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Alkaloid, Flavonoid, Fatty Acid and Vitamin Profiles of the Unripe Fruit of *Solanum melongena* L. (Round Variety)

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ABSTRACT: *Solanum melongena* L. (round variety) is an eggplant that is commonly called "garden egg" in Nigeria. The unripe fruit is often eaten as snack, dessert or vegetable. The dried fruit powder was evaluated for its alkaloid, flavonoid and fatty acid profiles by Gas Chromatography (GC). The vitamin profile was estimated by High Performance Liquid Chromatography (HPLC). The alkaloid profile showed the presence of high amounts of solamargine (134 ± 0.719 mg/100g) and solasonine (115 ± 0.455 mg/100g), with other alkaloids present in lower amounts. Flavonoid analysis showed high concentrations of kaemferol (6.41 x 10^2 ± 1.72 mg/100g dry weight), quercetin (5.60 x 10^2 ± 4.81 x 10^{-1} mg/100g dry weight) and myricertin (1.62 x 10^2 ± 6.93 x 10^{-1} mg/100 g dry weight). The fatty acid analysis showed the presence of linoleic acid (57.9 ± 0.387%), palmitic acid (15.1 ± 0.194 %), oleic acid (14.0 ± 0.115 %), linolenic acid (5.96 ± 0.0852 %), with other fatty acids present in lower or negligible amounts. Vitamin A (27.07 ± 0.42 mg/100g) and vitamin C (13.96 ± 0.23 mg/100 g) levels were higher than other vitamins. These results justify the nutritional richness and medicinal properties of the fruit.

Keywords: Alkaloid, Flavonoid, Fatty Acid, Vitamin, *Solanum melongena*

Introduction

Eggplant is a common vegetable crop that is grown in the subtropical and tropical regions of the world (Sarker *et al*., 2006). It is commonly called "garden egg" in Nigeria, a name which was derived from the shape of the fruits of some varieties that are shaped very similarly to chicken eggs (Kandoliya *et al*., 2015). Eggplant is the third most important crop in the *Solanaceae* family after tomato and potato (FOASTAT, 2000; Hideki *et al.,* 2014). In Nigeria, several cultivars of eggplant are commonly found and cultivated domestically. Their fruits and leaves are eaten as snack, dessert and as vegetables (Chinedu *et al*., 2011). *Solanum melongena* is an eggplant that is white in colour and has two varieties that are round or oval in shape. *Solanum melongena* is edible in its raw state and can also be cooked and used as a stew sauce for eating staples such as yam, plantain, potato and cocoyam.

The nutritional content of eggplant can be compared to that of tomato, but it has high moisture content in its unripe stage (Odetola *et al*., 2004). The medicinal properties of eggplant are strongly linked to its nutrients and phytochemicals such as alkaloids, saponins, tannins and flavonoids (Liu, 2003; Ossamulu *et al*., 2014a). Some of the reported medicinal properties of eggplant include analgesic, anti-inflammatory, antioxidative, hypoglycemic, hypolipidemic and hypocholesterolemic properties (Igwe *et al*., 2003; Odetola *et al*., 2004; Bello *et al*., 2005; Ossamulu *et al*., 2014b).

Nutrient and phytochemical profiles show the specific types of nutrients and phytochemicals that are present in the food and their levels. The nutrient and phytochemical profiles of food are important in determining its nutritional quality. They can be used to determine the effects of consuming a particular food on a person's health, thereby preventing diseases and promoting health. It can also be used for information, education and as a tool to orient food consumption (WHO, 2010).

Alkaloids are produced in higher plants and have a wide range of pharmacological activities including anti-malarial and anti-asthma (Aniszewski, 2007; Kittakoop *et al*., 2014). Biological precursors of most alkaloids are amino acids, such as ornithine, lysine, phenylalanine, tyrosine, tryptophan, histidine, aspartic acid, and anthranilic acid (Plemenkov, 2001).

Flavonoids consist of a large group of hydroxylated phenolic substances and polyphenolic compounds having a benzo-γ-pyrone structure and are ubiquitously present in plants
(Meskin *et al*., 2002). In addition to providing health benefits, they also contribute to the distinguishable coloration of many fruits and vegetables (Heldt, 2005). They are synthesized by phenylpropanoid pathway. Flavonoids are responsible for the variety of pharmacological activities of plants (Meskin *et al*., 2004; Mahomoodally *et al*., 2005; Pandey, 2007).

