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Phytochemical Analysis of Some Selected Tomato Products

Musa Ismaila Bunu[1]* HeleneEne Onah[1] Usman Umaru[1], Suleiman Fanika[1]

Department of Chemistry, Federal college of Education, Kontagora, Niger State, Nigeria.

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ABSTRACT
In this study, selected tomato products (Vitali, Tasty-Tom, Derica, L_{77}, and Gino) were subjected to phytochemical analysis to determine the presence and concentration of various phytochemical (vitamin C, beta carotene, lycopene, sugar, and carbohydrates). The lowest lycopene content was found to be 858.5±0.10mg 100^{-1}g in Gino tomato and the highest lycopene content was 1000.5±0.40mg 100^{-1}g in Tasty-Tom tomato (table 3). The beta-carotene content was shown in table 2. The highest value of beta-carotene was found to be 269.06±0.22 mg $100^{-1}g^{in}$Vitali tomato and the lowest value of beta-carotene was 125.40±0.32mg 100^{-1}gfound in Gino. Vitamin C content in Vitali tomatoshowed highest value of 155.75±0.37mg 100^{-1}g,while the lowest vitamin C content is 150.77±0.42mg 100^{-1}gin Gino tomato. However, the concentration of sugar content ranges from 508.70 ±0.76mg 100^{-1}gDerica tomato to 360.16±0.54mg 100^{-1}gin Gino tomato. The Carbohydrate content ranges from 214.41±0.11mg 100^{-1}g in Tasty-Tom tomato to 202.74 ±0.17mg 100^{-1}gin L_{77}. Further studies wererecommended to explore the bioavailability and bioactivity of these phytochemical in the human body and their impact on human health.

KEY WORDS: Phytochemicals, Beta-carotene, Lycopene, Reducing sugar, Carbohydrate

I. INTRODUCTION

Tomato, Solanumlycopersicum, is one of the most important vegetable crops of solanaceae, grown all over the world. Giovannucci E. (1999). Tomatoes and tomato based-products are now being investigated for their potential role in prostate cancer prevention and therapy. Raw and processed tomatoes are among the most commonly consumed vegetables. They are rich in the phytochemicals, carotenoids and polyphenols. Lycopene and quercetin are the most abundant carotenoids and flavonols respectively. Canned tomato sauce is the primary source of lycopene whereas the tomato skin is enriched with flavonols. The health professionals follows-up study found that men who consumed 2 to 4 servings of raw tomatoes per week had a more than 20% reduction in prostate cancer risk compared to men who did not consume tomatoes, studies have already proved that lycopene can boost sperm count by up to 70% as well as conferring other benefits on the male reproductive system. It facilitates the absorption of light during photosynthesis and also provides protection against photosensitization (Stahl W, et al., 1996) Animals including human being, cannot synthesize lycopene therefore, they obtain lycopene exclusively from diet. The fraction of vitamin C in the diet that is absorbed and the rate at which the excess is eliminated from the body vary strongly with the dose. (Venturi et al 2007) suggested that the antioxidant action of ascorbic acid developed first in the plant kingdom when, about 500 million years ago (mya), plants began to adapt to antioxidant mineral deficient fresh waters of estuaries. The name "carotene" was first coined in the early 19th century by the scientist Wachenroder after he crystallized this compound from carrot roots. Beta-carotene is a member of the carotenoids, which are highly pigmented (red, orange, yellow), fat-soluble compounds naturally present in many fruits, grains, oils and vegetables (green plants, carrots, sweet potatoes, squash, spinach, apricots, and green peppers).

