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# Comparative study of the effect of boiling on nutritional composition of garden egg (Solanum melogena)

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**Abstract**
Garden egg is a plant with edible fruit and its potential as a medicinal fruit have also been investigated. Extract has been suggested to have effects that could be therapeutic and nutritional. Analyses were carried out to determine the proximate and phytochemical constituents of both processed and raw indigenous Africa eggplant (Solanum macrocarpon and solanum aethiopicum). Proximate analysis of process and raw solanum macrocarpon (WBA) per (100%) showed: 75.13% moisture, 3.50% protein, 1.40% lipid, 3.40% ash contents, 5.14% crude fibre, and 11.43% carbohydrates. And raw which is (WUA) showed: 72.11% moisture, 4.25% protein, 1.96% lipid, 3.90% ash content, 5.40% crude fibre and 12.38% carbohydrates. While that of processed Solanum aethiopicum (GBA) shows: 73.70%moisthere,4.05% crude protein, 0.91% lipid, 8.90% crude fiber, 3.36% Ash content, carbohydrates 9.08% and the GUA show: 71.96% moisture, 4.14% crude protein, 1.01%lipid, 8.56%crude fiber, 4.02%ash and the available cabohydrate 10.38%.
There was a significant presence of alkaloid, saponin, flavonoid, terpenoid, and absence of phlobatannin and steroids in WBA, while WUA shows the presence of phlobatannin, and absence of Tannins, saponins, glycosides and steroids. Saponins Glycoside and Tannins were present WBA and absent in WUA. Solanum aethiopicum in the other hand shows the presence of saponnin, flavornoid, alkaloids and absence of tannin, phlobatannins and steroids in both GBA and GUA, terpenoids and Glycoside are absent in GBA but present GUA.
The results should that the moisture content of WBA was higher than that of WUA, and other nutrients such as protein, lipid, fiber, Ash,and carbohydrates are significantly higher in WUA than WBA. In same vein, The moisture content is higher in GBA than in GUA, while the protein, lipid, Ash and carbohydrates are higher in GUA leaving only crude fiber higher in GBA.

**Keywords:** fruits, plants, unboiled, air-dried, boiled, raw, nutrients

## Introduction
Garden egg (*Solanum aethiopicum L.*) belong to the family *Solanaceae*, sub family *solanoidase*. The solanaceae is an highly rated family in the plant kingdom (Bremer *et al.*, 2003). It has estimated number of 2450 species with great variation in habit, morphology and ecology (Mabberley, 2008). The family is rated as third in economic importance and is known as a source of many morphologically different domesticated crop species beneficial to human health, diet, beauty and ornamental use (Mueller *et al.*, 2005; Sekura *et al.*, 2007), Potato, petunia pepper, tomatoes, tobacco and eggplant are some of the valuable family member (Doganlar *et al.*, 2000). The eggplants is a major part of the traditionas and culture of sub-Saharan African. The fruits is known to represent blessings and fruitfulness, are offered as a piece of goodwill during visits, marriages ceremonies and other social or marital events. They are eaten raw and also eaten boiled or boiled and then fried for eaten yams and also as ingredient of stews, soups and vegetables sauces. Wide variations exist within and between the African eggplant species including variations in characters like diameter of corolla, petiole length, leaf blade width, plant branching, fruit shape, and fruit color. They are used indigenously as medicine for weight loss and treatment of several ailments. Saveral studies support the folkloric use of the plant in local foods and medicinal preparation; for instance, different researchers have reported significant analgesic, anti-inflammatory, anti-asthmatic, anti-glaucoma, hypoglycemic, hypolipidemic and weight reduction effects of eggplants, particularly *S. Melongena*, on test animals and human. (Bello S.O. *et al.*, 2005) [3] These pharmacological properties have been attributed to presence of certain chemical substances in the plants, such as fiber, ascorbic acid, phenols, anthocyanin, glycoalkaloids, X-chaconine (Alozie S.O, *et al.*, 1978) [2] and other nutritional components such as protein, moisture, vitamins etc, Studies have shown that the eggplants are rich in protein, fat, crude, fibre, calcium, zinc (Oboh, *et al.*, 2005) [5] and have gastric medicinal benefits (Bonsu, *et al.*, 2004) [4]. Eggplants also aid in treatment of constipation, ulcers, tooth ache and also snake bite antidote (Oladiran, 1989) [6]. It is used in treatment of skin diseases infections and sores (Edijola, *Et al.*, 2005)
Generally, the fruit has been used as an indigenous medicine for the treatment of several ailments such as asthma, allergic rhinitis, nasal catarrh, skin infections, rheumatic disease and swollen joint pains, gastroesophageal reflux disease, constipation, dyspepsia and also in weight reduction (D *macrocarpon* alziel,

