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# The Influence of Location on the Nutritional Composition of the Rind of Watermelon *(C. lanatus)* in Parts of Selected Geographical Zones in Nigeria

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## Abstract

*Watermelon (C.lanatus)), which was formerly only grown in the Northern part of Nigeria, is now grown in Southern parts also. It is known that weather patterns and soil composition vary as we move from the northern to the southern parts of Nigeria. However, there is little to no data demonstrating how C.lanatus' nutritional composition is influenced by its geographic location. This study therefore sought to assess the nutritional composition of the rind of C.lanatus produced in parts of four states that corresponded to four geopolitical areas of Nigeria. Samples of C. lanatus were gathered from four geopolitical zones of Nigeria which include; North-East, South-West, South-East, and South-South. Fruits were cleaned before the rind was removed, blended, and freeze-drying carried out. The freeze-dried samples were subjected to established methods for the determination of the amino acid profile, vitamins, proximate, and mineral components. The results of the amino acid profile showed that distinct amino acids were present in each zone, with the southwest sample providing the highest quantities and the south-south zone providing the lowest concentrations. The rind of C. lanatus contained calcium, magnesium, potassium, sodium, iron, phosphorus, and manganese in varying amounts, and samples from the south-west and north-east having the highest concentrations of both vitamins and minerals. The results of the proximate composition determination showed that the southwest sample had the highest ($p < 0.05$) percentage of moisture, protein, and ash when compared to other zones, and that the northeast sample had a higher percentage composition of carbohydrate, ash, and fat when compared to other zones. Thus, the C. lanatus samples' nutritional value were distributed as follows: southwest > northeast > southeast > south-south. According to the findings, C.lanatus rind's nutritional qualities can vary depending on where it is cultivated.*

**Keywords:** Amino acids; Cultivation; Mineral; Proximate; Watermelon;Vitamins;

## INTRODUCTION

An organism's overall system for consuming, metabolizing, and using nutrients for all life-sustaining functions is referred to as its "nutrition". These are necessary for healthy biological function; without them, the body won't be able to work properly. Destructive effects on your body can also result from poor diet (Arvedson and Lefton-Greif, 2020). The significance of fresh fruits and vegetables in our daily lives cannot be overstated because fruits are excellent

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sources of natural components that are crucial for maintaining human health, particularly in preventing diseases and promoting healthy development and growth (Sodimu *et al*., 2020). For a healthy lifestyle that also helps reduce the occurrence of cardiovascular illnesses, the World Health Organization (WHO) recommended consuming 400g of fruits and vegetables per day (Balint *et al*., 2017). In Nigeria, a wide range of fruits and vegetables are regularly consumed, and they are an essential component of our diet. However, the seed and skin of these fruits are typically not eaten, only the juicy pulp. Fruits are mostly water, with an average water content of 85%, extremely minor amounts of fat and protein, cellulose, a decent amount of carbohydrate, starch, and sugar. In addition to having low energy density, they also have high quantities of micronutrients such carotene or provitamin A, vitamin K, ascorbic acid, riboflavin, iron, iodine, and other mineral components (Johnson *et al*., 2012). Because they are perishable by nature, fruits and vegetables can rot during any stage of their production, including harvesting, handling, transit, storage, marketing, and processing. . The spoiled produce is practically a loss because it cannot be sold. Watermelon is one fruit that does not lend itself well to processing and is typically utilized for direct eating (Ashoka *et al*., 2021). Originally from southern Africa, the watermelon plant, *C.lanatus* var. lanatus, belongs to the Cucurbitaceae family and is a vine-like (scrambler and trailer) flowering plant. 91% of a watermelon's weight is water, while only 6% of it is sugar. It is a source of vitamin C, like many other fruits. Citrulline, an amino acid, is present in large amounts in watermelons. Smooth and dark green with occasionally faint green streaks that turn yellowish green when ripe, the watermelon's skin is smooth. It is a good source of phytochemicals and a very rich source of vitamins(Gladvin *et al*.,2017). Although watermelon rinds are edible and rich in hidden minerals, most people stay away from them because of their unpleasant flavor. They are occasionally consumed as vegetables. They are stir-fried, stewed, or more frequently pickedled in China. In the Southern US, pickled watermelon rind is frequently consumed (Hoque and Iqbal 2015). According to Vinhas *et al*. (2002), watermelon biomass can be divided into three primary parts: 68% flesh, 2% seeds, and 30% rind. Because weather patterns and soil composition vary from the northern to the southern parts of Nigeria, geographic location has the potential to change the nutritional value of fruit harvests.

