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Evaluation of Proximate and Antioxidant Activities of Ethiopian Eggplant (*Solanum aethiopicum* L) and Gboma Eggplant (*Solanum macrocarpon* L)

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ABSTRACT: There are over 25 species of egg plants in Nigeria including those domesticated for their leaves, fruits or both; eaten as vegetables or used in traditional medicine. However, *S. aethiopicum* and *S. macrocarpum* are the most cultivated and most utilized in Nigeria. Nutritional composition, phytochemical screening and antioxidant activity of *S. aethiopicum* and *S. macrocarpon* were studied. The moisture, crude protein, crude fat and crude fibre contents were 91.20 ± 0.34, 1.07 ± 0.01, 0.38 ± 0.03 and 2.44 ± 0.04% for *S. aethiopicum* while those of *S. macrocarpon* were 92.00 ± 0.43, 0.52 ± 0.02, 0.15 ± 0.02 and 2.50 ± 0.02%. The results revealed that the *S. aethiopicum* specie has higher nutritional values than the *S. macrocarpon* specie. Alkaloids, tannins, saponins, flavonoids, terpenoids and cardiac glycosides are present in the species at different levels. The 2,2-diphenyl-1-picrylhydrazyl (DPPH) quantitative antioxidant analysis confirmed this. The extracts of the *S. macrocarpon* specie has a higher DPPH scavenging activity with a lower IC_{50} value of 33.56 µg/ml compared to the extracts of *S. aethiopicum* specie with IC_{50} of 38.92 µg/ml. The experimental results have revealed that the two species of African eggplant are nutritionally and therapeutically valuable and can be developed as functional foods having both nutritional and medicinal benefits to consumers.
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Keywords: *Solanum aethiopicum, Solanum macrocarpon,* phytochemical screening, antioxidant, DPPH

Foods that contain high quantity of antioxidants are very important in the prevention of chronic diseases such as cardiovascular diseases and cancer (Ames *et al.*, 1993). Several bioactive compounds like flavonoids and plant sterols present in plant foods are investigated for their health care potentials. Until recently, most research on the health benefits of rich plant diets has focused on the established vitamins, but the available data are not sufficient and the drive to identify other additional components of a healthy diet which may reduce the risk of chronic diseases continues (Hoper and Cassidy, 2006).

Eggplants are common and popular vegetable crops grown in the subtropics and tropics (Sarker *et al.*, 2006). They are perennial but grown commercially as an annual crop. There are about 25 species of eggplants in Nigeria. Prominent among these are the *S. aethiopicum L.* (Ethiopian eggplant) and *S. macrocarpon L.* (Gboma eggplant), which are widely cultivated in Nigeria and across the African continent (Bonsu *et al.*, 2002; Grubben *et al.*, 2004). The eggplants form part of the traditional sub-Saharan African culture. The fruits, said to represent blessings and fruitfulness, are offered as a token of goodwill during visits, marriages and other social events. They are eaten raw or when boiled or fried and also as ingredient of stews, soups and vegetable sauces. Their uses in indigenous medicine range from weight reduction to treatment of several ailments including asthma, allergic rhinitis, nasal catarrh, skin infections, rheumatic disease and swollen joint pains, gastro-esophageal reflux disease, constipation, dyspepsia, etc. (Osei *et al.*, 2010; Chinedu *et al.*, 2011). Eggplant fruit contains ascorbic acid and phenolic compounds, both of which are powerful antioxidants (Vinson *et al.*, 1998). Studies have shown that eggplant extracts suppress the development of blood vessels which lead to tumor growth and metastasis (Matsubara *et al.*, 2005), and also inhibits inflammation that can lead to atherosclerosis (Han *et al.*, 2003). Extracts obtained from the skin of eggplant fruit have been demonstrated to possess high capacity in scavenging superoxide free radicals and inhibition of hydroxyl radical generation by chelating ferrous iron (Kaneyuki *et al.*, 1999; Matsubara *et al.*, 2005).