1937). The aqueous fruit extract of the plant, has also been reported to exhibit lipid lowering activities as well as renal and hepatoprotective effect in diet-induced hypercholesterolemia in rats (Sodipo, *Et al.*, 2009). High phenolic and flavonoid content, thus possessing a potent antioxidant activity which can offer good protection against oxidative damage to body tissues (Adewale *et al.*, 2014). *Garden egg* is a widespread plant genus of the family *Solanacene*, has over 1000 species worldwide with at least one hundred species in Africa and adjacent island; these include number of valuable crops, plants and some poisonous ones; and it is represented in Nigeria by some 25 species including those domesticated with their leaves fruits or both, out of which *solanum macrocarpon and Aethiopicum* are two of them. (Gbile, *et al.*, 1987). *S. macrocarpon and S. Aethiopicum*, (Gboma eggplant), are widely cultivated in Nigeria and across the African continent. (Bonsu. K.O, *et al.*, 2002) [4] (Hausa: Dauta, Igbo: oranara, Yoruba: Igbagba), are highly valued constituents of the Nigeria food and indigenous medicines, they are commonly consumed almost on daily, basis (during its season) by both rural and urban families. (Tindal H.O, 1915)

This research aims at knowing the effect of boiling on the nutritional composition of two species of garden egg that are very much available in Nigeria (Solanum Macrocapon and Solanum Aethiopicum)

## Materials and Methods

### Materials

Petroleum ether, KOH, HCl, $H_2SO_4$, acid, kjedahl catalyst, NaOH, mixed indicator, weighing balance, filter paper, petridish, round bottom flask, soxhlet apparatus, oven, dessicator, burette, burner, muffle furnace, heating mantle, crucible, thread, beaker, musling cloth and pipette etc.

### Sample Preparation

The samples were bought during rainy season of year 2021, from Oja Oba market in Owo, Owo local Government Area of Ondo State, Nigeria. They were washed and each of them was divided into two parts, after which one part was of each sample was boiled and the other part was left raw and both part were dried for 60 days. Each of the samples was grounded using electric blender and were kept inside airtight containers. The S. Aethiopicum which is the green one was labeled: Green boiled Airdrie (GBA) and Green unboiled air-dried (GUA)., While the S. Macrocarpon which is white in color and oval in shape was labeled: White Boiled Air-dried (WBA) and White Unboiled air-dried (WUA) respectively.

### Methods

### Fats Content Determination

A fat free and clean filter paper was weighed (W1) and 5g of the sample was added to the filter paper and was then weighed again as (W2). This was tied with thread and dropped inside the thimble of soxhlet apparatus. 250ml of petroleum ether was poured into the round bottom flask of the apparatus. The soxhlet apparatus was set up on a heating mantle and the extraction process occurred for four hours. Petroleum ether siphoned over the barrel, the condenser was detached and the thimble was removed.

The solvent-extract (lipids) mixture was carefully poured into a clean dried petridish and transferred into a fume cupboard for 2 hours and the solvent evaporated and it was remaining the fat that was extracted. The filter paper containing the residue was dropped in a beaker and then in an oven at 50°C and was dried to a constant weight. The filter paper was later cooled inside desiccators and reweighed again (W3). The percentage fat was calculated.

$$\% \text{ fat content} = \frac{W2-W3}{W2-W1} \times \frac{100}{1}$$

### Moisture Content Determination

Clean and dry crucible was weighed and its weight was recorded (W1), sample was added into the empty crucible and their weight was also recorded as (W2).

