BERKELEY PUBLICATION
AND RESEARCH INTERNATIONAL
12.31.2020
Journal of Med., Biological and Pharm. Sci. Vol. 14 No. 3

ANTI-OXIDANT, MINERIAL NUTRIENT AND PHYTOCHEMICAL ANALYSIS OF NIGERIA GROWN RIPE AND UNRIPE TOMATO (Solanum esculentum) COLLECTED FROM SANGO MARKET, SAKI, OYO STATE

***IMRAN, MUSAH OLALEKAN, *LAWAL, ISMAIL AJEROGBA, *AZEEZ, GAFAR OLATUNJI AND **OLAGOKE, HALIMAH BUKOLA**

**Science Laboratory Technology Department, the Oke-Ogun Polytechnic, Saki. Oyo State. **Lautech Open and Distance Learning Centre, Ladoke Akintola University (LAUTECH), Ogbomoso, Oyo State.*

ABSTRACT

Tomato is important source of antioxidants such as polyphenols, ascorbic acid, tocopherols, Beta-carotene and lycopene which are not compulsory in diet but, when present in sufficient level, prevent chronic disease through the inhibition of the harmful effects of free radicals. Tomato can provide an important proportion (85%) of antioxidants in the human diet through carotenoids and phenolic compounds. Mineral Nutrients and Phytochemical composition of ripe and unripe tomatoes were investigated in accordance with standard procedure, as this is the aim of this work. Fresh Tomato (Solanum esculentum) of both ripe and unripe was properly

Introduction:

Tomato (Solanum esculentum) is a diploid plant with 24 chromosomes, belongs to the diverse family Solanaceae, which includes more than 3000 species, including plants of economic importance such as potatoes, eggplants, tobacco, petunias and peppers, occupying a wide variety of habitats (Fauquet 2003). Tomatoes were originating from the Andes, imported to Europe in the 16th century (Peralta 2001)

ISSN: 1211-4401

collected into a polythene bag from Sango market in Saki, Saki-west Local Government of Oyo State. Mineral concentrations were determined by using Atomic Absorption Spectrophotometer. The Mineral nutrients revealed high concentration of Cu (6.43±1.00) and (11.53±1.00) compare to Fe, Pb, Cd and Zn. The antioxidant composition values of unripe tomato are vitamin C (45.58±1.00), vitamin A (0.42±1.00), Beta-carotene (18.74±1.00), and Lycopene (6.36±1.00). For ripe tomato are vitamin C (26.83±1.00), vitamin A (2.33±1.00), Beta-carotene (7.01±1.00) and Lycopene (31.67±1.00). The aqueous extract and Ethanolic extract prepared from both ripe and unripe tomato showed qualitatively a marked presence of Alkaloids, Flavonoids, Steroid, Tannins, Terpenoids, Saponnins, Anthraquinone, Glycoside and Reducing sugar in ripe tomato and shows little difference in unripe tomato. The results of analysis revealed those phytochemicals that are of high antibacterial properties and pronounced antioxidant.

Keywords: *Tomato, Anti-oxidant, Phytochemicals, Vitamins, Minerals, Atomic Absorption Spectroscopy*

and introduced to North America from Europe. Thomas Jefferson is known to have raised them at Monticello in 1781. The tomato was used for food in Louisiana as early as 1812, but not in the north eastern states until about 1835. The natural geographic distribution or Centre of origin of Solanum lycopersicum, has been localized in the narrow band between the Andes mountain ranges and the Pacific coast of western South America. The top 5 largest tomato producers are: China, EU, India, US and Turkey. They account for 70% of global production, cultivated with 4.7 million hectares and production of 163 million tons, (Sato, 2012).

The fruits are commonly eaten raw in salads, served as a cooked vegetable, used as an ingredient of various prepared dishes and pickled. Additionally, a large percentage of the world's tomato crop is used for processing; products include canned tomatoes, tomato juice, ketchup, puree, paste, and "sun-dried" tomatoes or dehydrated pulp. Tomato is a perennial herbaceous plant but it is often grown as an annual crop even if biennial

and perennial forms exist. It is cultivated in tropical and temperate climates in open field or under greenhouse in temperate climate. Tomato is important source of antioxidants such as polyphenols, ascorbic acid, tocopherols, Beta-carotene and lycopene which are not compulsory in diet but, when present in sufficient level, prevent chronic disease through the inhibition of the harmful effects of free radicals (Berdanier 1997). Tomato can provide an important proportion (85%) of antioxidants in the human diet through carotenoids and phenolic compounds (Bender, 2003).

