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PHYTOCHEMICAL AND NUTRIENT / ANTINUTRIENT INTERACTIONS IN CHERRY TOMATO *(Lycopersicon esculentum)* FRUITS

OYETAYO, FOLAKE LUCY* & IBITOYE, MUYIWA FEMI
Department of Biochemistry, Ekiti-State University, Ado-Ekiti, P.M.B 5363 Ekiti-State, Nigeria

ABSTRACT
Fruits of Cherry tomato *(Lycopersicum esculentum Solanaceae*) were analysed for minerals and antinutrional composition. Phosphorous (33.04 ±0.21mg/100g) was the most abundant mineral in the fruit followed by Calcium (32.04 ±0.06mg/100) while Potassium (11.9±0.1mg/100g) and Manganese (9.55 ±0.28mg/100g) were also present in appreciable quantities. Antinutrients such as Phytate, Glycosides, Saponin and tannin were screened and quantified . Phytate (112.82±0.1mg/100g), Glycoside (2.33 ±0.00mg/100g), Saponin (1.31±0.00mg/100) and Tannin (0.21 ±0.00mg/100) were present in the fruits while Phlobatanin and Glycosides with steroidal ring were not found. The calculated Ca/Phytate ratio of the fruits was below the critical value and calculated [Ca] [Phytate]/[Zn] molar ratio was less than the critical value. The Ca/P (0.97 mg/100g) shows the fruits to be a good source of food nutrients while the Na/K value was less than 1.The results of the study generally revealed the fruits to be rich in minerals and the antinutrients content are not in sufficient quantities to result in poor mineral bioavailability.

KEYWORDS: Antinutrient composition, photochemical, mineral, [Ca], [Phytate] [Zn]

INTRODUCTION

Fruits form an important part of human diets and are usually regarded as good food (Brain and Alan,1992), their consumption have been associated with decreased risk of breast cancer (Zhang et al.,2009). The Cherry tomato plant (*Lycopersicon escelentum*) is a member of the nightshade family *(Solanaceacae*) of the genus Solanum, the fruits which are edible ripens to a distinctive red and yellow colour. The fruit has fleshy internal segments filled with slippery seeds surrounded by a watery matrix. The seed contain about 24% semidrying oil useful as salad oil, the residual mass is employed as a stocked feed and fertilizer (Hill, 1999). It originated from South America, and spread around the world following the Spanish colonization of the Americas (Smith,1994).

The consumption of tomato fruit is believed to benefit the heart among other organs. The fruit contains lycopene, one of the most powerful natural antioxidants (Sesso et al., 2003). Studies have shown that lycopene especially in cooked tomatoes, helps in the prevention of prostate cancer (Jian et al., 2007), improves the skin`s ability to protect against harmful UV rays, shows eventual senility and hence, it is used as a non chemical cosmetic by young girls (Stahl and Sies,2004). Cherry fruits contain phytochemicals which posses antioxidant, antibacterial, antifungal, antiviral and anti-carcinogenic properties (Steinmetz and Potter, 1996). The fruit is used in diverse ways, including raw in salads and processed into ketchup or tomato soup. It is acidic making it easy to preserve in home canning process, in pieces as tomato sauce or paste. The tomato fruit is an important compliment in soup preparations being consumed in the ripe form as source of minerals and vitamins (Sowunmi *et al*., 1986). In Nigeria, the cherry tomato plant is not usually cultivated, rather, It grows in the wild and as such, its consumption is not popular. Hence, there is paucity of information on its chemical composition. The present study hopes to provide information on the nutrient and antinutrient compositions of the Cherry tomato fruit and to encourage its husbandry if worthwhile.

