benefits owing to its rich content of essential vitamins, minerals, phytochemicals, and especially lycopene which helps prevent the development of some cancers. Tomatoes as a major food can be eaten fresh, dried, cooked and processed into a paste, this study aimed to compare the nutritional and phytochemical properties of Fresh tomatoes (FT), Sundried tomatoes (SDT), and three varieties of the same brand of processed tomato paste (Gino Tomato paste, (GTP), Gino Pepper and Onion Paste (GPAOP), Gino Party Jollof (GPJ) from the local market at Owode, Offa, Kwara State to ascertain whether they compare favorably well and are a good substitute. The Proximate analysis involved quantifying key Nutrients such as (Ash, Moisture, Protein, Crude- fibre, Fat, and Carbohydrate) and the qualitative analysis identified Phytochemicals such as (Saponins Alkaloids, Flavonoids, Tannins, Glycosides, and Phenols) in the five samples of Tomatoes. SDT had the highest amount of Saponins of 19.5% while the FT had the least 8.2%. GPAOP has the highest quantity of Alkaloids (53.9%). There was no significant difference in the amount of Flavonoids in the five samples. The highest value of Crude protein (38.28%) was found in the SDT while the GPAOP had a reasonable amount of Crude fat (12.71%) so exceeding others. The results provide scientific evidence about the secondary metabolites and nutritional importance of Tomatoes whether fresh sundried or processed as good substitutes.

Keyword: Tomatoes (*Solanum lycopersicum),* Proximate, Phytochemical Screening, Substitute, Nutrients

1. Introduction

In Nigeria and indeed most parts of Africa, medicinal plants have found a wide range of usage in the treatment of various diseases and also as sources of nutrients. These plants have been in use since time immemorial either solely or in combination with other plants in the traditional medical settings. Some of the medicinal uses of these plants had long been established and known by people, especially those who are in the interior villages with poor medical facilities.

The mechanism by which these plants act is unknown to a layman but is generally based on the phytochemical compositions of these plants. Some plants have a peculiar phytochemical which in

Corresponding Author: Ibitomi O. O.
Email: ibitomioluyemiolasumbo@gmail.com

combination with other phytochemical(s) synergistically triggers metabolic responses (De Kok *et al.,* 2018).

Tomato is one of the major food crops worldwide, representing the second highest produced and consumed vegetable in Western countries (Willcox *et al.,* 2013). Tomato is an annual vegetable commonly consumed in Nigeria. It is a widely distributed crop which can be consumed fresh, dried, cooked or processed into a paste or syrup, otherwise called tomato puree. Tomato crop can grow in several climates and this confers on the crop its ability to survive at various temperatures. More than 30% of global tomato is grown from the Mediterranean (Ahmet and Vedat, 2009). However, a greater percentage also comes from Turkey which is located in the East of the Mediterranean (Ahmet and Vedat, 2009). According to Villanueva (2018), tomato is grown with a view to consuming it fresh or processing it into other forms such as paste or puree. A good number of tomatoes paste products currently sold in Nigeria are mostly supplied from China and other Asian Countries.

Tomatoes have modest to high concentrations of several nutrients. The folate (Vitamin B9) content of tomatoes is similar to the concentrations found in Carrots and Potatoes, and about one-tenth the levels observed in Spinach, so it is one of the sources of this important vitamin useful for cell division and DNA synthesis. Tomatoes are also rich sources of Potassium and vitamin C, compared to carrots, potatoes, or spinach. Vitamin A activity, in the form of Beta-carotene, is substantially lower in tomatoes compared to carrots or spinach (Villanueva, 2018). However, when this modest level of vitamin A activity is combined with the high consumption of tomatoes and tomato juice, these foods are the number four contributors of vitamin A and pro-vitamin A in the U.S. diet. Only liver, carrots, and eggs contribute more total vitamin A activity to the U.S. diet than these tomato products. Using similar calculations, tomatoes and tomato juice are the number three contributor of vitamin C, after orange juice and grapefruit/grapefruit juice, and the number nine contributor of Potassium to the Amer ican diet.

