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Phytochemicals and Proximate Composition of *Citrullus Lanatus* (Watermelon) Seed

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Abstract: *Citrullus lanatus* (watermelon) is cultivated extensively in tropical and subtropical regions, primarily for its edible pulp, while the seeds are often discarded despite their nutritional and medicinal value. This study examined the proximate composition and phytochemical constituents of *C. lanatus* seeds to highlight their potential as a functional food resource. Fresh seeds were obtained from Onitsha, Anambra State, Nigeria, identified botanically, manually extracted, sun-dried, milled into flour, and stored under controlled conditions before analysis. Proximate parameters were determined following standard AOAC procedures, while phytochemical constituents were quantified using established laboratory methods. The proximate analysis showed moisture content of 24.18%, ash 4.45%, protein 22.89%, fibre 14.00%, lipids 24.41%, and carbohydrates 10.07%. Phytochemical screening indicated low levels of tannins (0.0009 µg/g) and phenols (0.0009 µg/g), moderate flavonoid content (131.5 µg/g), and high alkaloid concentration (239.3 µg/g). When compared with previously reported values for dried seeds, the present results revealed higher protein and alkaloid contents but lower fibre levels, variations attributable to differences in seed moisture, processing, and environmental conditions. The findings confirm that *C. lanatus* seeds are a rich source of proteins, lipids, and bioactive compounds with potential antioxidant and antimicrobial properties. Their utilization could contribute to dietary diversification, nutraceutical development, and the reduction of agricultural waste.

Keywords: *Citrullus Lanatus, Proximate Composition, Phytochemicals, Nutritional Value, Bioactive Compounds.*

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I. INTRODUCTION

Citrullus lanatus, commonly known as watermelon, is a widely cultivated fruit in tropical and subtropical regions due to its high water content and nutritional value. While the fruit pulp is widely consumed, the seeds are often discarded despite their rich phytochemical and nutritional profile. In recent years, the nutritional and medicinal potentials of watermelon seeds have gained increasing scientific attention due to the growing interest in plant-based sources of nutrients and bioactive compounds (Oseni & Okoye, 2013; Oyeyinka & Oyeyinka, 2020).

Watermelon seeds are known to contain a significant quantity of proteins, essential fatty acids, carbohydrates, minerals, and dietary fiber. Moreover, they are rich in phytochemicals such as phenolics, flavonoids, alkaloids, and saponins, which are known to exhibit antioxidant, antimicrobial, and anti-inflammatory properties (Oluba *et al.*, 2011; Ogunka-Nnoka & Mepba, 2021). The increased consumption of plant-derived nutraceuticals has prompted several researchers to explore underutilized seeds like those of *C. lanatus* as potential candidates for food fortification, pharmaceutical applications, and industrial use.

Despite the nutritional richness of watermelon seeds, their utilization remains limited in many communities due to a lack of awareness and scientific documentation of their proximate and phytochemical composition. Therefore, the present study investigates the phytochemical constituents and proximate composition of *C. lanatus* seeds to establish their potential value as a functional food ingredient.

II. REVIEW OF RELATED LITERATURE

➢ *The Botanical Profile of Citrullus Lanatus*

Citrullus lanatus belongs to the family Cucurbitaceae and is cultivated primarily for its edible fruit. The plant is characterized by trailing vines, yellow flowers, and large fruits with juicy pulp. The seeds are flat, oval-shaped, and

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vary in color from white to black. Although traditionally discarded, these seeds have been identified as nutritionally dense and rich in phytochemicals (Oluba *et al.*, 2011).

➢ *Nutritional Composition of Watermelon Seeds*

Watermelon seeds are an excellent source of essential nutrients. According to Oseni and Okoye (2013), the seeds contain high levels of proteins, fats (particularly unsaturated fatty acids), and carbohydrates. Oyeyinka and Oyeyinka (2020) also reported that the seeds contain significant amounts of minerals such as potassium, magnesium, calcium, and iron. Their nutritional profile positions them as potential functional ingredients in food formulations.

➢ Phytochemical Constituents of *Citrullus Lanatus* Seeds

The seeds of C. lanatus are known to contain a range of phytochemicals, including alkaloids, flavonoids, tannins, saponins, and phenolic compounds. These compounds are associated with biological properties such as antioxidant, anti-inflammatory, and antimicrobial activities (Ogunka-Nnoka & Mepba, 2021).

➢ *Health Benefits of Phytochemicals in Watermelon Seeds*

Flavonoids and phenolics have been shown to act as antioxidants that protect the body from oxidative stress-related diseases. Alkaloids and saponins contribute to antimicrobial and anti-inflammatory properties. These benefits make watermelon seeds suitable candidates for pharmaceutical applications (Oyeyinka & Oyeyinka, 2020).