MATERIALS AND METHODS

Cherry tomato fruits were obtained from a farmland along Ado-Ekiti road in Ikere –Ekiti, Nigeria, oven dried at 60^{o}C and powdered. The minerals were analyzed from the solution obtained by first dry ashing, 1g of the sample was placed in a crucible in a muffle furnace at 550^{o}C for 5 hours to ash and then transferred into a desiccator to cool. The cooled ash was dissolved in 10% HCl and filtered into clean graduated sample bottles. The solution was made to 50ml with deionised water and analyzed for K, Na, Ca, Mg, Zn, Fe, Mn using the atomic absorption spectrophotometer and for P, using UV-visible spectrophotometer at 436nm after making ammonium vanadate molybdate complex according to established procedures of Perkin-Elmer (1982). The powdered sample was screened for the presence of phytochemicals such as Saponin, tannin, phlobatanins, anthraquinones and cardiac-glycosides as described by standard methods (Sofowora, 1993, Trease,1989 and Harborne, 1973). Tannin content was determined as follows. 200mg of three replicates of the sample was extracted with 70% Acetone. Standard tannic acid solution 50mg/100ml was prepared and serial dilutions were made. Absorbance of the solutions were measured at 725nm after the addition of 0.5ml Folin and 2.5ml 20% of $NaCO_3$ (Marker *et al.*,1993). To determine the cyanide concentration, 4g of the sample were soaked in a mixture of 2ml orthosphosphoric acid and 40ml distilled water overnight to free bound cyanide. The resulting solution was distilled

and the distillate was titrated against 0.01M $AgNO_3$. Flavonoid concentration was obtained as follows. 100ml of 80% aqueous methanol was used to extract 10g of sample repeatedly at room temperature and filtered through Whatman filter paper No 42 (125mm). The filtrate was evaporated to dryness in a crucible over a water bath until a constant weight was reached (Bohnm and Kocipal-Abyazan, 1994).

RESULTS AND DISCUSSION

Table 1, presents the Mineral Composition of *Lycopersicon esculentum* (Solanaceae) fruit. The most abundant mineral in the fruit was phosphorous 33.04± 0.21 (mg/100g) followed by calcium 32.04±0.06 (mg/100g).These concentrations were higher than 2.7 (mg/100g) obtained by Burton and Foster (1988) for *Lycopersicon esculentum* Cerasiforme but lower than 76(mg/100g) reported by Adenipekun and Oyetunji (2010) for *Lycopersicon esculentum Cerasiforme*. Calcium is an important constituent of bones and teeth. Hence, the consumption of the fruit could be important in the prevention of osteoporesis, rickets and colon cancer. The fruits contain phosphorous, calcium and magnesium in appreciable amounts. These minerals are important in bone formation. Their deficiencies can lead to abnormal bone development (Aletor and Aladetimi,1989). Iron composition 0.4 mg/100g of the Cherry fruit is comparable to 0.6 mg/100g obtained by Ihekoronye and Ngoddy (1985) . Iron is required for blood formation and it is also important in normal functioning of the Central Nervous System (Shills et al.,1992). Manganese, a nutritionally valuable mineral element was also present in the fruit in appreciable quantity. Manganese is required by several metalo enzymatic reactions such as those catalyzed by superoxide dismutase, an antioxidant enzyme which is protective against unstable cell damaging free radicals and also required for proper bone and cartilage formation.

Table 2 presents the calculated mineral/mineral and phytochemical interaction ratio. The ratio of sodium to potassium in the body is of great concern for the prevention of high blood pressure. Na/K ratio of the fruit of *Lycopersicon esculentum* was less than one . Hence, consumption of the fruit would prevent the incidence of high blood pressure. Food is considered "good" if Ca/P ratio is above 1.0 and "poor" if the ratio is less than 0.5, while Ca/P ratio above 2.0 helps to increase the absorption of calcium in the small intestine (Agatemor, 2007). The Ca/P ratio of the fruit (0.97) showed that it is not a poor source of calcium and zinc since the ratio was above 0.5. The Ca/Mg ratio of (3.35) was higher than the recommended value 1.0 (Shills et al., 1992). The importance of food dietary micronutrients depends on the total mineral content and on the level of other constituents in the diet that affect their bio-availability. Antinutrients affect or inhibit the availability of certain nutrients despite their adequate consumption. They can lead to trace element deficiency since some of them form stable complexes with minerals which render them unavailable for intestinal uptake. The Ca/Phytate ratio of *Lycopersicon esculentum* fruit was 5:1 which is less than the 6:1 critical value. However, [Ca][phytate]/[Zn] molar ratio is a better predictor of bioavailability of Ca and Zn than either the Ca:Phytate or Zn:Phytate molar ratio. The Ca/Phytate/Zn molar ratio of the *Lycopersicon esculentum* fruit was 0.03. This is less than the critical value (0.5).