Tomatoes together with their derived products, are one of the major food sources of Carotenoids, providing an estimated 80% of daily intake of Lycopene, folate, ascorbic acid, flavonoids, a-tocopherol (vitamin E) and Potassium in the western diet (Willcox *et al.,* 2003). Several epidemiological studies have underlined the beneficial effect of tomato consumption in the prevention of chronic diseases such as cancer and cardiovascular disease (Giovannucci *et al.,* 2012). This effect has been attributed mainly to the antioxidant activity of tomato phytochemicals, in particular, Lycopene, a very efficient radical quencher capable of fighting reactive oxygen species and thus avoiding cell injury (Riso *et al.,* 2014); however, several other mechanisms of the healthy action of Carotenoids have been suggested (Krinsky and Johnson, 2015). In addition, tomatoes contain many other compounds, such as vitamin C and Phenolics, whose synergistic effects on human disease prevention should be considered (Willcox *et al.,* 2013).

Studies have shown that lycopene from processed tomatoes was better absorbed than lycopene from fresh tomatoes. This suggests that processed tomato products such as tomato paste, tomato sauce, and ketchup are better sources of this antioxidant. It has also been reported that lycopene from tomato paste is 2.5 times more bioavailable in humans than lycopene from fresh tomatoes especially when boiled with oil, a common medium in which tomato is prepared in this region of the world (Ahmet and Vedat, 2009). Recent reports have shown that lycopene helps prevent the development of some cancers, such as Prostate cancer (Anonymous, 1997). This implies that commercially sold processed tomato paste should contain a good amount of this phytochemical which should be able to benefit humans when consumed. Several parameters have been used to assess the quality of tomato paste. These include: The consistency, total solids content, titratable acidity, pH, and levels of sugar (Ahmet and Vedat, 2009, Lu *et al.,* 2014).

Well-structured studies that examined the quality of different tomato brands sold in Nigeria are limited. However, available but unvalidated reports have repeatedly shown that many tomato brands

imported into the country were adulterated with starch and colorants. Umeofia (2016), a leading chief executive in one of the Tomato manufacturing companies in Nigeria, has lamented that the country loses huge sums of money to the importation of fake tomato products. He reported that a good number of tomato products imported into the country from Asia were often adulterated with starch which could have adverse effects on the health of Nigerians. According to Shehu (2013), imported fake and sub-standard tomato products from Asia are now being dumped in Nigeria. He added that tomato sector stakeholders were extremely concerned about the recent importation of colored tomato sauce posing as tomato paste. The activities of unpatriotic marketers conspiring with unethical foreign businesses to import tomato paste into the country that is loaded with starch and treated with food color additives to achieve the deep red color have been blamed for the infiltration of low-quality tomato products. The premium placed by the National Agency for Food and Drugs Administration and Control (NAFDAC) on the scrutiny of drugs imported into the country to the detriment of food and cosmetics has also enhanced the activities of unpatriotic marketers of tomato products (Shehu, 2013).

The importation of fake tomato products is not only a problem in Nigeria. The Ghana Standards Board (Daniela *et al.*, 2015) has reported that most tomato brands sold in Ghana has starch and sugar which have raised eyebrows and safety concerns among the consumers of such products. The reports showed that the products had labels that indicated that they contained modified starch, tomato paste, sugar, and some acidic components, but there were no indications of the relative quantities of those ingredients, a situation that has raised concerns over the quality of the products and the possible health implications related to their consumption. The consequences of consuming fake and substandard products are better imagined than experienced. The effects and several deaths resulting from the "My Pikin teething powder" episode in Nigeria can never be forgotten. The high prevalence of several diseases such as cancer, hypertension, diabetes, cardiovascular disorders, and kidney and liver diseases are evident within the country. Several manufacturers have been forced to close their businesses and companies due to the Nigerians' preference for imported goods even when such products are unhealthy and substandard when compared with locally made products.

Nigeria has the biggest economy in Africa, premised on her economic size and huge population, manufacturers all over the world have hinged on this to bring in several products into the country with a view to increasing sales and making more profit. The desire for imported goods has driven many Nigerians to relegate several locally manufactured products to the background, even when it has been hypothesized that locally made goods were better than imported products. On this account, several manufacturers from across the globe have brought fake and substandard products into the country believing that since most Nigerians prefer cheap products to costlier ones, reducing the quality of such products could attract more purchase and patronage. This has predisposed the nation to become a dumping ground for several sub-standards, fake and unhealthy products. With poor regulatory systems, poor adherence to quality management systems, and porous borders, there is no doubt that it is the responsibility of researchers to assess the quality of several products sold in the nation's markets to generate evidence-based data and information that could help strengthen regulatory agencies, formulate better policies that will benefit the nation, improve public health and quality of life of citizens.

