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Evaluation of Proximate and Phytochemical Constituents of Two Garden Egg Varieties Grown in Zaria Metropolis: Potential Applications in Livestock Health, Skin Quality and Leather Manufacturing

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ABSTRACT :

This study evaluates the proximate composition and phytochemical constituents of two garden egg varieties cultivated in Zaria metropolis, with a focus on their potential applications in animal feed, quality hide and skin, and leather production. The carbohydrate, fibre, ash and fat contents of S. melongena are respectively 68.85%, 8.18%, 5.51% and 2.10%, while their respective contents in S. gilo are 66.28%, 7.77%, 4.44% and 1.22%. Also, the protein and moisture contents of S. gilo are higher when compared with those of S. melongena. All the secondary metabolites tested were present in both species, except phenols, which are absent in S. melongena and steroid which is absent in S. gilo. The findings demonstrate that garden egg varieties contain nutrients and bioactive compounds with potential for improving animal nutrition and adding value to hide and leather production, warranting further research into their practical applications.

Key Words: Solanum spp, Proximate, Phytochemicals, Nutrients, Medicinals, Hide and skin, Leather.

INTRODUCTION

Garden eggs, which belong to the genus *Solanum*, are among the most widely consumed vegetables in many parts of Nigeria. They are valued for their availability, affordability, and rich nutritional benefits. It from tropical Africa and got its name from egg like shaped (Agorejo *et al.,* 2012). The garden egg is widely consumed and culturally significant fruit in West Africa and other tropical regions, particularly Nigeria. Vegetables generally contribute significantly to human nutrition because they supply vital nutrients such as vitamins, minerals, fibre, and diverse bioactive compounds. Garden eggs are no exception. Beyond its role as a food source, the African garden egg is deeply embedded in the traditional culture of sub-Saharan Africa. Consumed raw, boiled, or fried, it is a staple ingredient in various stews, soups, and sauces. In communities such as Ohodo in Igbo-Etiti, and across many West African cultures, the garden egg transcends its dietary function, serving as a symbol of hospitality and cultural heritage (Attamah *et al.,* 2025).

The ethnobotanical importance of S. melongena is well documented, with traditional medicine employing it for a range of health applications, from managing weight to treating conditions like asthma, skin infections, and gastrointestinal issues. Modern pharmacological studies have substantiated many of these traditional uses, demonstrating that eggplant extracts possess significant analgesic, anti-inflammatory, hypoglycemic, and hypolipidemic properties (Gürbüz *et al.,* 2018). These therapeutic effects are largely attributed to the fruit's rich composition of bioactive compounds, including dietary fiber, ascorbic acid, phenols, and anthocyanins (Docimo *et al.,* 2022).

To understand the nutritional and therapeutic value of a food, two key evaluations are often performed: proximate and phytochemical analysis. Proximate analysis determines the major macronutrient components of a food, including its moisture, ash, crude protein, fat, and fiber content (Olayanju *et al.,* 2020). Concurrently, phytochemical analysis identifies and quantifies the non-nutritive, plant-derived compounds responsible for a plant's defense mechanisms and many of its health benefits. These phytochemicals are recognized for their antioxidant, antimicrobial, cholesterol-lowering, and anti-inflammatory activities (Attamah *et al.,* 2025). In northern Nigeria particularly within Zaria metropolis two major varieties dominate local markets and diets: *Solanum melongena* (commonly known as the long, purple or oval eggplant) and *Solanum gilo* (often referred to as the African garden egg or green/white variety). These two species play essential roles in household nutrition, culinary practices, and traditional medicine. They are valued for their availability, affordability, and rich nutritional benefits. *Solanum melongena* and *Solanum gilo,* are widely cultivated and consumed vegetables in Nigeria (Grubben & Denton, 2004). They contribute to food security and provide essential nutrients, but their potential extends beyond human nutrition. Proximate analysis and phytochemical screening reveal its value for both nutritional and health applications (AOAC, 2012). Additionally, the nutrient profile of garden egg suggests its suitability as a component of animal feed, contributing to livestock health and productivity. Its application to improving the quality of hides and skins, and subsequently in leather production, highlights its industrial relevance and potential for value addition. This study evaluates the proximate and phytochemical constituents of two garden egg varieties grown in Zaria metropolis and explores their potential applications in animal feed, animal health, quality hide and skin enhancement, and leather production.