Flavonoids isolated from *S. melongena* showed potent antioxidant activity (Sudheesh *et al.*, 1999; Sadilova *et al.*, 2006) against chromosomal aberrations induced by Doxorubicin. Various parts of the plant are useful in the treatment of inflammatory conditions, cardiac debility, neuralgia, ulcers of nose, cholera, bronchitis and asthma, they are analgesic and hypolipidemic (Mutalik *et al.*, 2003; Sudheesh *et al.*, 1997). *S. melongena* is also a natural source of vitamin A. It would play an important role for vision and eye health because vitamin A has been recognized as a critical factor in eye health (Igwe *et al.*, 2003). Eggplant is one of the common vegetables used in Nigerian dishes. However, data with respect to the nutritional and antioxidant abilities of the species of eggplant popular in Nigeria can be found in just few literatures. Therefore, the aim of this research was to carry out the proximate analysis and

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determine the antioxidant activities of *S. aethiopicum* and *S. macrocarpon* and document appropriately.

MATERIALS AND METHODS

Eggplant fruits, *Solanum macrocarpon* and *Solanum aethiopicum* fruits, were purchased at Ipata market, Ilorin, Kwara State Nigeria. Identification of the samples was done by a taxonomist at the herbarium in Plant Biology department in University of Ilorin, Nigeria. All reagents were of analytical grade and they include DPPH, Phenolphthalein, Boric acid indicator, methylene red, methylene blue, ethanol, potassium iodide, deionized water, 0.01 M hydrochloric acid (HCl), concentrated sulfuric acid (hot conc. H_2SO_4) 1.25 % sodium hydroxide (NaOH), 1.25 % sulfuric acid, ammonia solution, n-hexane, distilled water, sodium sulphate, copper tetraoxosulphate (VI) salt and selenium oxide catalyst. The reagents were purchased from Sigma-Aldrich through a chemical vendor.

Sample Preparation: The two samples (*S. aethiopicum* and *S. macrocarpon)* purchased from the market were prepared separately. Contaminated fruits (spoiled) were removed and the good samples were thoroughly washed with clean water, the water was allowed to drain and the samples were air dried at room temperature.

Proximate Analysis: Proximate analysis i.e. moisture, crude protein, crude fat, crude fiber and ash contents of the samples were carried out according to standard procedures given in AOAC (2000). All determinations were done in triplicates.

Moisture content was determined by heating 2 g of fresh sample to a constant weight in a crucible placed in an oven and maintained at 105 °C. Ash was determined by the total incineration of 2 g sample in a muffle furnace maintained at 550 °C for 5 – 6 hours. Crude fat was obtained by exhaustively extracting 2 g of sample in a Soxhlet extractor for 4 hours using light petroleum spirit (b.p. 40 – 60 °C) as the extractant. Crude fiber determination was done by digesting 2 g of sample successively with H_2SO_4 and NaOH and then incinerating the residue in a muffle furnace at 550 °C for 5 hours. Kjeldahl method was used to determine the crude protein content of the samples. The protein content was calculated by multiplying the nitrogen content obtained from the digestion, distillation and titration of 2 g sample by a factor of 6.25. Total carbohydrate content was estimated by subtracting the sum of percentages of all the nutrients already determined from 100 (AOAC, 2000).

Antioxidant Activity: Preparation of the extract: About 250 g of each fresh sample were cleaned and cut into pieces of approximately 1 cm^3 size and extracted with ethanol using soxhlet extraction method. The extraction was carried out for 6 h. The extracts were concentrated at 45 ^oC using a rotary evaporator and resultant residue was stored under refrigerated conditions until further studies.

Phytochemical Screening: Phytochemical screening of the extracts was carried out to determine the secondary metabolites present in the samples. The metabolites determined include tannins, flavonoids, glycosides, terpenoids, cardiac glycosides, steroids, alkaloids, saponins and anthraquinones. Standard procedures as described by Sofowora (1993) and Harborne (1873) were adopted for this analysis.

Qualitative DPPH antioxidant assay: A suitably diluted stock solution of the sample extract was spotted on pre-coated silica gel TLC plates and the plates were developed in solvent system of different polarities (polar, medium-polar and non-polar) to resolve polar and non-polar components of the extracts. The plates were dried at room temperature and sprayed with 0.02 % DPPH in methanol. Bleaching of the TLC plates by the DPPH was observed for 10 minutes and the colour changes (yellow on purple background) were noted.

DPPH radical scavenging activity: Free radical scavenging activity of the eggplant extracts were determined by using 2,2-diphenyl-1-picrylhydrazyl radical (DPPH) (Brand *et al.*, 1995). DPPH is a stable free radical of violet colour. The antioxidants in the sample scavenge the free radicals and turn it into yellow colour. The change of colour from violet to yellow is proportional to the radical scavenging activity.