Phytochemical screening of the *Lycopersicon esculentum* (solanaceae) fruit as shown on table 3 revealed that Saponin, anthraquinone and glycosides were present in the fruit while phlobatanin and steroidal glycosides were absent. Cardiac glycosides are known to be useful in the treatment of congestive heart failure (Schneider and Wolfling, 2004). They have been scientifically proved to have some anti-inflammatory effects on conjunctivitis (Fish and Fish, 1996).

The antinutrient composition of *Lycopersicon esculentum* (solanaceae) fruit is shown on table 4. The Phytate concentration (mg/100g) of the fruit was 112.82±0.0 [mg/100g]. Phytate can influence the functional and nutritional properties of food, depending on its concentration. Also it has the potential ability to lower blood glucose, reduce cholesterol and triacylglycerols, and reduce risk of cancer through its absorption of divalent and multivalent minerals which cancerous cells require for growth. The tannin concentration of *Lycopersicon esculentum* (Solanaceae) fruit was 0.20±0.00 %TA. Tannin helps to control all indications of gastritis, esophagitis, enteritis and irritating bowels disorders. It is also effective in protecting the kidneys, giving immediate relief of sore throat, diarrhea, dysentery, hemorrhaging, fatigue and skin ulcers (Shimomura *et al*., 2004). Apart from its health benefits, tannin serves as defense chemicals protecting the plant from predatory attacks of herbivores, pathogenic fungi and parasitic weeds. Cyanide concentration of the *Lycopersicon esculentum* (Solanaceae) fruit is 0.5 (mg/100g) this is higher than 0.09 (mg/100g) reported for the guinea corn *(Sorghum vulgare*) grain (FAO, 1988). Cyanide is a normal body constituent (Osagie, 1998) but it is a potent respiratory chain inhibitor at high concentrations (Leningher, 1987). Saponin (1.31 mg/100g) concentration was lower than 1.99mg/100g obtained by Ogundana and Fagade (1982), for edible mushroom *P. tuber-regium*. Saponin posses' antioxidants properties (Birk and Peri, 1980) and their toxicity is related to their ability to lower surface tension (Schipper's, 2002).

In conclusion, the result of the present study revealed that Cherry tomato fruits are rich in minerals and the antinutrients content are not in sufficient quantities to result in poor mineral bioavailability and therefore, its cultivation and consumption is therefore encouraged as additional source of minerals especially in the developing countries.

TABLE 1:Mineral composition (mg/100g) of *Lycopersicon esculentum* (solanaceae) fruit

Minerals	Concentration (mg/100g)
Phosphorous	33.04± 0.21
Potassium	11.90± 0.10
Sodium	4.56± 0.31
Calcium	32.04± 0.06
Magnesium	9.55± 0.28
Zinc	0.31± 0.00
Copper	0.05 ± 0.00
Iron	0.48±0.00
Manganese	0.36±0.00

TABLE 2: Calculated mineral/mineral ratio Phytate/Zn, Ca/Phytate and Ca/phytate/Zn molar ratio of Cherry tomato

Mineral	Concentration
Ca/P	0.97
Ca/Mg	3.35
Na/K	0.38
Ca/Phy	5.1
Phytate:Zn	35.50
$\frac{[Ca][Phy]}{[Zn]}$	0.03

TABLE 3: Phytochemical coposition of *Lycopersicon esculentum fruit*

Phytochemical	Result
Saponin	+ ve
Anthraquinone	+ ve
Phlobatannin	- ve
Glycosides	+ ve
Glycosides with steroidal ring	-ve

-ve : negative,+ve: positive

TABLE 4: Antinutrient composition of *Lycopersicon esculentum* (Solanaceae)

Antinutrient	Concentration (mg/100g)
Cyanide	0.54± 0.00
Phytate	112.82± 0.00
Anthraquinones	1.06± 0.00
Saponin	1.31± 0.00
Glycosides	2.33± 0.00
Tannin	0.21± 0.00 (TAE)*

* TAE**:** Tannic acid equivalent

REFERENCES

Adenipekun, C.O. and Oyetunji, O. J. (2010) Nutritional values of some tropical vegetables. *Journals of Applied Bioscience*, 35: 2294 2300. ISSN 1997-59- 02.