The most important natural antioxidant present in tomato is lycopene which represents 90% of the total carotenoids and which is responsible for the deep red colour of ripe tomatoes and their derived products . The dietary intake of lycopene has been reported to be associated with decreased risk of cancer and cardiovascular diseases (Franke et al., 2004). The lycopene from tomato is highly available source since, in contract with other phytonutrients, does not decrease by tomatoes processing, but rather significantly increase. Moreover the bioavailability of lycopene in heat processed tomato products is higher than in fresh tomato. Tomato has a high content of water (94.52%) and a low caloric value (18kcal $100g^{-1}$) but it is a good source of vitamin (A, C, K, E and B complex) and minerals (K,P,Mg, Ca, Fe, Na, and Zn) (USDA National Nutrient Database for Standard Reference 2016). It is an excellent source of vitamin A and C and also called as poor man's orange (Maqbool et al., 2008). In addition, tomato serves as an excellent model system for plant genetics and biology, including fruit biology, abiotic stress tolerance, and plant-microbe interactions. Development and practical use of molecular markers have been actively pursued in molecular breeding programs for tomato, especially for disease resistance to allow selection of a single resistance gene and combination of multiple resistance genes. Due to insufficient genetic variation in cultivated tomatoes, various wild relatives of tomato have been investigated and utilized as disease resistance sources (Peralta 2001). Economically speaking, tomatoes are worth a tremendous amount of money because, their high yield, short duration crop, they are very well suited for different cropping systems that are used on grains and legumes and also have very

high nutritional value as well as being ranked first on their nutritional contribution to a humans' diet (Van Montage et al., 2000).

Lycopene is a bright red carotenoids pigment and phytochemicals found in tomatoes and other red fruits. Fruits and vegetables that are high in lycopene include gac, tomatoes, watermelon, pink grapefruit, pink guava, papaya, red bell pepper, sea buckhorn, wolfberry (goji, a berry relative of tomato), and rosehip. Tomato (Lycopersicum esculentum) representing Solanaceae family is one of the most popular vegetable crops (Combs. 2007). Lycopene in fresh tomato fruits occurs essentially in the all-trans configuration. Isomerization converts all-trans isomers to cis-isomers due to the additional energy input and results in an unstable energy-rich state. The bioavailabity of lycopene is influenced by many factors including isomerization. In fact, several research groups have suggested that cis isomers of lycopene are better absorbed than the all-trans form (Redenbaugh et al., 1992).

Carotenoids are natural pigments, providing orange, yellow, red and purple colours throughout the natural world. The main tomato carotenoids are lycopene and carotene; while lutein and phytoene are present in lower quantities. Carotene is the precursor of vitamin A and makes up approximately6%oftomato carotenoids content (Franquet. 2003).

Phytochemicals are non-nutritive components present in a plant-based diet ('phyto' is from the Greek word meaning plant) that exert protective or disease-preventing effects. They have been associated with protection from and/or treatment of chronic diseases such as heart disease, cancer, hypertension, diabetes and other medical conditions (Bailey et al., 2012).

Mineral Nutrients Tomato requires at least twelve nutrients, also called "essential elements", for normal growth and reproduction. These are nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), sulfur (S), boron (B), iron (Fe), manganese (Mn), copper (Cu), zinc (Zn), and molybdenum (Mo) without these nutrients, tomato cannot grow properly or bear fruits. For instance, N is an essential component of many compounds, including proteins, amino acids, and enzymes responsible for biochemical changes in tomato growth (Manso et al., 2001). While some

nutrients, such as N, P, K, Ca, Mg, and S (also called macronutrients), are needed in large amounts for optimum production because the concentration of these nutrients are higher than other nutrients in tomato others, such as B, Fe, Mn, Cu, Zn, and Mo (also called micronutrients), are needed in small amounts. Because soil cannot supply adequate amounts of N, P, and K for optimum growth and production of tomato, these nutrients are added as amendments in the form of manures and fertilizers to the soil (Bharat Singh et al., 2003).