Briefly, the assay consists of taking 1 ml of 0.1 mM DPPH in ethanol, mixed with 1 ml of various concentrations of ethanolic extract of the sample and made up to 3.5 ml with ethanol. The contents were mixed well immediately and then incubated for 30 min at room temperature (27 ^oC). The absorbance of the mixture was then measured using UV–Vis spectrophotometer at 517 nm. The percentage of scavenging activity was then calculated.

$$Percentage\ radical\ scavenging\ activity = \frac{A_c - A_s}{A_c}\ X\ 100$$

Where A_c is the absorbance of control (solution containing all the reagents but no extract) while A_s is the absorbance of sample.

Percentage of radical scavenging activity was plotted against the corresponding concentration of the extract to obtain the IC_{50} value. IC_{50} is defined as the amount of antioxidant material required to scavenge 50% of free radical in the assay system. The IC_{50} values are inversely proportional to the antioxidant activity.

RESULTS AND DISCUSSIONS

The results of the proximate analyses of the *Solanum aethiopicum* and *Solanum macrocarpon* are presented in table 1

Table 1: Proximate composition of *Solanum aethiopicum L.* and *Solanum macrocarpon Fr*uits

Nutrients	Compositon (PER 100G Of Fresh Fruits)	
	Solanum Aethiopicum L.	*Solanum Macrocarpon L.*
Moisture content	91.20 ± 0.34%	92.00 ± 0.43%
Crude Protein	1.07 ± 0.01%	0.52 ± 0.02%
Crude Fat	0.38 ± 0.03%	0.15 ± 0.02%
Crude Fibre	2.44 ± 0.04%	2.50 ± 0.02%
Ash content	0.73 ± 0.03%	0.80 ± 0.03%
Carbohydrate	4.18 ± 0.08%	4.01 ± 0.06%
Dry matter	8.80 ± 0.19%	8.00 ± 0.11%

The moisture content (92.00 %) of *S. macrocarpon L.* was higher than that of *S. aethiopicum* (91.20 %). Similar results have been reported by Agoreyo *et al.,* (2012) in their earlier work on other species of solanum. These results reveal that eggplants generally have high moisture content which makes them prone to quick deterioration, hence they are classed amongst perishable fruits. However, the fibrous nature of their skin makes it a bit difficult for microorganisms to penetrate unlike that of pawpaw or other soft skin fruits. This high moisture content makes the eggplant to be of high nutritional benefits to people suffering from dehydration and the skin helps to keep the fruit fresh to meet market freshness demand.

The protein contents of 1.07% and 0.54% obtained for *S. aethiopicum* and *S. macrocarpon* respectively revealed that *S. aethiopicum* has higher protein content than *S. macrocarpon* which is also supported by Grubben and Denten (2004) who reported values of 1.6% and 1.4% for *S. aethiopicum* and *S. macrocarpon* respectively. Although the protein contents of eggplants are low, they are still useful in the repair of worn out tissues in the body.

The fat contents of 0.38% and 0.15% for *S. aethiopicum* and *S.macrocarpon* respectively were lower than the 1.0% reported for *S. macrocarpon* but higher than the 0.1% reported for *S. aethiopicum* (Grubben and Denton, 2004), but falls in line with the results of Chinedu *et al.*, (2011) who reported 0.52 ± 0.04% and 0.17 ± 0.01% for *S. aethiopicum* and *S. macrocarpon* respectively. These values show that the fat contents of these eggplant species are low. Solanum species have been reported to reduce Low Density Lipoprotein (LDL)/High Density Lipoprotein (HDL) ratio and increase HDL/LDL ratio in hypercholesterolemic rabbits (Igwe *et al.*, 2003; Odetola *et al.*, 2004). They are ideal fruits for people with increased serum lipid levels, high blood pressure and other ischemic heart diseases.

The crude fibre content of 2.44 % obtained for *S. aethiopicum* is slightly lower than the 2.96 % reported for *S. aethiopicum* whereas the 2.50 % obtained for *S. marcrocarpon* L. is higher than the 1.11 % reported by Chinedu *et al.,* (2011). High crude fibre and low-fat contents of these fruits may be helpful in preventing such disorders as constipation, carcinoma of the colon and rectum, diverticulitis and atherosclerosis (Showemimo *et al.*, 2004). They may also partly account for the weight reduction effect of African eggplants (Odetola *et al.*, 2004; Edijala *et al.*, 2005). The high fibre contents together with the low carbohydrate contents found in these fruits are also good in the management of *Diabetes mellitus* (Bonsu *et al.*, 2002).