➢ *Previous Studies on Watermelon Seed Composition*

Several researchers have explored the nutritional and chemical composition of watermelon seeds. Oluba *et al.* (2011) provided a detailed analysis of the fatty acid content of watermelon seed oil. More recently, Ogunka-Nnoka and Mepba (2021) compared phytochemical content from seeds obtained from different geographical locations, confirming variability based on environmental conditions.

III. MATERIALS AND METHODS

➢ *Sample Collection*

The sample used in this research work is watermelon (***Citrullus lanatus***) seeds. Watermelons were procured from a local market in Onitsha, Anambra state. The plant material was identified to species level at the Department of Botany, Faculty of Biological Sciences, Nnamdi Azikiwe University, Awka, by Mr. Finian Iroka with the Herbarium number: NAUH- 032 (BULB) and deposited in their herbarium. It was freshly peeled, air-dried, blended, and weighed.

➢ *Sample Preparation*

The watermelon fruit was washed and cut into four parts, and the seeds were easily extracted manually from the pulp. These seeds were shelled and sun-dried for four days. The shelled seeds were milled into flour in an electronic blender. The flour was then preserved for one week in an air-tight container to prevent contamination by insects or dust. It was labelled and kept in the laboratory at a temperature of 40 °C before analysis.

➢ *Proximate Analysis*

The proximate compositions of the dried watermelon seeds were determined using standard analytical methods. Nutritional contents such as carbohydrate, protein, lipids, water, minerals, fiber, and the ash content of the seeds were determined. All measurements were done in duplicates, and values are presented as percentages.

➢ *Moisture Content*

This is a measure of the percentage moisture lost to drying at an oven temperature of about 1050C °C (AOAC, 1999). 2g of the sample was oven-dried in a crucible at 105°C overnight. The dried sample was then cooled in a desiccator for one hour and weighed to a constant weight. The percentage loss in weight was expressed as percentage moisture content.

➢ *Ash Content*

The residue remaining was weighed after the ashing of 2g dried, ground seed in a crucible. The ashing was done in a muffle furnace temperature of 550°C for six hours. The ashed sample was cooled in a desiccator and weighed. The percentage residual weight was expressed as ash content (AOAC, 1999).

➢ *Crude Lipid Content*

Continuous extraction of lipid was done for 5hours with petroleum ether in a Soxhlet extractor. 2.00g of the sample was used for determining crude lipid (Udo and Oguwele, 1986).

➢ *Crude Protein Content*

The Kjeldahl (1883) method was used to determine total protein. 1g of the sample was placed on a filter paper and transferred into a Kjeldahl flask. 10 cm^3 of concentrated H_2SO_4 was added, and the mixture was digested in a fume cupboard until the solution became colorless. The distillation was carried out with 15mL of 50% NaOH. The tip of the condenser was dipped into a conical flask containing 6cm^3 of 4% boric acid in a mixed indicator until a green coloration was observed. Titration was done in the receiver flask with 0.01M HCl until the solution turned red.

➢ *Crude Fibre Content*

Estimation of the crude fibre was done by acid and alkaline digestion methods. 2.00g of each sample was used with a 20% H_2SO_4 and NaOH solution.

➢ *Carbohydrate Content*

The carbohydrate content of the test sample was determined by estimation using the arithmetic difference method (de Conto *et al.*, 2011; James, 1995). %CHO = 100 - (% fat + % ash + % fibre + % protein).

➢ *Quantitative Analysis of Phytochemical Analysis*

- *Alkaloids*

5g of the sample was weighed into a 250ml beaker, and 200ml of 20% acetic acid in ethanol was added and covered to stand for four hours. This was filtered, and the extract was concentrated using a water bath to one-quarter of the original

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volume. Concentrated ammonium hydroxide was added dropwise to the extract until the preparation was complete. The whole solution was allowed to settle, and the precipitate was collected by filtration and weighed (HARBORNE, 1973). Percentage alkaloids equals to weight of alkaloid all by the weight of the sample times 100.

- *Tannins*

The tannins were determined using the Folin-Ciocalteu method, with minor modifications [26]. About 0.1mL of the coffee extract was added to a volumetric flask (10 mL) containing 7.5 mL of distilled water, 0.5 mL of Folin-Ciocalteu phenol reagent, and 1 mL of 35% sodium carbonate solution, and was then diluted to 10 mL with distilled water. The mixture was shaken well and kept at room temperature for 30 min. A set of reference standard solutions of tannic acid (20, 40, 60, 80, 100 µg/mL) was prepared. Absorbance for the test and standard solutions was measured with a UV/Visible spectrophotometer (U-2900, Hitachi High-Tech Corporation, Tokyo, Japan) against the blank (distilled water) at 700 nm. The estimation of the total tannin content (TTC) was carried out in triplicate. The tannin content was expressed in terms of mg/mL of tannic acid in the sample. tilled water) at 700 nm. The estimation of the total tannin content (TTC) was carried out in triplicate. The tannin content was expressed in terms of mg/mL of tannic acid in the sample.