Agatemor, C. (2007) Fluted pumpkin (*Telfairia occidentalis*) Culture and cookery. Columbia, S.C USA: University of South Carolina press. ISBN 1-5700-3000-6.

Aletor, V.A. and Aladetimi, O. O. (1989) Compositional evaluation of some cowpea varieties and some under-utilized legumes in Nigeria. Nahrung, 33,999-1007.

Birk. Y. and Peri, T. (1980) The inhibitory effect of phytate, calcium and phenolic compound on non heme-absorption, University of Gotebory, Sweden. Pg 57.

Boham, B.A.-Kocipal-Abyazan, R. (1994) Flavonoids and condensed tannins from leaves of *Hawaiian vaccinium* vaticulatum and *V. calycinlum*. Pacific science, 48, 1974,Pp 458-463.

Brain, F.A and Alan G.C. (1992) Food science, Nutrition and health. Edward Arnold London.

FAO (1988a) Food analysis. Food and Agricultural Association. Rome.

FAO (1988b) Food analysis. Food and Agricultural Association Rome.

Fish J. D. and Fish, S. (1996) A student guide to the seashore. 2nd Ed. Cambridge University Press. Pg 564.

Harborne, J.B. (1973) Phytochemical methods. London. Chapman and Hall, LTD. pp. 49-188.

Ihekoronye, A.I., Ngoddy, P.O. (1985) Tropical fruits and vegetables. Integrated. Food science and technology for the tropics. Tropical fruits and vegetables. Macmillan education LTD. London and Oxford, 306.

Jian, L., Lee, A.H., Binns, C.W. (2007) Tea and lycopene protect against prostate cancer.Asian Journal of clinical Nutrition 16(1):Pp453-7.

Leningher, A.L. (1987) Principles of Biochemistry CBS Publishers Indian Edition 1011P

Marker, H.P., Blummunuel., S.M., Bowwy, N. K. and Becken, K. (1993)Determination of tannin and their correlation with chemical and protein precipitation method. *J Sci. Food Agric*. 61:161-185.

Ogundana, S.K., Fagade, O.E. (1982) Nutritive value of some Nigerian edible mushrooms. *Foof chemistry* (8)4 263-268

Osagie, A.U. (1998) Nutritional quality of plant foods. M.Sc Ph.D. Department of Biochemistry. University of Benin , Benin city, Nigeria Pp 160-171.

Perker-Elmer (1982) Analytical methods of atomic absorption spectrophotometer, Perklin Elmer Corp., USA

Sesso H.D, Liu S, Gaziano J.M, Buring J.E (2003): Dietary Lycopene tomato-based food products and vascular diseases in women.Journal of nutrition 133(7).Pp2336-41.

Schippers, R. (2002) African indigenous Vegetable, an overview of cultivated species. Natural Resource Institute, University of Greenwich London. P9154.

Schneider, G. and Wolfling, J. (2004) Synthetic Cardenolids and related compounds. Current Organic Chemistry 8(14).

Shills, M.Y. and Young, V.R., Nieman, D.C., Butterworth, D.E. and Nieman (1992) C.N (eds). Nutrition.,Wmc. Brown publishers, Dubugue, USA. Pp. 276-282.

Shimomura, H. Funatogawa, K. and Hayashi, S. (2004) Anti-bacterial activities of tannins derived from medicinal plants against *Helitobacter pylori, Microbiol. Immunol.* 48(4): 251-61.

Smith, A. F. (1994)The tomato in America early history, Sofowora A (1993): Medicinal plants and Traditional medicine in Africa. Spectrum Books LTD, Ibadan.p283.

Steinmetz, K.A. and Potter, J.D. (1996) Vegetables, fruit and cancer prevention : a review. *Journal of American Diet Association*, 96(10):1027-10

Trease, G.E. and Evans, W.C. (1989)Pharmacognosy.11th edn.Brailliar Tridel Can.

Wheeler, E.L. and Ferrel, R.E. (1971) A method of phytic acid determination in wheat fractions Cereal chemistry 48: 312-316, Macmillian pulishers.

Zhang, C.X., Ho, S.E., Chen, Y.M., Fu, J.H., Chen, S.Z., Lin, F.Y. (2009) Greater vegetables and fruits intake is associated with a lower risk of breast cancer among Chinese women''. International Journal of cancer 125(1):Pp181-8.