MATERIALS AND METHODS

Sample Collection and Preparation

Fresh samples of garden eggs (S. melongena and S. gilo) were bought within Zaria metropolis, and taken to the Department of Botany, Ahmadu Bello University (ABU) Zaria for identification and were properly labeled thereafter. They were washed with distilled water to remove all unwanted particles. The fruits were diced and portion of the fresh samples was isolated for the moisture content determination, while the rest samples were air-dried. The air-dried samples were pulverized, using an electric grinder. The powders were stored in air-tight container in refrigerator for further analysis like the proximate and phytochemical analyses.

Proximate Analysis

The proximate nutrients were determined in accordance with the official methods of the Association of Official Analytical Chemists, (AOAC, 2012).

Moisture Content Determination

The moisture content of the samples was determined using the hot air oven method, where the samples were heated at 105°C until a constant weight was achieved. An empty crucible was weighed into a crucible in triplicate, and then the sample was transferred into the crucible. This was taken into the hot air oven and dried for 24hours at 1000C. The crucible and its content were cooled in the desiccator and their weights taken. The loss in weight

was regarded as moisture content and expressed as:

$$\%Moisture = \frac{(W2-Wi)-(W3-Wi)}{Weight\ of\ sample} \times 100$$

This method effectively removes all moisture from the sample, providing an accurate measurement of the water content. The precision of this method is critical, as moisture content directly impacts the shelf life, texture, and overall quality of food products.

Protein Content Determination

The protein content was measured using the Macro kjeldahl method (AOAC, 2012) a widely recognized technique for quantifying the nitrogen content in organic substances, which was then converted to a protein content. This method was divided into three namely, digestion, distillation and titration. Approximately 1g of the sample was weighed into clean dried kjeldahl flask for digestion, and add 20ml of H_2SO_4 (sulphuric acid), and 1g copper tetraoxosulphate (iv) crystals. were added into the digestion flask. The flask was placed into the digestion block in the fume cupboard and heated until frothing ceased giving clear and light blue green coloration. The mixture was then allowed to cool and diluted with distilled water until it reached 250ml of volumetric flask. Distillation apparatus was connected, and 10ml of the mixture was poured into the receiver of the distillation apparatus also 60mls of 40% NaOH was added. The released ammonia by boric acid was then treated 0.02m of hydrochloric acid until the green colour change to purple. Followed by titration, titration is stopped (end point) when the colour of the distillate comes to the pink colour. Percentage protein in the sample was calculated using the formula below:

$$\%protein = \frac{TV \times N \times 0.014 \times 6.25}{Weight\ of\ used\ sample} \times 100$$

Fat Content Determination

About 2g of the sample was weighed into a filter paper and wrapped carefully and placed in the sample holder of the Soxhlet extraction apparatus. clean dried and weighed Soxhlet extraction flask was half filled with diethyl ether and the whole apparatus was assembled together, and the flask placed on the heating mantle and heated at 34°C. The fat was extracted for three hours, then, the sample holder was disconnected and the extraction flask removed. At the end of 3 hours (end extraction) the sample holder was disconnected and the sample removed. Then. the equipment is re-assembled with only the extraction flask and its oil content. The flask was then heated at 34°C and the solvent evaporated leaving the oil in the

flask. The oil was dried in a moisture extraction oven in order to remove the solvent residues in oil. The dried sampled was cooled in a desiccator and re-weighed. The drying. cooling, and re-weighing of the
oil sample were repeated until a constant weight was obtained. The percentage fat content was determined thus;

%crude fat = $\frac{W1-W2}{weight\ of\ sample} \times 100$

This method was particularly effective for determining the total lipid content in food, which was essential for understanding the caloric value and nutritional profile of the sample.

Ash Content Determination

Ash content, which represents the total mineral content of the food, was determined according to the ASTM D2939 method. In this process, an empty crucible was weighed and about 5g of each sample was added into the crucibles in triplicate, and then the sample was incinerated in a muffle furnace at 550°C until a light grey ash was observed and a constant weight obtained. The sample was cooled in the desiccator to avoid absorption of` moisture and weighed to obtain the ash content.

% ash = $\frac{W2-W1}{Weight\ of\ sample} \times 100$

This method provides insight into the mineral composition of the food, which was crucial for assessing its nutritional value.

