

Proximate, Mineral and Anti-nutritional Compositions of Melon (*Citrullus lanatus*) Seeds.

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ABSTRACT

Objective: The purpose of this present study was to investigate the mineral, nutritional and anti-nutritional compositions of melon (*Citrullus lanatus*) seed flour.

Methods: The proximate compositions were determined by soxhlet extraction, AOAC, Kjeldhal and other standard procedure^{1,2}. Mineral contents were determined using Atomic Emission Spectrometry, Atomic Absorption Spectrophotometry and Vanado-molybdate method, while anti-nutrient determinations were carried out using standard procedures³⁻⁵.

Results: The results obtained from proximate analysis were: moisture content (7.10%), ash content (2.70%), crude protein (30.63%), crude lipid (49.05%), crude fiber(6.00%), carbohydrate (4.52%), dry matter (92.90%), organic matter (97.30%) and energy value (582.05Kcal/100g). The mineral analysis showed that iron have the highest value (144.70mg/100g), followed by manganese (22.73mg/100g), zinc (21.05mg/100g) and magnesium (20.46mg/100g), while calcium was the least (0.10mg/100g). The Na/K and Ca/P ratio were 0.043 and 0.002 respectively. The anti-nutritional factors analyzed were oxalate (26.40mg/100g), tannin (39.40mg/100g) and hydrocyanic acids (1.56mg/100g).

Conclusion: The results of the study revealed that *Citrullus lanatus* seed flour is a good source of important nutrients such as fat, protein, fiber and minerals. The high contents of protein and fat make these seeds valuable dietary supplements especially for people in the rural areas where there are lack of adequate access to dairy foods and meats.

Keywords: Melon, *Citrullus lanatus*, Seeds, Proximate, Mineral, Nutritional, Anti-nutritional.

INTRODUCTION

Malnutrition is a very serious global health problem among the rural populace, especially the pregnant women and children in developing countries. Food contains essential ingredients for sustenance of plants and animals¹. Small but mighty, seeds are packed with life-enhancing nutrients such as protein, iron, fibre, vitamins and omega-3 fatty acids that can help the body fight diseases and promote good healthy living. Studies have shown that seeds do not only contain nutritionally important biocompounds but are also sources of other phyto-compounds which at certain critical levels have significant anti-nutritional effects². *Citrullus lanatus* belongs to the family *cucurbitaceae* (Common name: melon; Yoruba name: egusi), a tendril climber or crawling annual crops with fibrous and shallow root system. It is mostly grown as a subsidiary crop interplant with early maize and yam in some savannah belt of Nigeria. Melons are major food crops with several varieties which serves as major food sources³. *Citrullus lanatus* are among the economically most important vegetable crops worldwide and are grown in both temperate and tropical regions^{4,5}. Melon seeds are major soup ingredients and they are used to thicken soups. The seeds are less expensive and widely distributed.

In Nigeria, the seeds are used to prepare food condiment with characteristic aroma. The condiment is used as a flavouring agent in stews, soups and sauces⁶. According to previous study, the seeds contain 35 percent protein and 50 percent oil, therefore may be useful raw materials for the food and cosmetic industries. Melon contains, vitamin C, and B₂, minerals, riboflavin, fat, protein and carbohydrate⁷. They can contribute substantially towards obtaining a balanced diet⁸. Many plant proteins usually in the form of protein extracts are being investigated and tested for

new products, such as low cost fabricated food to which are nutritious, attractive and acceptable to consumers just like conventional foods from meat and fish^{9, 10}. Seeds have nutritive and calorific values, which make them necessary in diets. Research attention is being focused towards increasing utilization of plant protein sources for food use¹¹⁻¹⁵. The ultimate success of utilizing plant proteins as ingredients largely depends upon the beneficial qualities they impact to foods, which in turn depend largely on their nutritional and functional properties¹⁶.

Despite the nutritional, industrial and medicinal significance of melon⁶, little detail on its mineral composition is available to an international readership and despite extensive research on it in many part of west Africa^{6,8,17-19}, there is a dearth of study in our locality. Further study on *C. lanatus* seeds will provide additional data on their nutritional and anti-nutritional constituents. Information from available data may expand the scope of knowledge and provide valuable research updates for the public and other stakeholders on the nutritional qualities for possible local and/or industrial utilization of melon seeds.