Most fatty acids are synthesized in both plants and animals. Some fatty acids such as linoleic acid and linolenic acid are termed essential because they can only be synthesized by plants but cannot be synthesized by humans, thus dietary sources of these fatty acids are very important. Linoleic acid and linolenic acid are unsaturated fatty acids and replacing saturated fatty acids with these unsaturated fatty acids, helps to lower levels of total cholesterol and low density lipoprotein cholesterol (LDL cholesterol) in the blood (Reiner, 2011). Many health authorities such as the American Dietetic Association advise that saturated fatty acid is a risk factor for cardiovascular disease due to their ability to increase the level of total cholesterol (Kris-Etherton and Innis, 2007).

Vitamins are micro nutrients because they are required in relatively small quantities, which the body need for proper functioning. They are important for the metabolism of nutrients that provide energy. When they cannot be synthesized by the body, vitamins must be obtained from diet. A varied diet is likely to contain adequate amounts of all the vitamins. Inadequate supply of vitamins in diet leads to deficiency diseases and many other health problems. Fruits are rich sources of both water soluble and fat soluble vitamins (Wargovich, 2000).

Nutritional and phytochemical studies on *Solanum melongena* L. have mostly focused on estimating the total content of the nutrients and phytochemicals but have not gone further to identify and quantify the specific type of compounds. Since the nutritional quality and medicinal property possessed by most plants are linked to the type and quantity of nutrients and phytochemical that they contain (Evans, 2005; Doughari, 2012); the aim of this study therefore, was to determine the type and quantity of alkaloids, flavonoids, fatty acids and vitamins in the unripe fruits of *Solanum melongena* L. (round variety).

Materials and Methods

Plant sample

Mature, fresh unripe fruits of *Solanum melongena* (round variety) were obtained from Oba market, located in Oredo Local Government Area of Edo state.

Preparation of *Solanum melongena* dried fruit powder

The eggplant samples were washed thoroughly with distilled water. The crowns were plucked off and each fruit was diced into thin slices and then transferred into the oven for drying at 60 °C. After drying, the eggplant samples were ground to a smooth powder and then stored in dry airtight glass containers to prevent it from reabsorbing moisture before analysis.

Determination of nutrient and phytochemical profiles of *Solanum melongena*

Alkaloid, flavonoid and fatty acid profiles of the eggplant samples were estimated by gas chromatography (GC). Selected standards were used as calibration guide for all the compounds analysed. Peak Area and Retention Time of compounds in comparison with that of standards were used to determine the specific types and quantity of compounds present in the eggplant samples. GC analysis was carried out on a GC HP 5890 Powered with HP ChemStation Rev. A 09.01[1206] Software, with a suitable detector for each assay. Vitamins where quantified by High Performance Liquid Chromatography (HPLC). Vitamin standards were used as calibration guide for all the vitamins analysed. HPLC analysis was carried out on a HPLC Agilent 1200 Series, an Agilent 1260 Infinity Variable Wavelength Detector, an Acclaim Polar Advantage II Column. All standards were of analytical grade and obtained from Sigma Aldrich, Germany and all solvents where also of HPLC grade.

Alkaloid Profile

The extraction of alkaloids was carried out using the modified method of Ngounu *et al*. (2005). A measured quantity of 2.0 g of the pulverized sample was macerated in 20 ml of hexane for 72hr.
The extract was filtered and the residue air-dried. The residue was treated with 10% aqueous ammonia and macerated in trichloromethane for 24 hr and filtered. After filtration and evaporation at reduced pressure, the resultant crude extract was treated with 15 ml of 5% aqueous HCl. The aqueous phase was made alkaline with aqueous ammonia and extracted thrice with chloroform. The chloroform fraction was washed with water. The chloroform extract was poured into the round bottom flask of the rotatory evaporator and concentrated. Water was removed from the concentrated extract using

anhydrous sodium sulphate before gas chromatography analysis. 1.0 µL of the extract was injected into the gas chromatograph to determine the alkaloid profile.

GC Conditions for Alkaloids

Column Type DB-5MS with column dimensions 30 m × 0.25 mm × 0.25 µm was used. Hydrogen was the carrier gas at a constant flow of 1ml/min and split ratio of 20:1. The injector temperature was 250 ºC and detector temperature was 320 ºC. The oven temperature was programmed at initial temperature of 60 ºC for 5 min, with a decrease to 10 ºC/min for 20 min and 15 ºC/min for 4 min. Flame ionization detector was used at a temperature of 320 ºC, hydrogen pressure of 28 psi and compressed air 32 psi.