Crude Fiber Content Determination

5g of each sample was weighed into 250ml beaker containing 200ml of 0.125M tetraoxosulphate (iv) acids (or 0.75M sulphuric acid). It was then brought to boiling and refluxed for exactly 40 minutes counting from the start of boiling. The flask was removed from the heater, cooled a little then filtered using a muslin cloth over a Buckner funnel. The residue is washed three times with hot water to remove the acid and then put into a beaker containing 200ml of potassium hydroxide. The mixture was heated as before over steam bath for 2 hours. The solution was filtered and the residue washed three times with hot water then with alcohol and water. The final residue obtained was put in a clean pre-weighed crucible and dried at 1200"C to a constant weight. The crucible with the oven dried sample was put in a muffle furnace and ash at 5500°C for 30 minutes such that the sample becomes white ash. The crucible and its contents were removed from the furnace cooled in a desiccator and re-weighed. Percentage fibre was calculated
as followed;

%crude fibre = $\frac{Weight\ of\ oven\ dried\ sample - weight\ of\ ash}{Initial\ weight\ of\ sample} \times 100$

Carbohydrate Content Determination

The carbohydrate content of the sample was obtained through estimation by difference method.

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

This method provides an estimate of the total carbohydrate content in the food sample, which was a critical component of the overall energy value. These methods are fundamental in food analysis, providing essential data for nutritional labelling, quality control, and research. The accuracy and reliability of these techniques ensure that food products meet regulatory standards and consumer expectations.

Phytochemical Screening

All reagents and chemicals used for the phytochemical screening were of analytical grade, and standard analytical methods were used.

RESULTS AND DISCUSIONS

Table 1: Proximate Composition

Parameter	*Solanum melongena (%)*	*Solanum gilo (%)*
Ash	5.51	4.44
Moisture	11.11	14.30
Fibre	8.18	7.77
Fat	2.10	1.22
Protein	4.25	5.49
Carbohydrate	68.85	66.28

Table 2: Phytochemical Screening

Phytochemical	*Solanum melongena*	*Solanum gilo*
Tannins	+	+
Saponins	+	+
Flavonoids	+	+
Alkaloids	+	+
Glycosides	+	+
Phenols	–	+
Lipids	+	+
Oxalate	+	+
Phytate	+	+
Steroid	+	–
Quinone	+	+

Key:

Absent = (-)

Present = (+)

The results obtained from the proximate compositions of the two varieties of garden eggs (*S. melongena,* and *S. gilo*) as shown in table 1, revealed that both contain ash, moisture, fat, fiber, protein and carbohydrate in different proportions. The ash (5.51%), fiber (8.18%), fat (2.10%) and carbohydrate (68.85%) contents are higher in *S. melongena* than in *S. gilo*. On the other hand, the moisture (14.30%), and protein (5.49%) compositions are higher in *S. gilo.*

The proximate analysis of *S. melongena* and *S. gilo* revealed the presence of ash, moisture, fat, fiber, protein, and carbohydrates, albeit in differing proportions. The moderate moisture content in our samples is consistent with the general understanding that eggplant fruits are rich in water (Sharma and Kaushik, 2021). Furthermore, our findings contribute to the body of evidence, such as that provided by Obembe *et al.* (2023) demonstrating significant nutritional variability across different Solanum species.

The lower moisture content observed in *S. melongena* is particularly noteworthy. A reduced moisture level is a key factor in inhibiting the growth of microorganisms, thereby preventing spoilage. This principle is well-established, as the water activity of a food product is a primary determinant of its stability and susceptibility to microbial contamination (Rahman and Al-Farsi, 2020). Consequently, the lower moisture in *S. melongena* may contribute to its extended shelf life than *S. gilo*, asserting its suitability to be incorporated into animal feeds.

The protein content in both S. melongena was found to be appreciable and is comparable. As a fundamental dietary component, protein supplies essential amino acids required for tissue repair, immune function, and overall physiological regulation. The protein levels in the varieties suggest that *S. gilo* and, to a lesser extent, *S. melongena* can serve as valuable supplementary protein sources in animal feeds. Adequate protein intake ensures healthy skin and hide's development. It enhances collagen synthesis, leading to the growth of strong, resilient skin, which translates to higher quality and durable hides or leather (Kumar, 2017).