- *Flavonoids*

The total flavonoid content was determined using the aluminum chloride colorimetric method, as reported by Afify et al. (2012), with some modifications. 0.5ml of sample (1mg/ml) was mixed with 1ml of 10% aluminum chloride, 1ml of potassium acetate (1M), and 2.5ml of distilled water. Quercetin was used to make the calibration curve. The absorbance of the mixtures was measured at 415nm by using a spectrophotometer. The total flavonoid content was expressed in terms of quercetin equivalent (mg QE/g of the sample). All analyses were repeated three times, and the mean absorption value was obtained.

- *Phenol*

100mg of the extract of the sample was weighed accurately and dissolved in 100ml of distilled water. 1.5ml of this solution was transferred to a test tube, then 1ml 2N of the Folin-Ciocalteu reagent and 2ml 20% Na_2CO_3 solution were added, and ultimately the volume was made up to 8ml with distilled water, followed by vigorous shaking and finally allowed to stand for two hours, after which the absorbance was taken at 765nm. These data were used to estimate the total phenolic content using a standard calibration curve obtained from various diluted concentrations of gallic acid (Hagerman *et al.*, 2000).

IV. RESULTS

Table 1 Proximate Composition of *Citrullus Lanatus*

Parameters	Concentration (%)
Ash Content	4.45±0.02
Moisture Content	24.18±0.19
Protien	22.89±11.00
Fibre	14.00±0.05
Lipids	24.41 ±172.67
Carbohydrate	10.07±0.45

Values are represented in Mean ±SEM of triplicate sample.

Table 2 Quantitative Phytochemicals of *Citrullus Lanatus*

Phytochemicals	Concentration (Ug/G)
Tannins	0.0009±1.9998
Alkaloid	239.3±169.83
Flavonoid	131.5±135.89
Phenols	0.0009±1.998

Values are represented in Mean ±SEM of triplicate sample.

V. DISCUSSION

The proximate analysis of *Citrullus lanatus* seeds revealed ash content of 4.45%, moisture content of 24.18%, protein at 22.89%, fiber at 14.00%, lipids at 24.41%, and carbohydrates at 10.07%. These values demonstrate that the seeds contain appreciable levels of macronutrients and minerals. Compared to the work of Imafidon *et al.* (2018), who reported 10.40% moisture, 6.60% ash, 7.70% protein, 42.80% fiber, and 14.60% fat in dried seeds, the current study records markedly higher moisture and protein levels but lower fiber content. Similarly, Mamman *et al.* (2022) documented 8.39% moisture, 2.86% ash, 15.23% protein, 34.64% fiber, 31.84% fat, and 7.03% carbohydrates in dried seeds, which also differ from the present findings. The elevated moisture content in this study is nearly twice that of dried-seed analyses, likely reflecting the fresh or partially hydrated state of the sample. This higher water content proportionally reduces the concentration of other components, such as protein, lipids, ash, and fiber. Nonetheless, protein (22.89%) and lipid (24.41%) levels remain significant, positioning them between the lower protein reported by Imafidon *et al.* (2018) and the higher lipid documented by Mamman *et al.* (2022). These results suggest that sample condition and processing methods strongly influence nutrient composition, with fresh seeds retaining more water but still providing substantial macronutrient value.

Quantitative phytochemical analysis showed minimal tannins and phenols (~0.0009 µg/g), moderate flavonoids (131.5 µg/g), and high alkaloids (239.3 µg/g). In comparison, Nwachoko and Owhonda (2019) reported phenols at 2.18 µg/g, flavonoids at 47.95 µg/g, and alkaloids at 32.45 µg/g in dried seed extracts. The present findings reveal alkaloid concentrations nearly an order of magnitude higher and flavonoid content almost three times greater than reported for dried seeds, while tannin and phenol levels were substantially lower.

Such differences may arise from variations in extraction methods, moisture levels, or cultivar type. Fresh or minimally processed seeds can retain higher concentrations of certain bioactive compounds, whereas drying can lead to degradation

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or volatilization. Nwachoko and Owhonda (2019) also identified specific flavonoid subclasses, such as rutin, catechin, and kaempferol, as well as alkaloid subclasses like ribalindine and lunamarine—details not captured in the present generalized phytochemical categories.

Overall, the findings suggest that *Citrullus lanatus* seeds, particularly in a fresh state, retain valuable nutrients and bioactive compounds, making them promising for both nutritional and functional food applications.

VI. CONCLUSION

The analysis of *Citrullus lanatus* seeds revealed a nutrient-rich composition characterized by substantial protein and lipid contents, moderate fiber, and significant levels of bioactive phytochemicals. The elevated moisture content in the present study, compared to values from dried-seed analyses, reflects the fresh or partially hydrated nature of the sample and accounts for variations in proximate parameters when compared with literature values.

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