Fig 1.0: Ripe and unripe Tomato (Solanum esculentum)

Vitamins are classified as either water -soluble or fat-soluble. In humans there are 13 vitamins: 4 fat-soluble (A, D, E, and K) and 9 water-soluble (8 B vitamins and vitamin C). Water-soluble vitamins dissolve easily in water and, in general, are readily excreted from the body to the degree that urinary output is a strong predictor of vitamin consumption (Tanumihardjo 2011). Because they are not as readily stored, more consistent intake is important. Fat-soluble vitamins are absorbed through the intestinal tract with the help of lipids (fats). Vitamins A and D can accumulate in the body, which can result in dangerous hyper vitaminosis.

Collection of the Sample

Fresh Solanum esculentum of both ripe and unripe were properly collected into a polythene bag from Sango market in Saki, Saki-west Local

Government of Oyo State. Samples were taking into the laboratory, rinsed with distilled water and blended using mortar and pestle and then filtered into a cleaned test tube. To 50 ml each of the samples juice (filtrate) 100 ml of 70% of ethanol was added into a cleaned beaker for 24 hours. Then the second extract was done using 100% distilled water also for 24 hours, then filtered into a cleaned test tube before the phytochemicals test.

RESULTS AND DISCUSSION

Table1.0 Results of Phytochemicals test of both Aqueous and Ethanolic extracts of ripe and unripe tomatoes (solanum esculentum) Juice.

Phytochemicals	A1	A2	B1	B2
Steroids	+	+	+	+
Flavonoids	+	+	+	+
Saponnins	+	+	+	+
Tannins	+	+	+	+
Alkaloids	+	+	+	+
Terpenoids	+	+	-	-
Phlobatannin	-	-	-	-
Glycosides	+	+	-	-
Reducing sugar	+	-	+	-
Antraquinone	+	-	-	-

KEY: A1 is Ethanolic extract for ripe tomato (+) indicate present
A2 is Ethanolic extract for unripe tomato (-) indicate absent
B1 is aqueous extract for ripe tomato
B2 is aqueous extract for unripe tomato

The above result shows the presence of steroid, Flavonoids, saponnins, anthraquinone, alkaloids, terpenoids, reducing sugar, tannin and glycosides in sample A1(Ethanolic extract for ripe tomato) and no indication of phlobatanin. The Ethanolic extract of unripe tomato (Solanum esculentum) showed the presence of steroid, Flavonoids, alkaloids, saponnins, terpenoids, tannin and glycosides i.e A2.The

indication of phlobatannin, reducing sugar and anthraquinone were not recorded.

The Aqueous extract of ripe tomato (S. esculentum) (B1) phytochemicals analysis showed the presence of steroid, Flavonoids, saponnins, alkaloids, reducing sugar and tannin. The phytochemicals analysis result showed absence of terpenoids, phlobatannin, anthraquinone and glycosides. The Aqueous extract of unripe tomato(B2) phytochemicals analysis result shows the presence of steroid, Flavonoids, saponnins, alkaloids and tannin. While there was no result of terpenoids, phlobatannin, reducing sugar, anthraquinone and glycosides in B2.

Table2.0. Minerals (mg/kg) determined in ripe and unripe tomato(S. esculentum) samples.

Sample	Fe	Zn	Pb	Cu	Cd
RT(mg/kg)	1.01±1.00	1.33±1.00	0.00±0.00	6.43±1.00	0.06±0.00
UT(mg/kg)	1.21±1.00	1.62±1.00	0.00±0.00	11.53±1.00	0.09±0.00

KEY: RT- means Ripe Tomato. UT- Means Unripe Tomato

From the table above, **Iron (Fe)** concentration for ripe tomato sample(RT) was 1.01±1.00mg/kg and unripe tomato(UT) was 1.21±1.00mg/kg. These results showed that unripe tomato has the highest concentration of iron compared to the mean value of ripe one. The permissible limit of iron is 0.3mg/kg according to World Health Organization. The results showed that the iron content in both samples was a bit above the permissible limit. Iron present in tomato helps in increasing the red blood cells and aids in circulation throughout the body.