In this study, the ash content of the garden egg was higher in range than that reported by Adeyeye *et al.* (2020). This finding corroborates the understanding that ash content serves as a direct indicator of a food's total mineral composition. Therefore, the high ash levels observed suggest a corresponding high mineral profile in the garden eggs' varieties. Minerals like zinc, copper, and selenium support skin health and immune function.

Notably, the fiber content in our samples diverged from the findings of Obembe *et al.* (2023) and Adeyeye *et al.* (2020), who reported different levels in their respective analyses of eggplant species. The high fiber content found in this study is particularly significant due to its well-documented health benefits. Dietary fiber is crucial for maintaining intestinal motility and has been strongly linked to a reduced risk of coronary heart disease, hypertension, and type 2 diabetes (Reynolds *et al.,* 2019). It improves leather strength and stability (Zhang, 2018).

Similarly, the high carbohydrate content of the garden eggs in this study contrasts with the lower levels reported by Obembe *et al.* (2023) and Adeyeye *et al.* (2020) for other eggplant varieties. This high carbohydrate concentration indicates that S. melongena can be an effective source of dietary energy. Energy-rich carbohydrates support overall animal health, promoting healthy hide growth (Adeyemi, 2018). Sugars or starches can improve leather softness and flexibility (Sathis *et al.,* 2017).

The fat levels in our study are significantly low in both varieties compare to the those reported by Attamah *et al.,* (2025) in their studies. The fat content in *S. melongena* is higher than that of *S. gilo* by 0.88%. Low fat content could give a higher probability of longer shelf life of the sample in terms of rancidity. However, Fatty acids, particularly omega-3 and omega-6, support skin health, potentially leading to better leather quality. Optimal fat levels improve hide flexibility, softness, water resistance and texture, reducing defects (Kundu, 2019).

The phytochemical screening of the samples confirmed the presence of several bioactive compounds, which aligns with recent research identifying *S. melongena* as a rich source of valuable secondary metabolites (Plazas *et al.,* 2019).

The phytochemical screening results in Table1 shows that both the *Solanum melongena (S. melongena)* and *Solanum gilo (S. gilo)* contain many useful plant chemicals, as most of the tested compounds were present. Tannins, saponins, flavonoids, alkaloids, glycosides, lipids, oxalate, phytate, and quinones were all detected in both samples, which means the two varieties share many similar phytochemical properties. Phenols were absent in *S. melongena* but present in *S. gilo* showing one clear difference between the two varieties. Another difference is in steroids, which were found in *S. melongena* but not in *S. gilo*. These few variations suggest that while the two varieties are chemically similar, they still have some unique properties that may affect their nutritional and medicinal value. Overall, both varieties contain important phytochemicals that can contribute to health benefits, but *S. gilo* has phenols while *S. melongena* has steroids, making each sample slightly different in composition. The presence of these compounds substantiates the fruits' medicinal applications, as phytochemicals are known to exhibit analgesic, anti-inflammatory, and antimicrobial properties (Gürbüz *et al.,* 2018).

Phytochemicals are bioactive compounds found in plant-based feeds that can influence animal hide and skin quality. Tannins can bind to proteins, including collagen in hides, enhancing their strength and resistance to microbial degradation. Moderate levels of tannins in feed can improve hide quality by making it more resistant to putrefaction, similar to their role in leather tanning (Kundu, 2019). Flavonoids and Phenols act as antioxidants, reducing oxidative stress on skin cells. This can lead to improved hide texture and reduced defects. Studies on dietary antioxidants show benefits for skin health in animals (Liu, 2018). Saponins affect cell membrane permeability and have antimicrobial properties, potentially influencing skin health and hide quality indirectly by affecting overall animal health (Cheeke, 2000).

CONCLUSION

The presence of valuable proximate components and bioactive compounds in both garden egg varieties grown in Zaria metropolis justifies their widespread consumption. The levels of crude protein, fat, fibre, and carbohydrates indicate that the fruit is a beneficial source of energy and nutrients essential for human and animal growth and health. The impact of phytochemicals on hides and leather quality includes: improved collagen stability due to tannin-protein interactions. Enhanced resistance to microbial attack, reducing hide defects. Antioxidant effects leading to better skin texture and reduced oxidative damage. Animal feed technologists will find this information on the nutritional differences between *S. melongena* and *S. gilo* useful in feed formulation.

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