The ash contents were 0.73 ± 0.03 and 0.80 ± 0.03 % for *S. aethiopicum* and *S. marcrocarpon* respectively. A slightly higher value (0.87 ± 0.03 %) was recorded for *S. aethiopicum* and lower value (0.47 ± 0.02 %) for *S. Macrocarpon* by Chinedu *et al.,* (2011). Ash content, which represents a measure of the total amount of minerals present, makes both fruits good sources of minerals with *S. aethiopicum* yielding higher level of minerals.

Carbohydrate contents of 4.18 ± 0.08 and 4.01 ± 0.06 % obtained for *S.aethiopicum L.* and *S. marcrocarpon L.* respectively compared well with the results of Shalom *et al.*, (2011) that reported 4.14 ± 0.11 % and 4.42 ± 0.12 % for S. *aethiopicum L.* and

S. marcrocarpon L respectively. This reasonably good amount of carbohydrate and moderate amount of crude fibre and low crude proteins make them good source of raw material for food industries (Edem *et al.*, 2009).

The results for the preliminary phytochemical screening of the two samples are presented in Table 2.

Table 2: Phytochemical screening results of S. *aethiopicum* and *S. marcrocarpon*

Phytochemicals	*Solanum aethiopicum*	*Solanum macrocarpon*
Alkaloids	+++	+++
Saponins	+++	+++
Flavonoids	+	+
Tannins	++	++
Terpenoids	+	+
Steroids	+	-
Cardiac glycosides	+	+
Anthraquinones	-	-

Key: - indicates absent; + indicates present; ++ indicates moderately present; +++ indicates highly present.

The results of the phytochemical screening of both species indicated a significant presence of alkaloids, saponins, flavonoids, tannins and cardiac glycosides. Terpenoids were slightly present in both species while anthraquinones were absent in both species. Steroids were found to be in *S. aethiopicum* but not in *S. macrocarpon*. *S. aethiopicum* generally contained higher levels of the phytochemicals than *S. macrocarpon* (Chinedu *et al.*, 2011). Alkaloidal extracts of Solanum species have been reported to show analgesic effects and CNS depression (Vohora *et al.*, 2011). Bitterness of eggplants is due to the presence of alkaloids, mainly glycoalkaloids and degree of bitterness determines to a great extent, their edibility or otherwise. Poisoning by Solanum species have been attributed to the presence of toxic glycoalkaloids which cause diarrhea or carcinogenic glycosides causing excessive deposition of calcium in tissues. Some researchers have insisted that caution should be applied in their uses and that they should be consumed in small quantities (Bello *et al.*, 2005).
Saponins, which are present in the samples, are important dietary supplements and nutraceuticals. They possess antimicrobial activities and protect plants from microbial pathogens. Researchers have discovered that saponins present in traditional medicine preparations cause hydrolysis of glycosides from terpenoids which avert the toxicity associated with the intact molecule (Xu *et al.*, 1996; Asl *et al.*, 2008). The presence of saponins in the eggplants justifies their use in traditional medicine. Additionally, both *S. aethiopicum* and *S. macrocarpon* contain flavonoids which are antioxidants and this potential is reflected in the antioxidants activities of the eggplant (Bagchi *et al.*, 1999).

The qualitative DPPH analysis gave a positive result indicating the presence of antioxidants in the ethanolic extracts of the two fruits. This is based on the ability of the extracts (which contains antioxidants) to bleach the purple colour of DPPH free radical to yellow (the stable form). The results obtained for the quantitative analysis is shown in Table 3.

Table 3: DPPH antioxidant activity

Concentration (µg/ml)	%DPPH *S. macrocarpon*	%DPPH *S. aethiopicum*
500	70.33	69.1
250	73.61	65.04
125	71.76	60.97
62.5	75.61	63.41
31.25	54.96	58.94
15.62	44.06	46.75
7.81	42.76	56.26
3.9	51.11	51.22
1.99	36.63	37.8
0.97	24.83	23.13

DPPH is a widely used free radical compound for testing the free radical scavenging ability of various plant samples. The scavenging activity of both *S. aethiopicum* and *S. macrocarpon* on DPPH radicals increased with increasing concentrations. The optimum free DPPH radical scavenging activity was recorded at 62.5 µg/ml for *S. macrocarpon* (75.61%) though that of *S. aethiopicum* was increasing even till 500µg/ml with a value of 69.1%. With this optimum it implies that the peak of antioxidant activity of *S. macrocarpon* is attained at a lower concentration than *S. aethiopicum.* The amount of antioxidant material required to scavenge 50% of free radical in the assay system (IC_{50}) was calculated from the plots. There is an inverse relationship between IC_{50} and antioxidant activity. *S. aethiopicum* has higher IC_{50} value (38.92 µg/ml) than *S. macrocarpon* (33.56 µg/ml) which revealed that the *S. macrocarpon* has a higher antioxidant activity which may be attributed to the higher phenolic, anthocyanin and flavonoid contents of the sample (Nisha *et al.*, 2009).