The location of the soil and the climate in the area have a significant impact on the soil composition, which in turn impacts how a plant grows. Because of variations in soil composition and climate, plants grown in different places will produce significantly variable crops with regards to both nutritional quality and yield (Akporido and Okoro, 2022). Therefore, it is important to assess how the nutritional profile of *C.lanatus* corresponds to the region of cultivation.

**MATERIALS AND METHODS**

Study area: The study was carried on samples gotten from Bali Local Government Area of Taraba State, Yewa North Local Government Area of Ogun State, Imo State's Owerri West Local Government Area, and Nigeria's Ethiope East Local Government Area of Delta state.

Collections and preparation of samples: The samples (*C.lanatus*) were gathered from watermelon farms in Bali Local Government Area of Taraba State, Yewa North Local Government Area of Ogun State, Imo State's Owerri west Local Government Area, and Nigeria's Ethiope East Local Government Area of Delta state.A taxonomist in the Department of Botany, Faculty of Science, Delta State University, Abraka, authenticated the fruits. The fruits were thoroughly cleaned before being sliced open with a knife to remove the seeds and separate the flesh from the rind. The rind was freeze dried after being homogenized in a

blender. The analyses of the proximate, mineral, vitamins, and amino acid profiles were performed on the freeze-dried sample.
Biochemical analysis: All the biochemical analysis was carried out according to the procedures outlined earlier, (Akporido and Okoro, 2022).

Data Analysis:
The SPSS-PC software package (Version 23.0) was used to conduct the statistical analysis. ANOVA and the student T-test were used to examine the data, and the majority of the results were presented as Mean (SD) Standard deviation for measurements made in triplicate. At 95% confidence level, all results were deemed significant.

**RESULTS AND DISCUSSION**

Table 1: Proximate analysis of the *C.lanatus* rind cultivated in parts of selected geopolitical zones in Nigeria

| Parameters (%) | South-South | North-East | South-West | South-East |
|---|---|---|---|---|
| Moisture | $36.30\pm0.75^{a}$ | $31.60\pm0.60^{b}$ | $38.13\pm1.21^{b}$ | $35.67\pm1.06^{a}$ |
| Crude Protein | $1.57\pm0.05^{a}$ | $1.03\pm0.07^{b}$ | $1.87\pm0.04^{b}$ | $1.53\pm0.04^{a}$ |
| Ash | $2.63\pm0.35^{a}$ | $3.77\pm0.45^{b}$ | $4.24\pm0.07^{b}$ | $2.82\pm0.16^{a}$ |
| Fat | $0.74\pm0.19^{a}$ | $0.91\pm0.11^{a}$ | $0.88\pm0.06^{b}$ | $0.72\pm0.20^{a}$ |
| Fibre | $4.04\pm0.25^{a}$ | $4.95\pm0.29^{b}$ | $3.95\pm0.29^{b}$ | $4.03\pm0.23^{a}$ |
| Carbohydrates | $54.66\pm0.50^{a}$ | $57.74\pm0.70^{b}$ | $51.27\pm0.31^{b}$ | $55.23\pm0.32^{a}$ |

*Values are expressed as mean ± standard error of mean, **Values with different superscripts differ significantly ($p>0.05$) across rows

Results of the proximate composition of *C.lanatus* rind grown in four geopolitical zones of Nigeria are shown in Table 1. The geopolitical zones' moisture contents varied greatly, ranging from 31.60% to 38.13%. As a result, moisture assessment in the chosen parts of each zones revealed the trend South-West> South-South>South-East>North-East. Accordingly, the increasing moisture content is a consequence of perishability due to microbial contamination in relation to lack of proper storage facilities. According to Ogbonna *et al*. (2013), the moisture levels of the rind samples were consistently growing and reasonably high, making them excellent sources of water for the body and capable of satisfying thirst.

The samples generally contained low levels of protein, and among the parts of each of the four zones, the proportion of protein increases in the following order: South-West >South-South > South-East > North-East. Animals and humans both depend on proteins to survive, their primary role in nutrition is to provide the body with the necessary amounts of the essential amino acids. Protein deficiency results in growth retardation, muscle wasting, edema, abnormal belly swelling, and fluid retention (Apiamu *et al*., 2015).

The ash concentration varied between 2.63% and 4.24% in the four samples, and there was a significant difference between them at ($p>0.05$). The samples from south-west contained the most amount of ash, while those from the south-south had the least. According to Coimbra and Jorge (2011), the amount of ash present corresponds to the amount of minerals found in the fruit samples.Since high concentrations of different mineral elements are predicted to occur in samples with high percentages of ash contents, these samples are predicted to help accelerate metabolic processes and enhanced growth and development (Bello *et al*., 2008; Ekpete and Edori, 2013).