Flavonoid Profile

The flavonoids extraction was carried out by the modified method of Milogo-Kone *et al*. (2001b). A measured quantity of 5.0 g of the powdered sample was weighed and transferred to Stoppard flask and treated with ethanol until the powder was fully immersed. The flask was shook every hour for the first six hours and then kept aside and shook after 24 hr. The process was repeated severally and the extract was filtered and evaporated to dryness using nitrogen stream. 0.5 g of the concentrate was weighed into 250 ml conical flask capacity with the addition of 100 ml of deionised water and boiled for 10min.The flavonoid extract was obtained by pouring 100 ml of the boiling methanol: water (70:30, v/v) into the homogenate. The homogenate was allowed to macerate for 4 hr and then filtered through filter paper (Whatman No. l). The filtrate was derivatised for volatility. The mixture was concentrated to 2 ml in Agilent vial for gas chromatography Analysis.

GC Conditions for Flavonoids

Column Type HP-1 with dimensions 30 m x 0.25 mm x 0.25 µm was used. Nitrogen was the carrier gas at a constant flow of 1ml/min and split ratio of 20:1. The injector temperature was 250 °C and the detector temperature was 320 °C. The oven temperature was programmed for 60 °C for 5 min, with a decrease to 15 °C/min for 15 min and 10 °C/min for 4 min. Flame ionization detector was used at a temperature of 320 °C, hydrogen pressure of 28 psi and compressed air 32 psi.

Fatty Acid Profile

The method of AOAC (2006) was used to extract the fat in the pulverized sample. The fat was derivatised to fatty acid methyl esters (FAME) for gas chromatography.

Fatty Acid Methyl Ester Analysis

Fifty milligrams of the extracted fat was esterified for five 5 min at 95°C with 3.4 ml of 0.5 M KOH in methanol. The mixture was neutralized by using 0.7 M HCl. 3 ml of 14% boron triflouride (BTF) in methanol was added. The mixture was heated for 5 min at 90 °C to achieve complete derivatisation. The fatty acid methyl esters were extracted thrice from the mixture with redistilled n-hexane. The extract was concentrated to l ml for gas chromatography analysis and 1 µL was injected into the injection port of the Gas Chromatograph.

GC Condtitions for Fatty Acid Methyl Esters (FAME)

Column Type HP INNOWax with column dimensions 30 m × 0.25 mm × 0.25 µm was used. Nitrogen was the carrier gas at a constant flow of 1 ml/min and split ratio of 20:1. The injector temperature was 250 ºC and detector temperature was 320 ºC. The oven temperature was programmed at initial temperature of 60ºC for 5 min, with a decrease to 12 ºC/min for 20 min and 15 ºC/min for 3 min. Flame ionization detector was used at a temperature of 320 ºC, hydrogen pressure of 22 psi and compressed air 35 psi.

Vitamin Profile

The vitamin profile of the pulverized sample was determined by HPLC using the modified method of AOAC (2006). A measured quantity of 0.10 g of the sample was weighed into 10 ml beaker and was extracted using the above stated modified methods. After extraction, the extract was concentrated to 1.0 ml for chromatographic analysis. Mobile Phase for running HPLC consisted of 0.015% formic acid, Methanol/ Acetonitrile (17/83). Flow rate was 0.21 ml/min and wavelength was 210 nm.

HPLC conditions for vitamins

The HPLC (Agilent 1200 series) was equipped with agilent 1260 infinity variable wavelength detector, an injection volume of 5.0 microliter, wavelength of 210 nm and flow rate of 0.21 ml/min. The chromatographic separation was achieved using acclaim polar advantage II, 2.1 x 150 mm column with dimensions of 5 micrometer, 4.6x250 mm and Hamilton microliter syringe. The total runs time for the gradient elution was 25 min.

Statistical analysis

Data obtained from the analysis was subjected to statistical evaluation. Analysis of variance of data was done by the statistical analysis system (INSTAT Software). Tukey-Kramer multiple comparison test was employed (INSTAT