To the best of our knowledge, little or no research work has been reported on the proximate and mineral composition of *C. lanatus* seeds variety planted and harvested in Karshi, Abuja. The present study was aimed at investigating the proximate, mineral and anti-nutritive compositions of *C. lanatus* seed flour produced in Karshi, Abuja in order to evaluate their health benefits.

MATERIALS AND METHODS

C. lanatus seed samples were obtained directly from local farmers in Karshi, Abuja, Nigeria two months after

harvest and identified by Mr. Edayi Fredrick Eghe, a Botanist in the Department of Biological Sciences, Federal University Dutsin-Ma, Katsina State, Nigeria. Samples were manually mixed together to obtain homogeneity and representative samples were collected at random²⁰, dehulled and screened. The seeds were dried to constant weight in an oven at 50°C after which they were ground in mortar with the help of pestle, kept in an airtight container and stored in desiccators prior to further analysis.

Proximate Analysis

The moisture content and the fat content were determined according to the procedures described by²¹, while the ash content, crude fibre and crude protein were estimated using procedures described by²². The nitrogen was estimated based on the Kjeldhal procedure and the percentage nitrogen was converted to crude protein by multiplying by a factor of 6.25 while carbohydrate was determined by simple difference as follows: Carbohydrate = 100 - (%Ash + %Crude protein + %Crude fat + %Crude fibre). Energy value was obtained by the summation after multiplying percentage carbohydrate, protein and fat by factors of 4, 4 and 9 respectively and expressed in Kcal/100g^{23,24}. All analyses were carried out in triplicates.

Mineral Analysis

Sodium and potassium in the sample were determined by atomic emission spectrometer (200A Model, Buck Scientific Ltd UK) while other minerals were determined after wet digestion with a mixture of nitric, perchloric and sulphuric acids in the ratio of 9:2:1 respectively using Atomic Absorption Spectrophotometer (Alpha 9 Model, Buck Scientific Ltd USA). The concentration of phosphorus was

determined by the Vanado-molybdate method²².

Determination of anti-nutrients

The anti-nutrients (oxalates, hydrocyanic acid and tannin) were determined using standard methods described by^{23, 24, 25} respectively.

RESULTS AND DISCUSSION

Proximate Analysis

The proximate composition of *Citrullus lanatus* seed flour is shown in Table 1. The moisture content was 7.10% which is a little higher than what were reported for varieties of melon seeds; 4.78-5.21%²⁶ and pumpkin seeds; 5.00%²⁷, but lower than those reported for mango seeds; 12.50%²⁸ and gardenia aqualla seeds; 49%²⁹. The low moisture content in the melon will help to improve its lifespan. The ash content was 6.70% which is higher than that reported for melon seed varieties; 3.35-4.89%²⁷, but close to that reported for melon seeds; 6.84-6.99% by³⁰. The high ash content in the sample indicates the percentage of inorganic mineral elements present in melon seeds. High mineral elements in foods enhances growth and development, and also catalyses metabolic processes in human body.

The crude fibre content was 6.40%, which is higher than those reported for four varieties of melon seeds, 1.66-2.16%²⁶ and *Mangifera indica* kernels, 2.22-3.95% cultivars grown in Western parts of Nigeria³¹, but a little lower than those of ripe and unripe *Carica papaya* seeds, 7.85% and 7.40%; ripe and unripe *Citrus sinensis* seeds, 8.05% and 7.40% respectively³². It is believed that fibre reduces the level of cholesterol in human blood and decreases the likelihood of different cancers.

The fat content was found to be 49.05% which is a little higher than that reported for four varieties of melon seeds,

40.26-45.21%²⁶ but significantly higher than those reported for different cultivars of mango kernels, 5.92-13.50% and ripe and unripe *Carica papaya* seeds, 0.10% and 0.15% respectively³². However, the fat content is lower than those reported for *Citrullus lanatus* seeds from Southern Nigeria, 57.26%¹⁹ and *Colocynthis citrullus* seeds, 53.85%³⁰. The high value of fat in the melon seeds is the reason for it being referred to as the oils seed. Fat is very vital since it provides the body with tremendous amount of energy.

The protein content is 30.63% which is comparable to those reported for *Colocynthis citrullus* seeds 28.63%³⁰ and *Cucurbitapepo L* seeds, 27.48%²⁷, thus *Citrullus lanatus* seeds could provide the necessary protein requirement for the rural populace.

Carbohydrate value of the sample was found to be very low, 7.22%. From this result, melon seeds cannot be considered as potential source of carbohydrate especially when compared with other sources such as cereals which contain 65-75% carbohydrate.