Phytochemicals are non- nutritive plant chemicals that have protective or disease preventive properties. There are more than thousand known photochemical. It is well known that plant produce these chemicals to protect itself but recent research demonstrate that they can protect humans against diseases. Some of the well-known photochemical are lycopene in tomatoes, flavones in soy and flavanoids in fruits. (Encyclopediaof life 2023),

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Importance of phytochemicals

Phytochemicals are broken into different classes which are:

Carotenoid: carotenoid are class of phytochemicals with more than 600 naturally occurring pigments synthesized by plants, algae and photosynthetic bacteria, carotenoids are found in the most richly coloured yellow, orange, and red fruits, and vegetables like pumpkin, tomatoes, tangerines, carrots, water melon etc. carotenoid are known for their high antioxidant properties and protective effect against certain cancer like prostrate. Gruszecki Wi et al 1999.

Flavonoids: flavonoids are a class of phytochemicals found in plant pigments that has been said to act as an antioxidant, enhance effects of vitamin c and strengthen cell tissues, one of the most flavonoid is quercetin (quercetin is found in apples, onions, berries etc). Slimestad R et al; 2009.

Mechanism of Action of Tomatoes Phytochemicals:

The mechanism of action of tomato phytochemicals involves their interaction with biological systems and pathways within the body while the specific mechanism can vary depending on the phytochemical involve, the following are some common mechanism through which tomato phytochemicals exert their effects.

Anti-Oxidant Activity: many phytochemicals found in tomatoes such as lycopene, beta-carotene possesses strong anti-oxidant properties. They scavenge and neutralize harmful free radicals which are highly reactive molecules that can damage cells and DNA. By reducing oxidative stress and preventing cellular damage, tomato phytochemicals contribute to the maintenance of cellular health and can help protect against chronic diseases including cardiovascular disease and certain types of cancer. Tinkler et al (1994)

Cell Signaling and Gene Expression:tomato phytochemicals can influence cell signaling pathways and gene expression patterns. They can interact with receptors on cell surfaces or within the cell nucleus, triggering specific signaling cascades that regulate cellular processes, by modulating gene expression, tomato phytochemical can influence the production of proteins cell growth, appotosis (programmed cell death) and immune response. Tinkler et al (1994)

Hormonal Effect: some tomato phytochemicals can mimic or modulate hormone activity within the body. For instance, certain phytochemicals exhibit estrogenic or anti-estrogenic effects, interacting with estrogen receptors and influencing hormonal balance. These effects may have implications such as menopause or hormone dependent cancer. It is important to note that the mechanism of action of tomato phytochemicals are complex and can involve multiple pathways and interactions within the body. The specific effects may vary depending on the type and concentration of phytochemicals consumed as well as individual variation in metabolism and genetic factors. Tan et al (1994)

Importance of Tomatoes

Tomatoes are highly important in various aspect including nutrition, culinary application and potential health benefits, here some key reasons highlighting the importance of tomatoes

Nutritional Value: tomatoes are rich in essential nutrients including vitamins (such as vitamin C,A,&K) minerals(such as potassium) and diatery fiber, they are low in calories and fat while providing a good amount of anti-oxidants, particularly lycopene which is a potent carotenoid with various health benefits.Gester H. (1997)

Eye Health: tomatoes contain important nutrients like vitamin C, vitamin A and lutein, which are beneficial for maintaining healthy vision and reducing the risk of eye disorders like cataracts and age-related macular degeneration (AMD). Lycopene, present in tomatoes has also been associated with a lower risk of developing AMD.Gester H. (1997)

Cancer Prevention:tomatoes contain various phytochemicals including lycopene which have been linked to a lower risk of certain types of cancer. Studies suggest that lycopene may help protect against prostrate, lung, stomach and breast cancers among others. Other compounds present in tomatoes such as flavonoids and vitamin C also exhibit anti-cancer properties. (Levy J,et al . (1995)

Materials and Methods

Tomato Samples Used and pretreatment

Samples used in carrying out this experiment include sachet and tin tomatoes, which include Gino, Derica, Vitali, Tasty-Tom, L_{77}.

CHEMICAL ANALYSIS OF SAMPLES.