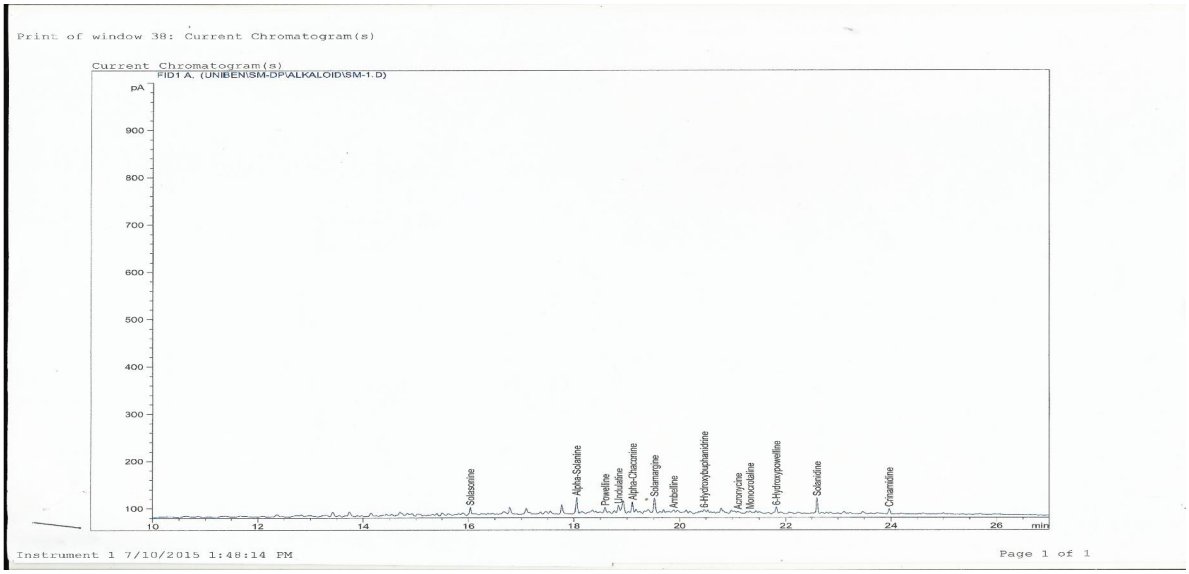
Software) to determine the statistical differences among the means. Results were expressed as Mean Values of triplicates ± Standard Error of Mean (SEM).

Results

The mature, fresh unripe samples of *Solanum melongena* (round variety) that were used in this study are shown in Fig. 1.

Fig.1. Unripe fruits of *Solanum melongena* (round variety)

The chromatogram for the alkaloid profile of *Solanum melongena* (round variety) is shown in Fig. 2. The various types of alkaloids present in *Solanum melongena* (round variety) include solamargine, solasonine, alpha-solanine, alpha-chaconine and solanidine, which were present in high amounts (Table 1).



Legend: Y axis=Area, X axis=Retention time

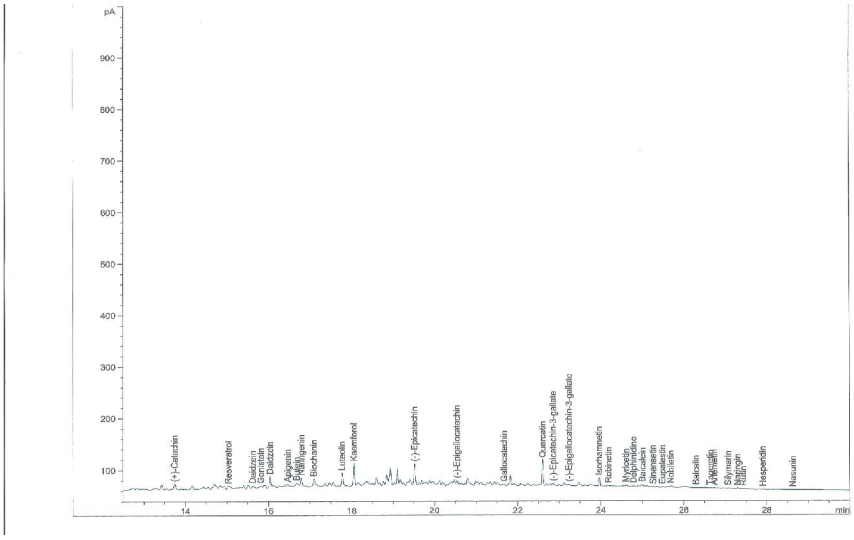
Fig. 2. Chromatogram of the alkaloid profile of *Solanum melongena* (round variety)

Table 1. Alkaloid profile of *Solanum melongena* (round variety)

Types of Alkaloids	Amount (mg/100g Dry weight)
Solasonine	115 ± 0.455
Alpha-solanine	75.1 ± 0.412
Powelline	$5.07 \times 10^{-5} \pm 6.01 \times 10^{-7}$
Undulatine	$3.08 \times 10^{-5} \pm 3.06 \times 10^{-7}$
Alpha-chaconine	53.3 ± 0.289
Solamargine	134 ± 0.719
Ambelline	$5.54 \times 10^{-5} \pm 8.03 \times 10^{-7}$
6-Hydroxybuphanidrine	$3.24 \times 10^{-5} \pm 3.99 \times 10^{-7}$
Acronycine	$2.71 \times 10^{-5} \pm 4.26 \times 10^{-7}$
Monocrotaline	$3.19 \times 10^{-5} \pm 5.51 \times 10^{-7}$
6-Hydroxypoweline	$7.02 \times 10^{-3} \pm 4.64 \times 10^{-5}$
Solanidine	36.6 ± 0.310
Crinamidine	$1.38 \times 10^{-5} \pm 2.90 \times 10^{-7}$

Means± SEM for three determinations

The chromatogram for the flavonoid profile of *Solanum melongena* (round variety) is shown in Fig. 3. The types of flavonoids present in *Solanum melongena* (round variety) include kaemferol, quercetin, myricetin, which were also present in high amounts (Table 2).