The crucible containing the sample was transferred into the oven at 105°C and was dried for four hours. The crusible was transferred into desiccators and was cooled for one hour and it was reweighed again (W3). The percentage moisture content was calculated

The moisture content was determined by using drying method which is based on weight loss.

$$\text{Moisture content} = \frac{W_2 - W_3 \times 100}{W_2 - W_1}$$

### Ash Content Determination

A clean crucible was weighed and the weight was recorded ($W_1$). 2g of sample was weighed into the crucible ($W_2$) and was transferred into the muffle furnace and the muffle furnace was ignited at 600 C for four hours until a grayish white substance was obtained. The crucible was transferred into a desiccator and was cooled and was reweighed again ($W_3$).

The percentage ash content was calculated;

$$\% \text{ ash content} = \frac{W_3 - W_1 x\ 100}{W_2 - W_1 \quad 1}$$

**Crude Fibre Content Determination**
5g of the defatted sample was weighed ($W_1$) into 2500ml of conical flask. 200ml of 1.25% $H_2SO_4$ was added and was brought to boiling 30minutes then was allowed to cool and was filtered through poplin cloth by suction using Bunchier funnel and was rinsed well with hot distilled water. The residue was scrapped back into flask with spatula and 200ml of 1.25% NaOH was added and was boiled gently for 30minutes and was cooled and filtered through poplin cloth and was washed with hot distilled water, and once with 10% HCL, four times again with hot water, twice with methylated spirit. The residue was savage into crucible after drain, and was dried in an oven at 105°C and cooled in desiccator and was weighed ($W_2$). The crucible containing the residue was placed in muffle furnace at about 300°C for about 30 minutes, and removed into desiccator and cooled to room temperature and weighed again ($W_3$).

$$\% \text{ crude fibre} = \frac{W_2 - W_3 \text{ x } 100}{W1}$$

**Determination of Protein Contents**
2g of sample was weighed into 50ml kjedahl flask, and 12.5ml of concentrated $H_2SO_4$ was added with one kjedahl catalyst tablet. The flask was peated on a heater with a low heat for about 15minutes, and increase to medium heat for about 30minutes and finally at high heat until digested. The flask was rotated at intervals until the digest is clear, and the heating continue for few minutes after that to ascertain completed digestion. The flask was allowed to cool and the sample residue was washed and filtered, to make the digest up to 50ml ($V_1$).
After the digestion was completed, 5ml of 2% boric acid ($H_3BO_3$) was placed into 100ml conical flask (as receiving flask) and 3 drops of mixed indicator was added. The receiving flask, was placed so that the tip of the condenser tube is below the surface of the boric acid, out of the 50ml of the digest 5ml ($V_2$) was pipetted into the distillation tube and 10ml of 40% NaOH was added. The heater was turn on and the distillation continues until approximately 50ml of distillate has been collected into the receiving flask, and then the heater was turn off. The distillate was titrated with 0.01M HCl and blank was titrated with the acid as well.

$$\%N = \frac{MxTx0.014 \text{ x } V_1 \text{ x } 100}{W \quad V2 \quad 1}$$

$$\% \text{ protein} = \% \text{ N x } 6.25$$

**Carbohydrate Content Determination**
The term carbohydrate embraces in broad spectrum of compound ranging from simple monosaccharide to complex polysaccharides. This carbohydrate content determination was done by subtracting of the sum of all the nutrient content determination from total weight.

CHO = 100 - (% protein + % fat + % ash +% moisture + % fibre)

**Phytochemical screening of the sample**
**Test for Tannins**
Each sample (0.30g) was weighed into a test tube and boiled for 10 minutes in a water bath containing 30$cm^3$ of water. Filtration was carried out after boiling using number 42 (125mm) whatman filter paper. To 5$cm^3$ of the filtrate was added 3 drops of 0.1% ferric chloride. A brownish green or blue-black coloration showed positive test. (Eikeme *et al.*, 2009).

**Test for Phlobatannins**
To each sample (0.30g) weighed into a beaker was added 30$cm^3$ of distilled water. After 24hours of extraction (10$cm^3$) of each sample was boiled with 5$cm^3$ of 1% aqueous hydrochloric acid. Deposit of red precipitate showed positive test. (Eikeme *et al.*, 2009).

**Test of Saponnin**
Distilled water (30$cm^3$) was added to the sample (0.30g) and boiled for 10minutes in water bath and filtered using whatman filter paper number 42 (125mm). A mixture of distilled water (5$cm^3$) and filtrate (10$cm^3$) was agitated vigorously for a stable persistent froth. The formation of emulsion on addition of three drops of olive oil showed positive result. (Eikeme *et al.*, 2009).

