# Comparative Studies on the Chemical Composition of *Chrysophyllum albidum* Seed and Five Different Melon Seeds

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## ABSTRACT

*Chrysophyllum albidum* fruits, pulp, and seed shell had been observed to be excellent sources of vitamins, nutrients, and minerals needed in the human body, but the contents of the seed has not been well documented**.** Seeds of *Chrysophyllum albidum* and the five different melon seeds were bought from Lafenwa market in Abeokuta, Ogun State, Nigeria. The seeds were removed from the shell manually, air dried and ground to a fine powder. The chemical compositions of these seeds were determined to evaluate the nutrients, anti–nutrients levels, and the seed oil using standard analytical methods.

The nutrients compositions of the six sample seeds showed that carbohydrate content ranged between 1.43 –69.21g/100g; ash, 3.14 – 4.75 g/100g; crude fibre,3.29 -7.10 g/100g; protein,1.37 – 33.74 g/100g; and fat,4.5 – 53.81 g/100g. All the seeds had low level of anti–nutrients with high mineral and nutrient levels except *Chrysophyllum albidum* seed*.* The extracted oil from the seeds were moderately acidic (pH 6.64 - 6.8); peroxide, 22.21 – 27.41 meq/kg; acid value, 1.23 – 9.85 mg/KOH/g; and free fatty acid, 1.33 – 23.77 mg/KOH/g. *Chrysophyllum albidum* had the highest saponification value (210), The result showed that *Chrysophyllum albidum* had low levels of nutrients compared to the five melon seeds but it is a very good source of carbohydrates.

(Keywords: *Chrysophyllum albidum*, *Curcubit species*, nutrients, anti-nutrients).

## INTRODUCTION

The *Chrysophyllum albidum* (Sapotaceae) tree is common throughout the tropical regions. The fruit is sweet and edible and it is used for various ethno-medicals (Nwadinigwe, 1982). *Chrysophyllum albidum* fruits (Africa star apple) is commonly known as Agbalumo (Yoruba) or Udala (Igbo) throughout southern Nigeria. The fruits are available between December and March. The epicarp is yellow when ripe and the pulp within the epicarp is reddish. It is good for jams and similar preparations (Amusa *et al*., 2003).

Adisa (2000), reported *Chrysophyllum albidum* fruits as an excellent source of vitamins, iron, and flavors to diets. Three to six seeds are embedded in the pulp which are not usually eaten. Husks of the seeds are dark brown and hard with two cream cotyledons. The fruits also contain 90% anacadic acid, which is used industrially to protect wood and as a source of resin. The roots and leaves are used for medicinal purposes. The roots are alternative remedy for yellow fever and malaria treatments, while the leaves are used as softener, treating spots on skin, diarrhea, and stomach disorders, these may be due to infections and inflammatory reactions (Adewusi, 1997).

*Lagenari asiceraria, Citrullus vulgaris,* and *Cucumeropsis mannii* belong to Cucurbitaceae family, which is also known as the gourd family. They grow in warm climate, all the species in the family are economically important (Egbebi, 2014,). They can easily be cultivated. The fruits have about 300 seeds per gourd (Achinewhu,1984). Members of this family are potential sources of oil, dietary proteins, and have nutritionally adequate amino acids (Fokou*et al*. 2004). Their seeds are obtained either in shelled or unshelled forms in the markets, they are greatly used in African dishes, as starting materials for the production of protein concentrate which is very essential in human nutrition (Gonzalez-Quijada*et al*., 2002). They have nutritional and calorific values which make

them necessary in human diets. The egusiito protein product can be used as additives to food, in the same way, as soy protein (Casimir*et al*., 1992). Locally, the seed is used to prepare soup, as cereal for breakfast and as a light meal among Adamawa State indigenous and other tribes in Nigeria. In spite of the wide consumption and nutritive value of *Chrysophyllum albidum* fruit, the nutrient and anti-nutrient composition of the pulp and flesh had been fully investigated but that of the seed has not been well documented.

The *C. moschata* is oblong in shape and exhibits various colors viz: orange, yellow or dark green, It was observed that the seeds are edible and good sources of protein, oil, vitamins, and micro element (Ardabili*et al*., 2011). *Chrysophyllum albidum* seed physically is similar to melon seeds, many observations have been reported on its fruits, pulp and seed shell but that of the seed has not been well documented. Therefore, it becomes necessary to determine the nutrients content of the seed, properties of its soil; these were compared with that of five melon seeds.

## MATERIALS AND METHODS

*Chrysophyllum albidum* seeds and *Citrullus vulgaris* (melon) seeds were purchased from Lafenwa market, Abeokuta, Ogun State. The bad seeds and dirt were hand-picked, and the cotyledon seeds were removed from the shells manually. The cotyledons seeds were air dried, ground to fine powder, and placed in polythene bags. Oils were extracted from 150 g of the ground seeds using Soxhlet extraction technique. At the end of the extraction, saponification, peroxide, iodine, and fatty acid values of the extracted oils were determined using standard methods (AOAC, 2010).