Legend: Y axis=Area, X axis=Retention time

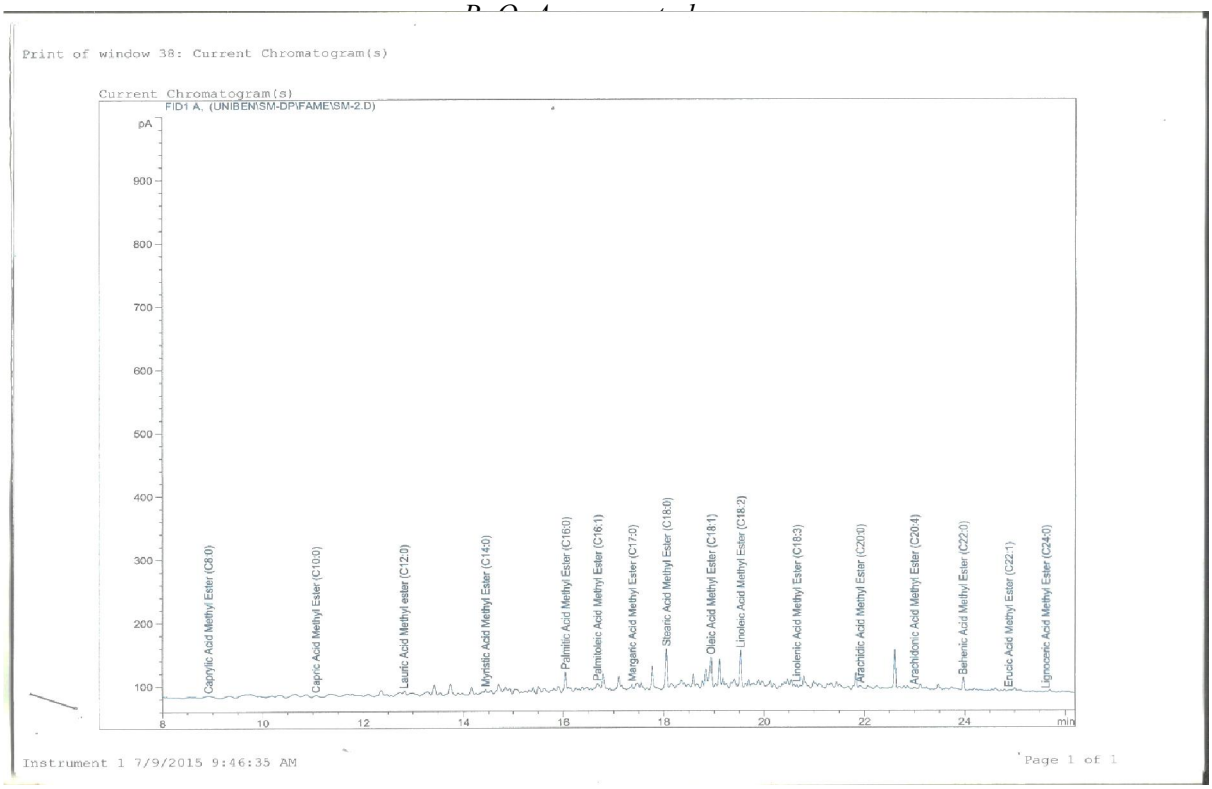
Fig. 3. Chromatogram of the flavonoid profile of *Solanum melongena* (round variety)

Table 2. Flavonoid profile of *Solanum melongena* (round variety)