Mineral Analysis

The result for the mineral composition is shown in Table 2. The most abundant mineral found in the sample is iron with the concentration of 144.70mg/100g. Iron helps in the formation of blood and in the transfer of oxygen and carbon dioxide from one tissue to another³³. Iron deficiency results in impaired learning ability and behavioural problems in children, and also anaemia³⁴. Manganese is the second most abundant element in the seed sample with the value of 22.73 mg/100g. Manganese plays important role in the transfer of oxygen from lungs to cells and activation of enzymes reactions concerned with carbohydrate, fat and protein metabolism³⁵. Its deficiency scarcely occur because it is present in abundance in food, however in an

event of it occurring, manganese deficiency can results to retard growth and skeletal disorder.

Zinc and magnesium are the next abundant mineral elements found in the sample of melon seeds with the values of 21.05mg/100g and 20.46mg/100g respectively. Zinc boosts the health of our hairs, plays a role in the proper functioning of some sense organs such as ability to taste and smell³⁵, helps in carbohydrate and protein metabolism and also assists in metabolism of vitamin A from its storage site in the livers and facilitates the synthesis of DNA and RNA necessary for cell production³³. Magnesium is beneficial to blood pressure and helps to prevent sudden heart attack, cardiac arrest and stroke. Like calcium, magnesium is an important component of bone and contribute to its structural development. While calcium stimulates muscles, magnesium relaxes the muscles³³. The daily value for magnesium is 400mg for adults and children aged 4 and older and according to³⁶, green leaf, legumes, nuts, seeds and whole grains are good sources of magnesium. Magnesium deficiency results in uncontrolled twisting of muscles leading to convulsion, which may eventually lead to death³⁷ and it is common in people with chronic alcoholism³⁸.

The values of potassium and sodium in the sample are 4.94mg/100g and 0.21mg/100g respectively. High concentration of potassium in the body was reported to increase iron utilization³⁹ and beneficial to people taking diuretics to control hypertension and suffer from excessive excretion of potassium through the body fluid⁴⁰. Potassium is available in several foods like fruits, dairy products and vegetables and its recommended daily intake value stands at 3500mg. Sodium regulates fluid balance in the body and helps in the proper functioning of muscles and nerves³⁵. According to³⁶, the daily value for sodium is

2400mg for adults and children aged 4 and older. However, there is a need to judiciously consider this sample, especially in sodium and potassium restricted diets. This is important since high dietary sodium is implicated in cardiovascular and renal disorders⁴¹. Similarly, people who suffer from, or are prone to hypertension are discouraged from high dietary sodium.

The concentration of calcium was found to be 0.10mg/100g, the least of all mineral elements present in the sample. Calcium is a constituent of bones and helps the body to contract correctly, blood to clot and the nerves to convey messages. When the calcium supply to the body becomes insufficient, the body on its own extract the needed calcium from the bones. If the body continues to tear down more calcium than it replaces over a period of years the bones will become weak and break easily. Calcium is essential for disease prevention and control and may therefore contributes to the medicinal influences of the plant⁴².

The concentration of phosphorus in melon seeds was estimated as 5.77mg/100g. This value is very low in comparison with the phosphorus value of 47.68mg/100g reported for pumpkin seeds²⁷ but much higher than 0.87mg/100g reported for *Juglans regia* seeds⁴³. The recommended daily value for phosphorus is 1000mg⁴⁴. The low value of phosphorus in the sample may not be unconnected with the fact that whole grains and vegetables are usually low in phosphorus. Rich sources of phosphorus include dairy, meats and fish. It is important to note that phosphorus from food sources are relatively bioavailable with the exception of plant seeds (beans, peas, cereals, nuts) that contain a special storage form of phosphate called phytic acid. Deficiencies in phosphorus are rare because of the prevalence of phosphorus in foods and is generally observed only in cases of starvation.

The copper content of 2.53mg/100g for *Citrullus lanatus* seeds in this study falls between its recommended daily allowance of 1.5-3.0mg per day for adult male and female⁴⁵. *Citrullus lanatus* seeds can therefore be recommended as good source of copper. Copper helps the body to use iron and sugar properly. It is also necessary for bone growth and nerve function. Deficiency of copper may result to anaemia and osteoporosis (weak bones).