The ground seeds were analyzed for nitrogen, free fatty acid, moisture, and ash contents. Micro Kjeldahl method was implored for the determination of nitrogen content which was converted to protein by multiplying by a factor of 6.25. Ash content was estimated in 5gm of the sample which was weighed into a crucible dish, the whole content was placed in the muffle furnace at 550$^{o}$C for 7 hours, and the residue was cooled, moistened with dilute $HNO_3$ and returned to the furnace for about 3 hours to ensure complete ashing.

Crude fiber was determined by first digesting with 0.25N $H_2SO_4$, then refluxed the resulting mixture for 1hour, which was filtered hot, the residue was weighed ($X_1$) and ashed at 550$^{o}$C for 4hours, the ash was weighed($X_2$), the difference between $X_1$ and ash weight ($X_2$) gave the weight of crude fiber.

$$\% \text{ Crude fiber} = \frac{X1 - X2}{\text{wt of sample}} \times \frac{100}{1}$$

Atomic absorption spectroscopy was used to determine minerals except, potassium and sodium which were determined using a flame photometer. To determine Oxalate content was determined by dissolving 1 g of each grounded seed in 100 ml of 0.5M $H_2SO_4$, the mixture was stirred carefully with a magnetic stirrer for 60 mins, the mixture filtered, 25 ml of the filtrate was boiled (80-90$^{o}$C), titrated against 0.1 M $KMnO_4$, the faint pink color which marked the end point persisted for 30 seconds.

Titre value x constant (0.225) = Oxalate content
Phytate was also determined using the method used by Reddy and Love,(1999), Four (4) g of each studied seed was soaked in 10 ml of 2 % HCl for 5 hrs. filtered, 5 ml of 0.3 % ammonium thyiocyanate ($NH_4SCN$) was mixed with 25 $cm^3$ of the filtrate, the mixture was titrated against 0.1M $FeCl_3$until a brownish yellow color was obtained, this marked the end point and it persisted for 5 mins.

Titre value x constant (0.164) = phytate content

## RESULTS AND DISCUSSION

The results of proximate composition of the seeds are presented in Table 1, *Chrysophyllum albidum* seed had lower moisture content (4.12%) compared to those of the five melon seeds which ranged between 6.10±0.38 to 7.61±0.08. Higher moisture content encourages microbial growth hence, with the low moisture content the studied seeds will have longer shelf life. The observed moisture contents observed were higher than reported values (3.92 ±0.01%) for *Vitellaria paradoxa* (Amoo and Adebisi, 2009). *Citullus vulgari* shad the highest ash content (4.75±2.76) followed *Chrysophyllum albidum* seed (4.50±0.50).

**Table 1:** Proximate Composition of the Seeds. (Values with same letter within the same column are not significantly different, p<0.05)

| Samples | Moisture | Fat | Protein % | Crude Fiber | Ash | Carbohydrate | Energy kcal |
|---|---|---|---|---|---|---|---|
| *Chrysophyllum Albidum* | 4.12±0.14c | 4.50±0.12c | 1.37±0.02d | 4.80±0.61c | 4.50±0.50a | 69.21±4.50a | 322.82c |
| *Cucurbita moschata* | 7.61±0.08a | 53.17±4.34a | 30.16±2.12b | 3.29±0.56d | 4.34±0.21a | 1.43±0.11d | 614.89a |
| *Cucumeropsis mannii* | 6.22±0.43b | 50.52±1.14a | 26.63±0.22c | 3.66±0.13d | 3.42±0.15b | 9.95±0.15b | 601.00a |
| *Citullus vulgaris* | 6.10±0.38b | 47.00±3.01b | 29.10±0.07b | 7.10±4.41a | 4.75±2.76a | 5.95±0.01c | 562.40b |
| *Lagenari asiceraria* | 6.13±0.11b | 48.78±0.32b | 33.74±1.23a | 5.13±0.21b | 3.14±0.42b | 3.08±0.42d | 586.30b |
| *Cucumis melo* | 7.12±0.21a | 53.81±2.34a | 24.55±1.56c | 4.12±0.23c | 3.24±0.11b | 7.16±0.11b | 611.13a |