Flavonoid Types	**Amount (mg/100g Dry weight)**
(+)-Catechin	$4.07x10^{-3} \pm 1.51x10^{-4}$
Resveratrol	$3.63x10^{-3} \pm 7.34x10^{-5}$
Daidzein	$4.39x10^{-4} \pm 1.12\ x10^{-5}$
Genistein	$4.83\ x10^{-3} \pm 2.18\ x10^{-4}$
Daidzein	$1.16\ x10^{-3} \pm 1.36\ x10^{-5}$
Apigenin	$4.08 \pm 5.70\ x10^{-02}$
Butein	$8.64\ x10^{-4} \pm 6.76\ x10^{-6}$
Naringenin	$2.60\ x10^{-5} \pm 3.00\ x10^{-7}$
Biochanin	$1.72\ x10^{-3} \pm 2.40\ x10^{-5}$
Luteolin	$8.42\ x10^{-2} \pm 1.16\ x10^{-3}$
Kaemferol	$6.41\ x10^{2} \pm 1.72$
(-)-Epicatechin	$3.43\ x10^{-3} \pm 1.64\ x10^{-5}$
(-)-Epigallocatechin	$4.14\ x10^{-3} \pm 2.74\ x10^{-5}$
Gallocatechin	$5.26\ x10^{-4} \pm 7.60\ x10^{-6}$
Quercetin	$5.60\ x10^{2} \pm 0.481$
(-)-Epicatechin-3-gallate	$2.85\ x10^{-4} \pm 4.61\ x10^{-6}$
(-)-Epigallocatechin-3-gallate	$2.36\ x10^{-3} \pm 1.28\ x10^{-4}$
Isorhamnetin	$3.26 \pm 2.22\ x10^{-2}$
Robinetin	$9.61\ x10^{-3} \pm 5.55\ x10^{-5}$
Myricetin	$1.62\ x10^{2} \pm 0.693$
Delphinidine	$7.23\ x10^{-3} \pm 9.39\ x10^{-5}$
Baicalein	$7.45\ x10^{-6} \pm 8.58\ x10^{-8}$
Sinensetin	$1.34\ x10^{-2} \pm 5.76\ x10^{-4}$
Eupalestin	$4.28\ x10^{-3} \pm 1.33\ x10^{-4}$
Nobiletin	$7.40\ x10^{-3} \pm 1.10\ x10^{-4}$
Baicalin	$1.47\ x10^{-5} \pm 5.76\ x10^{-7}$
Tageretin	$4.19\ x10^{-3} \pm 3.25\ x10^{-5}$
Naringin	$2.44\ x10^{-3} \pm 1.84\ x10^{-5}$
Artemetin	$2.27\ x10^{-3} \pm 3.03\ x10^{-5}$
Silymarin	$6.38\ x10^{-3} \pm 5.45\ x10^{-5}$
Rutin	$9.18\ x10^{-3} \pm 9.33\ x10^{-5}$
Hesperidin	$1.48\ x10^{-3} \pm 1.51\ x10^{-5}$
Nasunin	$1.77\ x10^{-3} \pm 3.09\ x10^{-5}$

Means ± SEM for three determinations

The chromatogram for the fatty acid profile of *Solanum melongena* (round variety) is shown in Fig. 4. The various types of fatty acid present in *Solanum melongena* (round variety) include, linoleic acid (C18:2), palmitic acid (C16:0) and oleic acid (C18:1), which were present in high amounts (Table 3).



Legend: Y axis = Area, X axis = Retention time

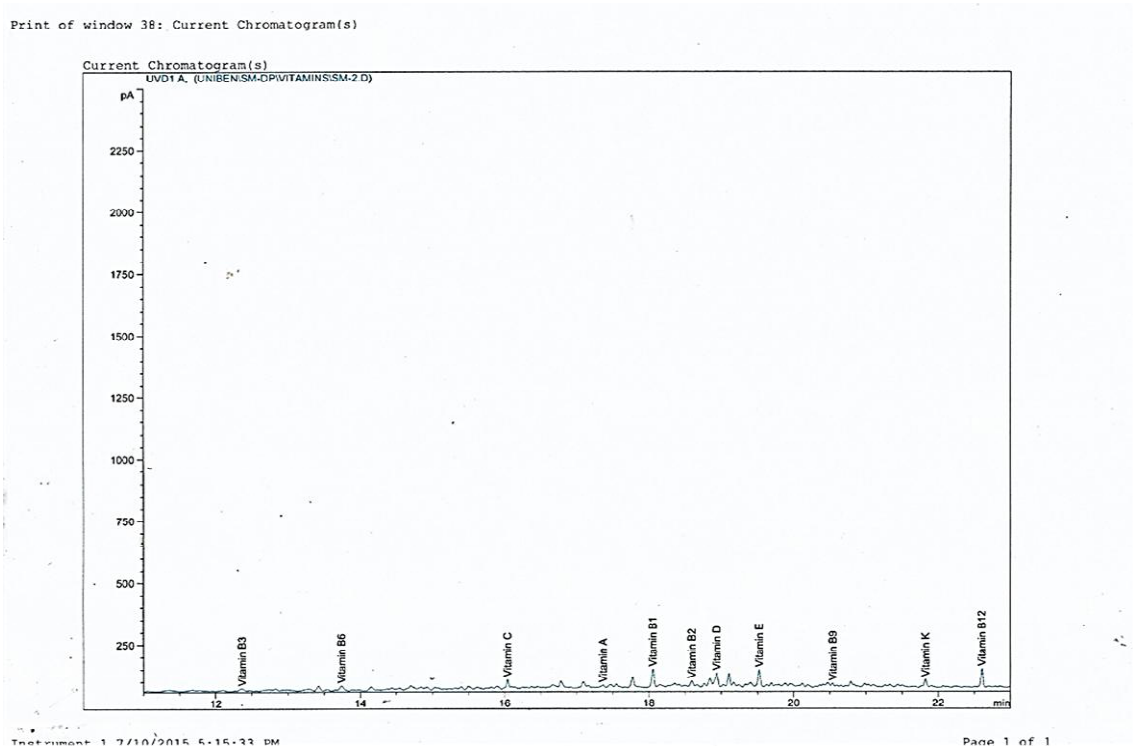
Fig 4. Chromatogram of the fatty acid profile of *Solanum melongena* (round variety)