Vitamin C content determination

Vitamin C content was carried out using the methods of laboratory technique in food analysis (Pearson, 1976). 1 gram of each sample was weighed out into a clean fest tube and macerated with 20ml of 0.4% oxalic acid and filtered using whatman NO.11 filter paper. Then 1ml of the filtrate was taken into a test tube and 0.2ml of 0.01% methylene blue solution was added. Also 5ml of acetate buffer pH 4.2 was added into the solution and made up to 5ml with

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water. Absorbance was read using spectrophotometer (Spectro 21D). The absorbance read in the spectrophotometer at 550nm.
Concentration of Vitamin C in mg/100ml =Mean of Absorbance x Dilution factor (50)/slope1 g

Beta-carotene content Determination.

This was carried out using basic biochemical methods (Alexander and Griffiths, 1993). 1g of the sample was weighed into a test tube and macerated with 10ml of acetone and hexane in the ratio of 1:1 and filtered using Whatman filter paper NO.11. About 10ml of 50% NH_4SO_4 was added and allowed to settle. Then the upper layer was collected and the absorbance read in the spectrophotometer at 450nm using hexane as blank.
Conc. of Beta-carotene in mg/ml =Mean of absorbance x Dilution factor (50)/slope1 g

Lycopene Content Determination.

Lycopene was determined using the method by (Snell and Snell 1958). 1 g of each sample was weighed out into a clean fest tube and macerated with 20ml of 1% metaphosphoric acid and filtered using Whatman filter paper NO.11.Also, 10ml of metaphosphoric acid was used to wash off. Then the resultant residue was macerated with 20ml of acetone and the absorbance read at 440nm against. Acetone as blank.
Conc. of Lycopene in mg/100ml =Mean of Absorbance X Dilution factor (50)/slop 1 g

Reducing sugar content determination

1g of the sample was weighed and Macerated with 20ml of distilled water and filter. 1ml of the filtrate was Pipetted and 1ml of alkaline copper reagent was added to it. It was boiled for 5minutes and cool. 1ml of phosphomolybdic acid reagent wasadded and 7ml of distilled water was alsoadded. Measure the absorbance at 420nm

Soluble Carbohydrate content determination

1g of the sample was weighed and Macerated with 50ml of distilled water and filtered using Whatman filter paper NO.11. 1ml of the filtrates was Pipetted and 2ml of saturated aqueous picric acid was also added. The absorbance at 530nm was taken.

II. RESULTS

Table 1: Concentration of vitamin C content in different Tomato Product

sample code	**vitamin C** mg 100^{-1}gRDA mg/day
A	155.75±0.37
B	153.75±0.3690 [https//www.ncbi.nml.nih.gov>NB…]
C	151.78±0.44
D	150.77±0.42
E	154.15±0.36

A= Vitali, B=Tasty-Tom, C= Derica, D= Gino, E= $L_{77.}$

RDA= Recommended Diatry Allowance

Table 2: Concentration of beta-carotene content in different Tomato Product

sample code	**beta-carotene** mg 100^{-1}g RDAmg/day
A	269.06±0.22 15-180[https//www.webmd.com>beta-car]
B	269.06±0.35
C	268.56±0.28
D	125.40±0.32
E	268.46±0.19

A= Vitali, B=Tasty-Tom, C= Derica, D= Gino, E= $L_{77.}$

RDA= Recommended Diatry Allowance

Table 3: Concentration of lycopene content in different Tomato Product

sample code	**lycopene** mg 100^{-1}g RDA (mg/day)
A	919±0.10 8-21. [https//www.healthline,com>lyco…]
B	1000.5±0.40
C	908.5±0.20
D	858.5±0.10
E	918±0.11

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A= Vitali, B=Tasty-Tom, C= Derica, D= Gino, E= L_{77}. RDA= Recommended Diatry Allowance

Table 4; Concentration of reducing sugar content in different Tomato Product

Sample code	**Reducing sugar** mg 100^{-1}g	RDAmg/day
A	496.49 ±0.73	30 g adult [https//www.nhs.uk>food-types]
B	361.76±0.54	24 g children
C	508.70 ±0.76	
D	360.16±0.54	
E	495.89 ±0.74	