The samples overall fat content was quite low, which is typical for fruits (Lim and Rabeta, 2013). The North-East had the highest fat concentration, followed by South-west, South-south

and South-east respectively, despite the fact that the fat contents in fruits were generally and notably extremely low. Fruits are advised as a component of diets intended to help people lose weight because, according to Fila *et al*. (2013), they are not particularly good sources of fat.

The result for fiber content only represent a portion of the real dietary fiber present in the samples. The results obtained in the four regions considered differed significantly from one another; the North-East had the highest content of crude fiber, followed by the South-South, South-East, and South-West, in that order. Foods high in dietary fiber, as reported by Hassan *et al*. (2009), help prevent a number of disorders which includes diverticulitis, colon cancer, diabetes, excess cholesterol and hemorrhoids. *C.lanatus* may be the best source of dietary fiber for the treatment of the aforementioned clinical disorders, according to a comparison of the four samples.

A significant difference in the carbohydrate content of the samples from the four zones was discovered at ($p>0.05$).The carbohydrate content ranged from 51.27% to 57.74%, which is very high and can therefore server as an excellent source of energy. The order of the rising carbohydrate content in the various fruit samples is South-West> North-East > South-South > South-East. Comparatively, the minimum and maximum range limits were formed by south-west and north-east(51.27% to 57.74% )respectively. In accordance to a paper by Apiamu *et al*. (2015), fruit samples with low carbohydrate content may be the best choice for diabetic and hypertensive individuals needing low-sugar diets. High percentages of the proximate composition was seen in the samples from North-east and South-west which can be attributed to the fact that *C lanatus* strives best in arid regions(Dube *et al.*,2020). According to Ufiobor (2017),the north-east, north-west and south-west regions of the country experience high temperatures, making them suitable for *C lanatus* farming.

Table 2: Mineral analysis of *C.lanatus* rind cultivated in parts of selected geopolitical zones in Nigeria

| Minerals(mg/kg) | South-South | North-East | South-West | South-East |
|---|---|---|---|---|
| Calcium | $0.11\pm0.02^{ab}$ | $0.15\pm0.03^{a}$ | $0.09\pm0.01^{b}$ | $0.12\pm0.03^{ab}$ |
| Magnesium | $0.13\pm0.20^{a}$ | $0.13\pm0.02^{a}$ | $0.14\pm0.02^{a}$ | $0.13\pm0.02^{a}$ |
| Potassium | $0.10\pm0.01^{a}$ | $0.04\pm0.01^{b}$ | $0.12\pm0.01^{c}$ | $0.10\pm0.01^{ac}$ |
| Sodium | $0.06\pm0.02^{a}$ | $0.07\pm0.01^{a}$ | $0.05\pm0.02^{a}$ | $0.06\pm0.01^{a}$ |
| Iron | $0.12\pm0.01^{a}$ | $0.14\pm0.20^{b}$ | $0.11\pm0.01^{a}$ | $0.11\pm0.00^{a}$ |
| Lead | $0.03\pm0.01^{a}$ | $0.01\pm0.0^{b}$ | $0.04\pm0.01^{a}$ | $0.03\pm0.01^{a}$ |
| Maganese | $0.41\pm0.01^{a}$ | $0.31\pm0.20^{b}$ | $0.43\pm0.01^{a}$ | $0.42\pm0.02^{a}$ |

*Values are expressed as mean ± standard error of mean, **Values with different superscripts differ significantly ($p>0.05$) across rows

Both macronutrients and micronutrients are essential nutrients that the body need in varying degrees to coordinate a range of physiological processes and maintain good health throughout life. (Gernad *et al*., 2016; Tucker, 2016). In order to prevent anemia and other related disorders, iron (Fe) is believed to be a crucial component of the diets of pregnant women, lactating mothers, babies, convulsing patients, and the elderly (Oluyemi *et al*., 2006). Because it distributes oxygen throughout the body, Fe is essential for energy and endurance. However, for optimum health, it is just marginally necessary (Dimari and Hati, 2010). The samples from the North-East zone had the highest iron content. Over 300 of our body's most crucial biological functions, including the creation of ATP and muscle contractions, require magnesium (Mg). Magnesium deficiency in humans is linked to severe diarrhea, migraines, hypertension, cardiomyopathy, arteriosclerosis, and stroke (Bello *et al*., 2008). It also plays

crucial roles in the majority of reactions involving phosphate transfer and is thought to be crucial for the structural stability of nucleic acids and intestinal absorption. According to Matthew and Panonnummal 2021, potassium(K) and calcium(Ca) regulate the synthesis, storage, and movement of ATP. Among the essential nutrients is manganese (Mn). Through the aforementioned metalloproteins, Additionally, it is essential for the processes of digestion, reproduction, and antioxidants (Asagba *et al*., 2010). Samples from the South-West had higher quantities of magnesium, potassium, lead, and manganese according to the mineral composition, whereas those from the North-East had higher concentrations of calcium, sodium, and iron.