Table 3. Fatty acid profile of *Solanum melongena* (round variety)

Fatty acid methyl ester	%
Caprylic Acid (C8:0)	0.00 ± 0.00
Capric Acid (C10:0)	0.00 ± 0.00
Lauric Acid (C12:0)	0.00 ± 0.00
Myristic Acid (C14:0)	0.00 ± 0.00
Palmitic Acid (C16:0)	15.1 ± 0.194
Palmitoleic Acid (C16:1)	2.46 ± 0.0854
Margaric Acid (C17:0)	0.00 ± 0.00
Stearic Acid (C18:0)	4.35 ± 0.255
Oleic Acid (C18:1)	14.0 ± 0.115
Linoleic Acid (C18:2)	57.9 ± 0.387
Linolenic Acid (C18:3)	5.96 ± 0.0852
Arachidic Acid (C20:0)	0.0435 ± 0.00781
Arachidonic Acid (C20:4)	0.00 ± 0.00
Behenic Acid (C20:0)	0.136 ± 0.0238
Eurucic Acid (C22:1)	0.00 ± 0.00
Lignoceric Acid (C24:0)	0.00 ± 0.00

Means± SEM for three determinations

The chromatogram for vitamin profile of *Solanum melongena* (round variety) is shown in Fig. 5. The various types of vitamins present in *Solanum melongena* (round variety) include vitamin A and vitamin C, which were present in high amounts (Table 4).



Legend: Y axis=Area, X axis=Retention time

Fig 5. Chromatogram of the vitamin profile of *Solanum melongena* (round variety)

Table 4: Vitamin Profile of *Solanum melongena* (round variety)

Vitamin	Amount (mg/100g Dry weight)
Vitamin B3	1.47 ± 0.02
Vitamin B6	0.08 ± 0.00
Vitamin C	13.96 ± 0.23
Vitamin A	27.07 ± 0.42
Vitamin B1	0.05 ± 0.00
Vitamin B2	0.05 ± 0.00
Vitamin D	0.03 ± 0.00
Vitamin E	0.01 ± 0.00
Vitamin B9	0.00 ± 0.00
Vitamin K	0.02 ± 0.00
Vitamin B12	0.51 ± 0.00

Means± SEM for three determinations

Discussion

Alkaloids such as solamargine, solasonine, solanidine, alpha-chaconine, alpha-solanine were present in higher concentrations compared to others which appeared at relatively insignificant levels in the unripe fruits of *Solanum melongena* (round variety) (Fig. 2 and Table 1). These bioactive alkaloids have been reported to serve as important sources of medicines such as contraceptives and steroidal anti-inflammatory drugs (Maurya *et al*., 2013). Biological investigations of solamargine and solasonine showed that they have significant cytotoxicity against several human cancer lines and skin tumours (Maurya *et al*., 2009).