Considering the lack of documented information on the quality assessment of imported and locally produced tomato pastes sold in the Nigerian market, this study was conducted to bridge this gap. The objective of this study was to determine the nutritional and phytochemical parameters contained in selected Tomato samples and determine if there were differences between the selected Fresh tomatoes, Sundried tomatoes, and three varieties of the same brand of tomato paste to ascertain the nutritional and health implication variations in the nutrients of the samples.

2. Materials and Methods

The apparatus used included Erlenmeyer flasks, beakers, test tubes, volumetric flasks, Soxhlet extractors, and rotary evaporators, among others. The chemicals utilized were Acetic acid, Ammonium

Hydroxide, Copper Acetate, Ethanol, Hydrochloric Acid, Methanol, Sodium Chloride, Sulfuric acid, and Petroleum Ether, along with distilled water and other reagents for the experiments.

2.1 Collection and Preparation of Samples

Fresh tomatoes (FT) and three varieties of the Gino brand Tomato paste (i. the Gino Tomato Paste (GTP), ii. the Gino Pepper and Onion Paste (GPAOP), iii. the Gino Party Jollof Paste (GPJ) was obtained from the Owode market in Offa, Kwara State. The fresh tomatoes were cleaned and divided into two parts. One part was blended into a paste and used as a sample for the fresh tomato (FT). The second portion of the fresh tomatoes was sliced using a sharp knife and then put under the sun to dry, after drying, the dried tomato was crushed into a powder using a clean mortar and pestle. The powdered sample was then stored at room temperature and used as the Sundried Tomato sample (SDT). All five tomato paste samples labeled (GTP, GPAOP, GPJ, SDT, and FT) were further dried and evaporated to obtain a (fine powder) which was divided into 3 parts of 30g each. Each part was soaked in ethanol for a period of 48 h respectively. The extracts were then filtered with What-man's filter paper and the filtrates were concentrated at 40 °C using a rotary evaporator, after which the proximate and phytochemical analyses were then carried out.

2.2 Methods

2.2.1 Qualitative and Quantitative Phytochemical Screening of Crude Extracts

Qualitative Phytochemical screening of crude extracts was conducted to detect flavonoids, alkaloids, tannins, glycosides, and saponins using standard methods. Quantitative analysis, using standard procedures, determined alkaloid, flavonoid, saponin, tannin, and glycoside content through solvent extraction, filtration, evaporation, and precipitation. Each phytochemical's percentage was calculated based on the weight difference before and after processing.

2.2.2 Proximate Composition analysis

Proximate analysis of the five samples included the determination of moisture content, ash content, crude protein, crude fiber, and fat content using AOAC methods. Total carbohydrate content was calculated using the equation: total carbohydrate = 100 − (% ash + % moisture + % crude fiber + % crude protein).

3. Result and Discussion

3.1. Result

Table 1 below shows the result for the qualitative analysis indicating the presence of saponins, alkaloids, flavonoids, and phenols in all the five samples. Glycosides and tannins were also present in all the samples except in the Gino pepper and onion paste (GPAOP). While anthraquinone was absent in all the samples except in the sundried tomato (SDT) while Table 2 shows the result of the quantitative result of the five samples. The sundried tomato (SDT) has the highest quantity of saponin and glycoside (19.5% and 7.2%) while the fresh tomato (FT) has the least (8.2% and 0.2%). Gino pepper and onion paste (GPAOP) has the highest quantity of alkaloids and flavonoids (53.9%, 96%), while the remaining four samples have considerably lower amounts.