Conclusion: This research work studied the nutritional composition, phytochemical and antioxidant activity of two common species of eggplant found in Nigeria (*Solanum aethiopicum and Solanum macrocarpon*). The results revealed that the *S. aethiopicum* specie has higher nutritional values than the *S. macrocarpon* specie. The phytochemical analysis also revealed that the samples contain active chemical compounds like alkaloids, tannins, saponins, flavonoids, terpenoids and cardiac glycosides at different levels. From the DPPH quantitative antioxidant activity determinations, it can be deduced that *S. macrocarpon* has higher antioxidant activity than *S. aethiopicum*. The two species of African eggplant have been shown to be nutritionally and therapeutically valuable and they have the potential of providing precursors for the synthesis of useful drugs.

REFERENCES

AOAC (2000). Official methods of analysis.15th edition. Washington, D. C. Association of Official Analytical Chemists.

Agoreyo, BO; Obansa, ES; Obanor, EO (2012). Comparative nutritional and phytochemical analyses of two varieties of *Solanum melongena*. *Science World Journal* 7: 5-8.

Ames, BN; Shigenaga, MK; Hagen, TM (1993). Oxidants, antioxidants, and the degenerative diseases of aging. *Proc. Natl. Acad. Sci.* 90: 7915–7922.

Asl, MN; Hossein, H (2008). Review of pharmacological effects of *Glycyrrhiza*sp. And its bioactive compounds, *Phytotherapy Res.,* 22(6): 709–24

Bagchi, M; Milnes, M; Williams, C; Balmoori, J; Ye, X; Stohs, S; Bagchi, D (1999). Acute and chronic stress-induced oxidative gastrointestinal injury in rats and the protective ability of a novel grape seed proanthocyanidin extract, *Nutri. Res.,*19:1189–1199.

Bello, SO; Muhammad, BY; Gammaniel, KS; Abdu-Aguye, I; Ahmed, H; Njoku, CH; Pindiga, UH; Salka, AM (2005). Preliminary Evaluation of the Toxicity and Some Pharmacological Properties of the Aqueous Crude Extract of *Solanum melongena., Res. J. Agric. Biol. Sci.,*1(1): 1-9.

Bonsu, KO; Fontem, DA; Nkansah, GO; Iroume, RN; Owusu, EO; Schippers, RR (2002). Diversity within the Gboma eggplant (*Solanum macrocarpon*), an indigenous vegetable from West Africa. *Ghana J. Horticulture,* 1:50–58.

Brand, WW; Cuvelier, ME; Berset, C (1995). Use of free radical method to evaluate antioxidant activity. *Lebensm-Wiss. Technol*. 28: 25–30.

Chinedu, SN; Olasumbo, AC; Eboji, OK; Emiloju, OC; Arinola, OK; Dania, DI (2011). Proximate and Phytochemical Analyses of *Solanum aethiopicum* L. and *Solanum macrocarpon* L. Fruits, *Res.J.Chem.Sci.*1(3): 24-35

Edem, CA; Dosunmu, MI; Bassey, FI; Wilson, C; Umoren, P (2009). A Comparative Assessment of the Proximate Composition, Ascorbic Acid and Heavy Metal Content of Two Species of Garden Egg (*Solanum gilo* and *Solanum aubergine*). *Pak. J. Nutri.* 8(5): 582-584.

Edijala, JK; Asagba, SO; Eriyamremu, GE; Atomatofa, U (2005). Comparative Effect of Garden Egg Fruit, Oat and Apple on Serum Lipid Profile in Rats Fed a High Cholesterol Diet. *Pak. J. Nutri.* 4(4): 245-249

Grubben, GJH; Denton, OA (2004). *Plant Resources of Tropical Africa II: Vegetables* (Leiden, Wageningen: Backhuys Publishers) 35-198.

Harborne, J B (1973). Methods of plant analysis. In: Phytochemical Methods, Chapman and Hall, London.