Zinc(Zn) The zinc concentrations of ripe tomato sample (RT) revealed1.33±1.00mg/kg and unripe tomato sample (UT) was 1.62±1.00mg/kg. This shows that unripe tomato has the highest concentration of zinc as compared to the mean value of ripe tomato. Permissible limit of zinc sets by the WHO was 5mg/kg. The results showed that the zinc content in both samples is minute compared to the permissible limit of zinc.

Lead (Pb) was not detected in the samples. Lead is very toxic and has chronic health implication even at low concentration and the needs it in trace amount. The permissible limit of lead is 0.1mg/kg (according to WHO).

Copper (Cu) concentration for ripe tomato sample (RT) is 6.43±1.00mg/kg and unripe tomato (UT) is11.53±1.00mg/kg. The result shows that unripe tomato has the highest concentration of copper compared to the mean value of ripe tomato.

Cadmium (Cd) for ripe sample (RT) the value is 0.06±0.00mg/kg and unripe tomato (UT) is 0.09±0.00mg/kg. This result shows that unripe tomato has the highest concentration of cadmium compare to the ripe tomato. Permissible limit of cadmium is 0.06mg/kg according to WHO. The value of cadmium in ripe tomato is found within limit and that of the unripe tomato is insignificantly above the limit. Excess cadmium may cause lung damage. This is one of the disadvantages of taking unripe tomato. The results of this analysis showed that ripe tomato is the best for human consumption as compared to standard set by the World Health Organization (WHO).

Table 3.0. Results of antioxidants (mg/kg) present in the ripe(RT) and unripe(UT) tomato (S. esculentum) samples.

Sample	Vitamin C	Beta(β) Carotene	Lycopene	Vitamin A
RT	26.83±1.00	7.01±1.00	31.67±1.00	2.33±1.00
UT	45.58±1.00	18.74±1.00	6.36±1.00	0.42±0.01

The vitamin C concentration for ripe (RT) tomato is 26.83±1.00 mg/kg and unripe tomato 45.58±1.00 mg/kg. This result shows that unripe tomato has the highest concentration of vitamin C compared to the mean value of ripe tomato. Vitamin C is very essential for human nutrition and proper functioning of the body according to Benzie 1999.

The vitamin A concentration for ripe (RT) tomato is 2.33±1.00 mg/kg and unripe tomato (UT) is 0.42±0.01 mg/kg. From the result it shows that ripe

tomato has the highest concentration of vitamin A compared to unripe tomato, this helps in proper muscle growth and repairing the damaged skin cells.

The Beta-carotene concentration for ripe (RT) and unripe tomato (UT) ranges from 7.01±1.00 mg/kg to 18.74±1.00 mg/kg. The result showed that unripe tomato possessed the highest concentration of Beta-carotene compare to ripe tomato. The permissible limit of beta-carotene is 4 mg/day.

The lycopene concentration for ripe (RT) is 31.67±1.00 mg/kg and unripe tomato (UT) is 6.36±1.00 mg/kg. The ripe tomato has the highest concentration of lycopene compared to unripe tomato. On comparing this value with recommended value by the WHO, it is safe for consumption. Lycopene contributes to colour change of tomato. High consumption of lycopene can significantly reduce the risk of any type of cancer (singh et al., 2015).

CONCLUSION

The results of analysis revealed those phytochemicals that are of high antibacterial properties and pronounced antioxidant so, it can be concluded that consumption of ripe tomatoes on daily basis is encouraged.

RECOMMENDATION

As am recommending the intake of fresh, ripe tomatoes on a daily basis, Government and experts should encourage the production of this fruit to make it available at anytime. Further research is recommended for the isolation of those phytochemicals and other minerals in the result of this analysis.

REFRENCES

Bailey R.L, Fulgoni V.L, Keast DR, Dwyer J.T (May 2012). Examination of Vitamin intakes among US adults by dietary supplement use. J Acad Nutr diet. 112 (5): 657–663.e4.doi: 10.1016/j.jand.2012.0-1.026. PMC 3593649, PMID 22709770.