Table 3 Amino acid profile of *C.lanatus* rind cultivated in parts of selected geopolitical zones in Nigeria

| Amino Acids(pmol/ul) | South-South | South-West | South-East | North-East |
|---|---|---|---|---|
| Aspartic acid | 24.63 | 36.82 | 26.82 | 35.64 |
| Tryptophan | 54.12 | 55.87 | 60.37 | 65.81 |
| Leucine | 57.81 | 62.38 | 37.90 | 38.70 |
| Histidine | 25.87 | 31.04 | 25.04 | 20.12 |
| Threonine | 31.42 | 12.93 | 16.03 | 26.44 |
| Alanine | 16.64 | 20.13 | 16.13 | 12.94 |
| Arginine | 23.07 | 24.86 | 25.51 | 19.51 |
| Cysteine | 91.06 | 101.45 | 61.06 | 70.15 |
| Valine | 9.37 | 9.51 | 9.41 | 9.27 |
| Methione | 4.36 | 4.12 | 4.08 | 4.08 |
| Proline | **** | 298.22 | 4.30 | 15.79 |

Eleven (11) amino acids were identified from the amino acid profile determination, of which two (2) can be produced by the body and so are referred as non-essential amino acids and theses include alanine and aspartic acid, while three (3) were conditionally essential (the body can create conditionally essential amino acids). Finally, six (6) of the detected amino acids were essential (cannot be synthesized by the body and must be obtained from diets) which included histidine, leucine, methionine, tryptophan, threonine, and valine. However, The body periodically produces insufficient amounts of certain amino acids, such as arginine, cysteine, and proline, as in times of stress or illness. According to the results, the South West zone had higher concentrations of aspartic acid, leucine, histidine, alanine, cysteine, and proline, whereas the South-South, South-East, North-East, and South-East zones had lower concentrations of each. Proline was not found in the samples from the south-south zone, while tryptophan concentrations were highest in the north-northeast and lowest in the south-south; North East>South East>South West>South-South. South-South had the highest concentration of threonine, and South-West had the lowest concentration; South-South>North East>South East>South West. In contrast, South-East had the highest concentration of arginine, and South-East>South West>South-South>North East had the lowest concentration. According to Banerjee and Roychoudhury (2021) proline helps to minimize oxidative stress in humans by maintaining a consistent osmotic pressure, stabilizing a cytoplasmic environment that is deteriorating, and protecting membrane and enzyme structures. Proline had the highest concentration in this study. The prevalence of nutrient in the south-west sample may be due to the fact that the optimum soil for growing *C lanatus* is non-saline, sandy and loamy soil( Sulieman *et al*.,2021) and according to Aizebeokhai *et al*(2018), the reported that sandy and loamy soils are the predominant soils in the south-west geopolitical zones.

Table 4. Vitamin content of *C.lanatus* rind cultivated in parts of selected geopolitical zones in Nigeria

| Vitamin content (mg/kg) | South- South | South-West | South-East | North-East |
|---|---|---|---|---|
| Vitamin A | 2300 | 3190 | 1435.9 | 740 |
| Vitamin C | 3.00 | 3.00 | 4.00 | 2.00 |

Vision, growth and development, immune system, reproduction, and production of skin,, bones, and red blood cells are all impacted by vitamin A (Lee *et al*., 2020). South-West>South-South>South-East>North-East were the zones with the highest vitamin A content. While higher levels of vitamin C were found in South-East samples and in the trend South-East>South-West=South-South>North-East, respectively. The ability of vitamin C to function as an antioxidant constitutes one of its most significant attributes. Furthermore, it reduces oxidative stress and activates enzymes. (Akram *et al*., 2020).

## CONCLUSION

The study revealed significant differences in the samples from the four regions, with variations in the proximate, mineral composition, amino acid composition, and the content of vitamins A and C, indicating that the nutrition composition of *C.lanatus* can be influenced by the place of cultivation.

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