**Test for Steroid**
Each sample (0.30g) weighed into a beaker was mixed with 20$cm^3$ of ethanol. The component was extracted for 2hours. To the ethanol extract of each sample (5cm)$^3$ was added 2cm acetic acetic anhydride followed with 2$cm^3$

of concentrated tetraoxosulphate (vi) acid. A violet to blue or green colour change in sample indicates the presence of steroids. (Eikeme *et al.,* 2009).

**Test for Terpenoids**

Each wood powder sample (030g) was weighed into a beaker and extracted with 30cm$^3$ and component extracted for 2 hours. A mixture of chloroform (2cm$^3$) and concentrated tetraoxosulphate (VI) acid (3cm$^3$) was added to 5cm$^3$ of each extract to form a layer. The presence of a reddish brown colouration at the interface shows positive results for the presence of terpenoids. (Eikeme *et al.,* 2009).

**Test for Flavovoids**

Each sample (0.30g) weighed into a beaker was extracted with 30cm$^3$ of distilled water for 2hours and filtered with whatman filter paper number 42(125mm). To 10cm$^3$of the aqueous filtrate of each Sample extract was added 5cm$^3$ of 1.0m dilute solution followed by the addition of 5cm$^3$ of concentrated tetraoxosulphate (vi) acid. Appearance of yellow colouration which disappeard on standing shows the presence of flavonoids. (Sofowara and Harborne**)**

**Test for Alkaloids**

Extraction of component from 2 grams of each sample was carried out using 5% tetraoxosulphate (vi) acid ($H_2SO_4$) (20cm3) in 50% ethanol by boiling for 2 minutes and filtered through whatman filter paper number 42 (125mm). the filtrate was made alkaline using 5cm$^3$ of 28% ammonia solution (NH3) in a separating funnel. Equal volume of chloroform (5.0cm$^3$) was used in further solution extraction in which chloroform solution was extracted with 5cm$^3$ portions of 1.0m dilute tetraoxosulphate (VI) acid. This final acid extract was then used to carry out the following test: 0.5cm$^3$ of Draendorff's reagent (Bismuth potassium iodide solution) was mixed with 2cm$^3$ of acid extract and precipitated orange colour infers the presence of alkaloids. (Eikeme *et al.,* 2009).

**Test for Glycoside**

To 2.00g of each sample was added 20cm$^3$ of water, heated for 5 minutes on a water bath and filtered through Gem filter paper (12.5cm). The following tests were carried out with the filtrate.

A. 0.2cm$^3$ of Fehling's solution A and B was mixed with 5cm$^3$ of the filtrate until it became alkaline (test with litmus paper). A brick-red colouration on healing showed a positive result.

Instead of water, 15cm$^3$ of 1.0M sulphuric acid was used to repeat the above test and the quantity of precipitate obtained compared with that of (a) above. High precipitate content indicates the presence of glycoside while low content show the absence of glycoside. (Eikeme *et al.,* 2009).

**Results and Discussion**

**Table 1:** Result of phytochemical screening of raw and processed *Solanum macrocarpon*

| Phytochemical. | WBA | WUA | GBA | GUA |
|---|---|---|---|---|
| Tannins | + | – | – | – |
| Phlobatannin | – | + | – | – |
| Saponin. | + | – | + | + |
| Flavornoid. | + | + | + | + |
| Terpenoid. | + | + | – | + |
| Alkaloid | + | + | + | + |
| Steroids | – | – | – | – |
| Glycosides | + | – | – | + |

(+ Presmt and _ Absent.)

**Table 2:** Result of proximate composition of raw and processed *Solanum macrocarpon*

| Proximate | WBA | WUA | GBA. | GUA |
|---|---|---|---|---|
| Moisture | 75.13±0.16 | 72.11±0.33. | 73.70±0.24 | 71.96±0.61 |
| Crude protein | 3.50 ±0.021 | 4.25± 0.053 | 4.05±0.07 | 4.14±0.08 |
| Lipid | 1.40±0.09 | 1.96±0.031. | 0.91±0.01 | 1.01±0.03 |
| Crude fiber | 5.14±0.024 | 5. 40±0.01. | 8.90±0.23 | 8.56±0.11 |
| Ash content | 3.40±0.095 | 3.90±0.00. | 3.36±0.06 | 4.02±0.05 |
| Available carbohydrates | 11.43±0.01 | 12.38±00. | 9.08±0.04 | 10.38±0.21 |