Table 1 Phytochemical Qualitative Analysis

Phytochemical constituents	Saponins	Alkaloids	Flavonoids	Tannins	Anthraquinone	Cardiac glycosides	Phenols
Gino tomato paste (GTP)	+	+	+	+	-	+	+
Gino pepper and onion paste (GPAOP)	+	+	+	-	-	-	+
Gino party jollof (GPJ)	+	+	+	+	-	+	+
Sundried tomato (SDT)	+	+	+	+	+	+	+

Fresh tomato (FT)	+	+	+	+	-	+	+

Where: Positive (+) = present, Negative (-) = absent

Table 2 Quantitative Phytochemical Analysis

Phytochemical constituents	Saponins	Alkaloids	Flavonoids	Tannins	Cardiac glycosides
Gino tomato paste (GTP)	15.2%	26.4%	91.6%	3.5%	0.6%
Gino pepper and onion paste (GPAOP)	18.3%	53.9%	96.%	0.23%	1.3%
Gino party jollof (GPJ)	9.7%	43.5%	94.6%	16.42%	5.4%
Sundried tomato (SDT)	19.5%	23.4%	95.2%	12.34%	7.2%
Fresh tomato(FT)	8.2%	19.5%	94.5%	3.6%	0.2%

Table 3: Result of the proximate analysis of samples

Proximate composition	Ash %	Moisture %	Protein %	Crude fibre %	Crude fat %	Carbohydrate %
Gino tomato paste (GTP)	0.495	23	27.58	23.8	12.14	12.985
Gino pepper and onion paste (GPAOP)	0.22	21.7	20.56	24.8	12.71	20.01
Gino party jollof (GPJ)	0.124	23.3	15.56	16.6	8.22	36.196
Sundried tomato (SDT)	1.64	5	38.28	3.5	9.9	41.68
Fresh tomato (FT)	0.77	25	37.7	12.25	10.3	13.98

The result of the proximate analysis of the samples in Table 3 above revealed that all the tomato samples contain the required quantity of macronutrients needed for nutritional purposes by human beings.

3.2 Discussion

The proximate results revealed there was not much significant difference in the five samples except the SDT which had a relatively lower moisture content compared to that of the other four samples (GTP, GPAOP, GPJ, FT). The high moisture content of the other four samples can be associated with rapid microbial attack due to abundant water activity. Thus, SDT would have longer shelf lives compared to other samples. Various levels of moisture content for tomatoes have been reported and the results of this study conform with that of Mohammed *et al.,* (2017).

The results showed that there is a generally low percentage of ash content in all of the tomato samples used. The lower content of acid-insoluble ash indicates the presence of a small amount of non-physiological components like silica and silicates whereas the higher content of acid-soluble ash suggests a larger amount of acid-soluble compounds like oxalates, carbonates, phosphates, and oxides, and some minerals. This finding is closely in agreement with the results of Islary *et al.,* (2016) which reported low ash content in the fruits containing salt of metals and trace minerals. The results of the fat, fiber, and protein and carbohydrate contents of tomato fruits presented showed significant differences among the varieties; SDT has the lowest crude fat, this is because it had lower moisture content. There is consistency in the values obtained in this study for the tomato varieties used which conforms with the findings of (Rickman *et al.,* 2010). The outstanding results of the tomato as a source of special nutrients needed in the diet are indicated by the nutritive values. This implies that these tomato varieties may be utilized differently. All five tomato samples are good sources of quality and mineral elements. The variation in the nutritive values of different varieties of tomato used in this study might be due to

the size, shape, aroma, and lycopene contents. Also, the distribution of minerals needed for human health in the fruits can be affected by cultural production methods (Olaniyi *et al.*,2010).

With the phytochemical screening, the qualitative and quantitative determination of the chemical compounds of Tomatoes *Solanum lycopersicum L*. revealed the presence of the following metabolites in the ethanolic extracts (Saponins, alkaloids, flavonoids, tannins, cardiac glycoside, and phenols), bioactive compounds and additionally, the nutritional and medicinal properties.

4. Conclusion

The Proximate and Phytochemical screening showed that the samples of Tomatoes prepared from the fruits of *S. lycopersicum L.* revealed a marked presence of Phenols, Tannins, Carbohydrates, and Flavonoids. The results provide scientific evidence about the positive incidence of the application of the secondary metabolites and nutritional importance. Information obtained was evident that the quality of Fresh tomatoes, Sundried tomatoes, and varieties of processed tomatoes made in Nigeria, compared relatively well to those manufactured and packaged outside the country, despite variations in content between each sample of tomatoes used. There is therefore continuous need to patronize, encourage, and support local manufacturers while tightening regulatory processes in the registration of products imported into the country. This becomes very imperative and should not be compromised if the health, consumer rights, and well-being of the people are to be preserved

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