The main flavonoids found in the unripe *Solanum melongena* fruits (round variety) include, Kaemferol ($6.4 \times 10^2 \pm 1.72$ mg/100g Dry weight), quercetin ($5.60 \times 10^2 \pm 4.81 \times 10^{-1}$ mg/100g Dry weight), myricertin ($1.62 \times 10^2 \pm 6.93 \times 10^{-1}$ mg/100g Dry weight), which were present in significant amounts (Fig. 3 and Table 2). Quercetin has been found to be the predominant flavonoid in the human diet (Manach *et al*., 2005). It naturally occurs as a glucoside or as various glycoside forms that are either hydrolyzed by intestinal enzymes or by the colonic microflora before they can be absorbed. Quercetin is of particular interest, because micro molar plasma concentration is achievable through diet and has been reported to possess hepatoprotective properties (Tapas *et al*., 2008). This flavonoid also has anti-inflammatory and analgesic effects; quercetin is known to produce cell cycle arrest in proliferating lymphoid cells. In addition to its anti-neoplastic activity, quercetin exerted growth-inhibitory effects on several malignant tumor cell lines *in vitro* (Middleton, 2000). It has been experimentally proven that increased signal transduction in human breast cancer cells is markedly reduced by quercetin, which acts as an anti-proliferative agent.

Gas chromatographic analysis of fatty acid profile of the unripe fruits of *Solanum melongena* (round variety) showed that linoleic acid was significantly higher ($p<0.01$) than the other fatty acids (Fig. 4 and Table 3). Eggplants (*Solanum* species) have been reported to reduce LDL/HDL ratio and increase HDL/LDL ratio in hypercholesterolemic rabbits (Igwe *et al*., 2003; Odetola *et al*., 2004). They are ideal fruits for individuals with increased serum lipid levels, high blood pressure and other ischemic heart diseases. The results that were obtained in this study on the fatty acid profile of these fruits support these nutritional benefits. Oleic acid was found to be significantly higher ($p<0.01$) than arachidic acid, behenic acid and linolenic acid but significantly lower than linoleic acid. Oleic acid consumption has been associated with decreased low-density lipoprotein cholesterol (LDL cholesterol), and increased high density lipoprotein cholesterol (HDL cholesterol) (Smolinske and Susan, 2001). In epidemiological and clinical studies, stearic acid was also found to be associated with lowered LDL cholesterol in comparison with other saturated fatty acids (Hunter *et al*., 2009). Palmitic acid was found to be significantly higher than arachidic acid, oleic acid, behenic acid, palmitoleic acid and linolenic acid but significantly lower than linoleic acid, which has been reported to lower blood cholesterol level.

Linoleic acid was significantly higher ($p<0.01$) than all the other fatty acids in this study (Table 3). There is some evidence that linolenic acid consumption has preventive effect against cardiovascular diseases due to its blood cholesterol lowering ability (Pan *et al*., 2012). This therefore means that consumption of eggplants would also be useful in the prevention and treatment of hypercholesterolemia since these fruits are rich in linoleic acid. Linoleic acid has also become increasingly popular in the beauty products industry because of its beneficial properties on the skin. Research points to linoleic acid's anti-inflammatory, acne reductive, and moisture retentive properties when applied topically on the skin (Darmstadt *et al*., 2002). Palmitoleic acid is a beneficial fatty acid which has been shown to increase insulin sensitivity by suppressing inflammation, as well as inhibiting the destruction of insulin-secreting pancreatic beta cells (Yang *et al*., 2011). Fatty acids are the major sources of energy but should be consumed with caution so as to avoid obesity and other related diseases. The moderate levels of fatty acids in these fruits will prevent obesity and other related diseases. Moreover, the high levels of unsaturated fatty acids in these fruits will help to exert colon-cancer preventive effects (Showemimo and Olarewaju, 2004).

Vitamin profile of the unripe fruits of *Solanum melongena* (round variety) contained vitamin A (retinol) and other vitamins that are required for proper growth, development and maintenance of good health (Fig. 5 and Table 4). The presence of these vitamins supports the use of eggplants as a food delicacy in different parts of the world (Akunyili *et al*., 2013; Offor, 2015). Vitamins A and C were present in significantly high amounts in these fruits; however, vitamin A level (27.07 ± 0.42 mg/100g) was higher than vitamin C (13.96 ± 0.23 mg/100g). The high level of vitamin A in these fruits correlates with the report of Akunyili *et al*., (2013) that garden egg (eggplant) can be used for the prevention or treatment of glaucoma. Since retinol (vitamin A) is important for normal vision, gene expression, growth, immune function and maintenance of epithelial cell functions (Lukaski, 2004).Vitamin C (Ascorbic acid) found in significant amounts in these fruits is a very import antioxidant protects against scurvy and other ascorbic acid deficiency related ailments. Other vitamins that are present in these fruits are vital for energy production and keeping of the mucus membrane healthy.

Conclusion

Nutritional and phytochemical profiles of the unripe fruits of *Solanum melongena* L. (round variety) as observed in this study support the possible therapeutic and ethnomedicinal values of these fruits. The highly beneficial bioactive compounds and nutrients that are present in these fruits could also be exploited in drug development and nutritional supplement.

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