Han, SW; Tae, J; Kim, JA; Kim, DK; Seo, GS; Yun, K; Choi, SC;Kim, TY; Nah, YH; Lee, YM (2003). The aqueous extract of *Solanum melongena* inhibits PAR2 agonist-induced inflammation. *Clin. Chim. Acta* 328: 39–44.

Hoper, L; Cassidy, A (2006). A review of the health care potential of bioactive compounds. *J. Sci. Food Agric.* 86: 1805–1813.

Igwe, SA; Akunyili, DN; Ogbogu, C (2003). Effects of *Solanum melongena* (garden egg) on some visual functions of visually active Igbos of Nigeria. *J. Ethnopharmacol.* 86: 135–138.

Kaneyuki, T; Noda, Y; Traber, MG; Mori, A; Packer, L (1999). Superoxide anion and hydroxyl radical scavenging activities of vegetable extracts measured using electron spin resonance. *Biochem. Mol. Biol. Int.* 47: 979–989.

Matsubara, K; Kaneyuki, T; Miyake, T; Mori, M (2005). Anti-angiogenic activity of Nasunin, an antioxidant anthocyanin, in eggplant peels. *J. Agric. Food Chem.* 53: 6272–6275.

Mutalik, S; Paridhavi, K; Mallikarjuna, RC; Udupa, N (2003). Antipyretic and analgesic effect of leaves of *Solanum melongena* Linn.in rodents. *Ind. J. Pharmacol.* 35: 312–315.

Nisha, P; Abdul Nazar, P; Jayamurthy, P (2009). A comparative study on antioxidant activities of different varieties of *Solanum melongena. Food and Chemical Toxicology* 47: 2640–2644.

Odetola, AA; Iranloye, YO; Akinloye, O (2004). Hypolipidaemic Potentials of *Solanum melongena* and *Solanum gilo* on Hypercholesterolemic Rabbits. *Pak. J. Nutri*., 3 (3): 180-187.

Osei, MK; Banful1, B; Osei, CK; Oluoch, MO (2010). Characterization of African Eggplant for Morphological Characteristics., *J. Agric. Sci. Technol.*, 4 (3): 33-37.

Sadilova, E; Stintzing, FC; Carle, R (2006). Anthocyanins, colour and antioxidant properties of eggplant (*Solanum melengona* L.) and violet pepper (*Capsicum annuum* L.) peel extracts. Z. *Naturforsch.* 61: 527–535.

Sanchez-Mata, MC; Yokoyama, WE; Hong, YJ; Prohens, J (2010). Solasonine and Solamargine Contents of Gboma (*Solanum macrocarpon* L.) and Scarlet (*Solanum aethiopicum* L.) Egg plants. *J. Agric. Food chem.* 58(9): 5502–5508.

Sarker, RH; Yesmin, S; Hoque, MI; (2006). Multiple shoot formation in eggplant (*Solanum melongena* L.). *Plant Tissue Culture Biotech.* 16: 53–61.

Showemimo, FA; Olarewaju, JD (2004). Agro-Nutritional Determinants of Some Garden Varieties (*Solanum gilo L.*), *J. Food Technol.* 2(3): 172-175.

Sofowora, A (1993). Medicinal Plants and Traditional Medicine in Africa. John Wiley and Sons Limited, 2: 96-106

Sudheesh, S; Kumar, P; Kumar, V; Vijayalakashmi, NR (1997). Hypolipidemic effect of flavonoids from *Solanum melongena*. *Plant Food Human Nutr*. 51: 321–330.

Sudheesh, S; Sandhya, C; Asha, SK; Vijayalakshmi, NR (1999). Antioxidant activity of flavonoids from *Solanum melongena*. *Phytother. Res.* 13: 393–396.

Vinson, JA; Hao, Y; Su, X; Zubik, L (1998). Phenol antioxidant quantity and quality in foods: vegetables. *J. Agric. Food Chem.* 46: 3630–3634

Vohora, SB; Kumar, I; Khan, MSY (1984). Effect of alkaloids of *Solanum melongena* on the central nervous system, *J. Ethnopharmacol,* 11: 331-336.

World Health Organization (1976). African Traditional Medicine. (WHO: Afro-Tech. Rep)

Xu, R; Zhao, W; Xu, J; Shao, B; Qin, G (1996). Studies on bioactive saponins from Chinese medicinal plants, *Adv. Exp. Med. Biol.,* 404: 371–382.