Bender D.A. (2003). Nutritional biochemistry of the vitamins. Cambridge, U.K.: Cambridge University Press. ISBN 978-0-521-80388-5

Berdanier C (1997). Advanced Nutrition Micronutrients. CRC Press. pp. **22–39**. ISBN 978-0-8493-2664-6.

Combs GF (2007). The Vitamins Elsevier. ISBN 9780080561301. Comparison of Vitamin Levels in Raw Foods vs. Cooked Foods. Beyondveg.com. Retrieved on 2013.

Dietary Reference Intakes (DRIs) Food and Nutrition Board, Institute of Medicine, National Academies

Fauquet A. (2003). Encyclopedia of life. Phylogenetic analyses have established that the formerly segregate genera Lycopersicon, Cyphomandra, Narmania, Triguera are nested with in Solanum, and all species of these four genera have been transferred to Solanum "Solanum lycopersicum Tomato. Retrived 2014.

Franke, A.A., Custer, L.J. Arakaki, C. and Murphy, S.P. (2004). Food Compos. Analysis Vitamin C and flavonoid levels of fruits and vegetables consumed in Hawali. J., **17**: 1-35.

Fukuwatari T, Shibata K June (2008). "Urinary water-soluble vitamins and their metabolite contents as nutritional markers for evaluating vitamin intakes in young Japanese women". Journal of Nutritional Science and Vitaminology. 54 (3): 223–9 doi: 10.3177/jnsv.54.223

Institute of Medicine (1998)."Niacin" . Dietary Reference Intakes for Thiamin, Riboflavin, Niacin, Vitamin B6, Folate, Vitamin B12, Pantothenic Acid, Biotin, and Choline. Washington, DC: The National Academies Press. pp. 123–149. ISBN 978-0-309-06554-2. 2018.

Jessica K. Campbell, Kirstie Canene-Adams , Brian L. Lindshield, Thomas W.-M. Boileau, Steven K. Clinton , john W. Erdman, The Journal of Nutrition, Volume 134, Issue 2004, Pages 3486S–3492S, https://doi.org/10.1093/jn/134.12.3486S published: 2004

Manso, M.C., F.A.R. Olivera and J.M. Frias, (2001). Effect of ascorbic acid supplementation on orange juice shelf life. Acta Hortic., **566:** 499-504.

Maqbool A, Stallings VA (2008). "Update on fat-soluble vitamins in cystic fibrosis". Current Opinion in Pulmonary Medicine. 14 (6): 574–81. doi: 10.1097/MCP.0b013e3283136787 PMID 18812835.

Peralta, I. E.; Spooner, D.M.(2001). American journal of Botany. Granule –bound starch synthase (GBSSI) gene phylogeny of wild tomatoe (Solanum L. section Lycopersicon Mill) Wettst. Subsection Lycopersicon". **88** (10): 1888-1902. doi: 10.2307/ 3558365 JSTOR 3558365 PMID. 21669622.

Redenbaugh, K.; Hiatt, B.; Martineau, B.; Kramer, M.; Sheehy, R.; Sanders, R. Houck, C. Emlay, D.(1992). Safety Assessment of Genetically Engineered Fruits and vegetables: A Case Study of the Flavr Savr Tomato. CRC Press. P. **288**.

Sato, S.; Tabata, S.; Hirakawa, H.; Asamizu, E.; Shirasawa, K.; Isobe, S.; Kaneko, T.; Nakamura, Y.; Shibata, D. 2012. 'The tomato genome sequence provides insights into fleshy fruit evolution' Nature. **485** (7400): 35-641.

Tanumihardjo S.A. (2011). Vitamin A: biomarkers of nutrition for development. The American Journal of Clinical Nutrition. 94 (2): 658S–65S. doi: 10.3945/ajcn.110.005777.

USDA Table of Nutrient Retention Factors, Release (PDF). USDA. USDA. 2007.

Van Montagu, D. Inze, M. Sanmartin and A. Kanellis et al., 2000. Vitamin C as an antioxidant: Evaluation of its role in disease prevention. J. Am. Coll. Nutr., **22**: 18-35.