A= Vitali, B=Tasty-Tom, C= Derica, D= Gino, E= L. 77. RDA= Recommended Diatry Allowance

Table 5: Concentration of carbohydrate content in different Tomato Product

Sample code	**Carbohydrate** mg 100^{-1}g	RDA mg/day
A 211.81 ±0.10 [https//www.nap,nationalacademies.org/read/11767/chapter/9]		
B	214.41±0.11	130
C	203.30 ±0.15	
D	206.24±0.12	
E202.74 ±0.17		

A= Vitali, B=Tasty-Tom, C= Derica, D= Gino, E= L_{77}, RDA= Recommended Diatry Allowance

III. DISCUSSION OF RESULTS

Vitamin C content in vitalitomatoshowed highest value of 155.75±0.37mg 100^{-1}g,while the lowest vitamin C content is 150.77±0.42mg 100^{-1}gin Gino tomato (table 1).The whole of the samples has high concentration of vitamin c and are above the RDA value of 90 mg/day. The beta-carotene content was shown in table 2. The highest value was found to be 269.06±0.22 mg 100^{-1}gin Vitali tomato and the lowest value of beta-carotene was 125.40±0.32mg 100^{-1}gfound in Gino the RDA value is 180 mg/day. Therefore, the concentration in Gino cannot provide the daily needed beta-carotene. The lycopene and beta-carotene varied significantly among tomatoes. The lowest lycopene content was found to be 858.5±0.10mg 100^{-1}g in Gino tomato and the highest lycopene content was 1000.5±0.40mg 100^{-1}gin Tasty-Tom tomato (table 3) These contents can provide the daily needed lycopene (130mg/day). However, the concentration of sugar content ranges from 508.70 ±0.76mg 100^{-1}g Derica tomato to 360.16±0.54mg 100^{-1}gin Gino tomato as shown in (table 4), The reducing sugar is too high. The RDA for adult person is 30 mg/g and 24 mg/day for children. The RDA for carbohydrate is 130 mg/day. The carbohydrate content was shown in table 5. The content ranges from 214.41±0.11mg 100^{-1}g in Tasty-Tom tomato to 202.74 ±0.17mg 100^{-1}gin L_{77}. However, the products have enough carbohydrate that can provide the daily requirement but it is too high.

IV. CONCLUSION

Therefore, the phytochemical analysis of selected tomato product has provided valuable insights into the bioactive compounds present in these products and their potential health benefits. In conclusion, the phytochemical analysis of selected tomato products underscores the nutritional significance of tomatoes as a valuable source of beneficial bioactive compounds. Incorporating tomatoes and tomato-based products into a balanced diet can contribute to overall health and well-being.

The analysis revealed that tomatoes and tomato-based products are rich source of lycopene a powerful anti-oxidant and carotenoid responsible for the characteristics red colour of tomatoes and has shown its potential in reducing the risk of certain types of cancers particularly prostate cancer and its role in protecting against cardiovascular diseases. The concentration of lycopene was found to be higher in processed tomato products like tomato paste and tomato sauce compared to fresh tomatoes. Additionally, the presence of vitamin C contributes to their anti-oxidant properties and overall nutritional value.

V. RECOMMENDATION

- Due to the importance of tomatoes in human diet, it is recommended to consume 400-500grams daily, 140kg to 150kg per year of various tomatoes including 25kg to 32kg of tomatoes, the nutritional value, colour, and flavor of tomatoes and tomato-based products depend mainly on lycopene, beta-carotene, and

sugar. In order to increase the amounts of these content (lycopene and beta-carotene) in tomatoes, it is recommended to evaluate and investigate the influence of tomatoes genotypes on carotenoid accumulation.

- Further studies are warranted to explore the bioavailability and bioactivity of these phytochemicals in the human body and their impact on human health.
- Further research should be carry-out so that the interactions between different phytochemicals and their potential synergistic effects are fully understood and the health implications of consuming tomatoes.

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