Calcium, magnesium, phosphorus, manganese in combination with chloride, proteins, vitamin A, C and D are involved in bone formation⁴⁶. Therefore, from the results obtained, *Citrullus lanatus* seeds cannot be regarded as a good source of minerals needed for the formation of bones in the body. However, the sample was richer in mineral than those reported for melon varieties²⁶, mango seed, gmelina fruit²⁸, and selected Nigerian oil seeds⁶. The high value of some of the minerals may satisfy the nutritional needs of the consumer⁴⁷.

Na/K plays a very importance role in diet as it controls high blood pressure in the body. Studies had showed that lower sodium and higher potassium intake helps to reduce high blood pressure in hypertensive patients. The recommended Na/K ratio should be less than one. The Na/K value of 0.04 was obtained in *Citrullus lanatus* seeds in this study. The report of this investigation revealed that regular consumption of *Citrullus lanatus* seed flour would help to prevent hypertension and might lower blood pressure in hypertensive patients. This result agrees with the finding of⁴⁸ who reported that Nigerian underutilized legumes are good sources of diets for lowering blood pressure.

The Ca/P ratio of *Citrullus lanatus* seed flour is 0.02 which is lower than the standard of 0.5. Higher Ca/K levels in foods is required for favourable calcium absorption in the intestine for bone

formation⁴⁹. The Ca/P ratio in this study indicates that *Citrullus lanatus* seed flour would not help calcium absorption in the body.

Ant-nutritional Composition

The anti-nutritional composition of *Citrullus lanatus* seed flour is presented in Table 3. The concentrations of oxalate, tannin and hydrocyanic acid in the seed flour are 26.40mg/100g 39.40mg/100g and 1.56mg/100g respectively. Tannin has the highest value while hydrocyanic acid has the least value. These values are lower than the values of oxalate, tannin and hydrocyanic acid reported for mango seed which are 390.0 mg/100g, 370.0mg/100g and 84.0 mg/100g and gmelina fruit which are 229.5mg/100g 650.0mg/100g and 101.0mg/100g respectively²⁸. The oxalate concentration is low compared to 473.0mg/100g in *Hildegardia beteri* fruits⁵⁰ and 170-650mg/100g in some oil seeds⁵¹. Tannin concentration in the sample is higher than 6.08-15.25mg/100g reported for some Nigeria medicinal plants⁵². Higher value of oxalate in human diet can increase the risk of renal calcium absorption and has been implicated as a source of kidney stones⁵³. Higher value of tannin in foods interferes with protein absorption and digestive enzymes. A neurological disease known as Tropical Ataxia Neurophathy (TAN) is linked to consumption of high level of cyanide in cassava based diet⁵⁴. Only plants with more than 200mg of hydrocyanic equivalent acid per100mg fresh weight are considered dangerous⁵⁵. From the results obtained in this study, the concentrations of oxalate, tannin and hydrocyanic acid in *Citrullus lanatus* seed flour are low to cause any health risk in human being.

CONCLUSION

The analytical information available from this study has shown that *Citrullus*

lanatus seed flour is a good source of protein, fat and energy. Also, it is highly rich in iron needed for blood formation and transportation of oxygen and carbon dioxide between tissues. The low concentrations of anti-nutritional factors suggest that the seed flour is a good source of food for human and animals. However, results indicate that the seed flour is a poor source of calcium needed for bones formation and teeth development.

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Table 1. Proximate composition (%) and energy value (Kcal/g100) of *C. lanatus* seed flour

Parameter	Concentration
Moisture content(%)	7.10±0.20
Ash content(%)	6.70±0.10
Crude fibre(%)	6.40±0.20
Crude fat(%)	49.05±0.30
Crude protein(%)	30.63±0.20
Carbohydrate(%)	7.22±0.30
Dry matter (DM)(%)	92.90±0.40
Organic matter (OM)(%)	93.30±0.30
Energy value (Kcal/100g)	592.85

Data are mean of triplicate determinations ± standard deviation

Table 2. Mineral composition (mg/100g) of melon (*Citrullus lanatus*) seeds.

Element	Concentration
Na	0.21±0.008
Fe	144.70±0.237
Ca	0.10±0.002
Zn	21.05±0.015
Cu	2.53±0.002
Mn	22.73±0.013
Mg	20.46±0.007
K	4.94±0.004
P	5.77±0.007

Data are mean of triplicate determinations ± standard deviation

Table 3. Mineral composition (mg/100g) of melon (*Citrullus lanatus*) seeds.

Mineral	Composition (mg/100g)
Oxalate	26.40±0.2
Tannin	39.40±0.4
Hydrocyanic acid	1.56±0.01

Data are mean of triplicate determination ± standard deviation