**Discussion**

The table 1 above shows the results of proximate analysis of both processed and raw *Solanium macrocarpon* and Solanum aethiopicum. The carbohydrate content (11.43±0.04WBA, 12.38±0.00 WUA) Solanum Macrocapon, (9.08±0.04 GBA, 10.38±021 GUA) S. Aethiopicum. And the fibre content (5.14±0.24 WBA, 5.40±0.01 WUA)

S. Macrocapon, (8.90± 0.23 GBA, 8.56±0.11 GUA) S. Aethiopicum. And fibre. The crude lipid (1.40±0.09 WBA, 1.96±0.01 WUA) S. Macrocapon, (0.91±0.01 GBA, 1.01±0.03 GUA) S. Aethiopicum. Ash (3.40±0.05 WBA, 3.90±0.00 WUA) S. Macrocapon, (3.36±0.04 GBA, 4.02±0.05 GUA) S. Aethiopicum, The crude protein (3.50±0.02 WBA, 4.25±0.05 WUA) S. Macrocapon, (4.05±0.07 GBA, 4.14±0.08 GUA) S. Aethiopicum. The lipid (1.40±0.09 WBA, 0.96±0.03 WUA) S. Macrocapon, (0.91±0.01 GBA, 1.01±0.03 GUA) S. Aethiopicum. This study indicate that the moisture content of WBA is higher than WUA, and GBA is also higher than GUA, which implies that boiling increases the moisture content of both species. Also the average moisture content of S. Macrocapon is higher than that of S. Aethiopicum.

The crude protein, lipid, crude fiber and Ash content of WUA are relatively higher than that of WBA and same goes to GUA and GBA. This is because heating has had great effect on WBA and GBA. (Research, SSA and AWORINDE Rebecca, 2021). The high moisture content of both species of garden egg is pointing to the fact that the fruits is perishable and has short life span, and therefore should be stored under cool temperature in order to reduce it's perishability. Both species, (both boiled and unboil) are low in lipid which is the same with the statement made by (Sabo and Dia, 2009) [10].

The higher moisture content, moderate ash and protein content of the garden egg is typical of fleshy vegetables and desirable to remain fresh for shorter period. High crude fibre and low-fat may be helpful in preventing diseases such as constipation, carcinoma of the colon and rectum, diverticulitis and other related diseases. This may also partly account for the weight reduction effect.

Table 2 shows the results of the Phytochemical screening of the two species of garden egg. These results reveal that both plants contain alkaloid, terpenoid, flavonoid, while S. Aethiopicum contains saponnin. WBA contains Tannins, saponin, and glycosides which implies that the fruits may be source of antioxidants. In the other hand, those are absent in WUA while phlobatannins and steroids are absent in WBA but present in WUA. Tannin phlobatannins and steroids are completely absent in Aethiopicum while terpenoids and Glycoside are absent in GBA but present in GUA.Most of the observed effects of eggplants may be due to their phytochemical contents, the bitterness of eggplant is due to the presence of alkaloid. Saponin found in the WBA but absence in WUA are present in Solanum Aethiopicum and are important dietary supplements and nutritional. Economics and company are known to exhibit antimicrobial activities and protect plants from microbial pathogens (SCZKOWSKICP *et al.*, 1988).

The flavonoid is known to control high blood pressure and relieve stress (Harish *et al.*, 2008). Which means that both plants are good for controlling high blood pressure and equally relief stress.

**Conclusion**

The fruits of S. Macrocapon and S. Aethiopicum species of garden egg have been shown to possess very high amount of nuitrients, such as protein, crude fibre etc t and a reasonably good availability of phytochemical. This research indicate that the raw ones (WUA and GBA) contain higher amount of these nuitrients than the boiled ones (WBA and GBA) which implies that boiling has great effect on their nuitrients. Since these fruits are commonly cultivated in many Nigerian communities, they are recommended as part of a healthy balanced diet. Their low fat and fibre contents make them good choices for those wanting to lose weight and an antidote for digestive tract diseases.

There is a need to promote the use and preservation of this important but neglected crop.

It is therefore recommended that these fruits should be consumed raw in order to benefit from it's wholesome.

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