**Table 2:** Mineral Contents of the Seeds (mg/100 g). (Values with same letter along the same row are not significantly different, p<0.05)

| Minerals | *C. Albidum* | *C. moschata* | *C. mannii* | *C. vulgaris* | *L. siceraria* | *C. melo* |
|---|---|---|---|---|---|---|
| Nitrogen | 0.02±0.01d | 3.24±0.05b | 6.11±0.03a | 0.04±0.01 | 2.53±0.02c | 2.31± 0.04c |
| Phosphorus | 4.10 ±0.72e | 41.32±1.02a | 38.24±0.56b | 24.10±1.21d | 36.35±0.32b | 32.13±2.13c |
| Potassium | 70.11±1.72 | 171.03±2.81 | 164.11±0.97 | 157.34±1.21 | 163.11±2.65 | 168.91±1.45 |
| Calcium | 11.30 ±0.23c | 8.68±0.03e | 14.64±0.87b | 12.34±1.42c | 9.58±0.41d | 17.32± 1.12a |
| Magnesium | 4.10±0.32d | 63.27±0.02b | 58.22±1.96c | 61.22±2.34b | 67.33±1.06a | 59.24±2.45c |
| Sodium | 107.22±1.02f | 160.67±0.05a | 123.48±3.44e | 145.53±4.32d | 150.72±2.31c | 156.87±3.67b |
| Iron | 1.32±0.04d | 3.12±0.03c | 3.76±0.83c | 4.14±0.76b | 5.84±0.66a | 4.12±0.04b |
| Zinc | 8.09±0.01e | 11.13±0.02d | 14.23±2.11c | 17.32±1..32a | 15.34±1.32b | 16.21±1.11b |
| Manganese | 0.03±0.01c | 0.04±0.01c | 0.03 ±0.02c | 0.02±0.01c | 0.13±0.01b | 0.31±0.01a |
| Cobalt | 1.37±0.24b | 2.17±0.03a | 2.45±0.35a | 1.18±0.04c | 1.15±0.02c | 0.96±0.04d |

The value falls within the observations of Abiodun and Adeleke, (2010) and Fokou *et al*. (2004) who reported the ranges of 3.35 - 4.89%; 2.82 - 5.0% respectively for five melon seeds. High ash content indicates the presence of appreciable mineral content needed for metabolic processes.

The fat content of *Chrysophyllum albidum* seed (4.50±0.12) was much lower than the observations in the melon seeds which were higher than oil content observed in the groundnut seed (38.00%). The observed fat content in *Chrysophyllum albidum* seed is higher than reported values (1.29±0.1%) for *Carica papaya* seed (Oloyede, 2005). *Chrysophyllum albidum* seed is not a good source of oil and protein, this shows that it cannot be involved in building of tissues. (Amoo and Adebisi2009).

*Chrysophyllum albidum* seed is rich in carbohydrate (69.21±4.50 %), it can be considered a good source of carbohydrate when compared to some cereals which had 72-90 % Carbohydrate (Adewusi*et al*.,1995). The crude fiber value of the *Chrysophyllum albidum* seed (4.80±0.61) was higher than that of *Cucurbita moschata*, *Cucumeropsis mannii* and, *Cucumis melo*. All the observed values were higher than 1.0% fiber content value Oluyemi*et al*. (2006) reported for *Gardenia aqualla* seed and 1.23± 0.03 % for *Arthocarpushetero phyllus* seed (Bello et al., 2008). Fiber in food ease the removal of waste from the bowel hence prevents constipation, reduces cholesterol content in the blood and prevent cancers.

Iron content is low in all the studied seeds; least value was observed in *C. albidum* (1.07±0.04) while *L. siceraria*had the highest value (5.84±0.66). The observed values were lower than WHO recommended value (10–30 mg/day). Iron is a constituent of hemoglobin which transfers oxygen to the needed parts in the body (Cantilli*et al.*, 1994). Zinc content ranged from 8.09±0.01 to17.32±1.32 mg/100g with the least from *C. albidum* (Lanet al., 2011). Zinc is a micro nutrient which takes part in carbohydrates, protein metabolism and transfer of vitamin A. All the seeds had traces of manganese, this element plays role in physiological processes in the body,

however high content destroys blood cells and can cause nervous system disorder (Elinge *et al*.,2015).

Cobalt content ranged between 0.96±0.04 and 2.45±0.35mg/100g,it is involved in metabolism of vitamin B-12 and it activates some enzymes (Elinge *et al*.,2015).

The Magnesium content was very low in *C. albidum* though it was high in the five melon seeds but these were not as high as observed some legumes. Ojieh *et al* (2008) reported that magnesium content in legumes ranged from 140 190 mg/100 g. Magnesium is essential in bone and teeth formation. It regulates blood pressure and insulin release. Recommended dietar allowance of magnesium in adult is 350 mg/day while in children is 170 mg/day.

Calcium content observed in all the studied seeds are lower than calcium contents observed in some legume seeds; lima seed (68 mg/100g), pigeon pea seed (124 mg/100g).Calcium and Magnesium are necessary in photosynthesis, carbohydrate metabolism, nucleic acids and as binding agents of cell wall. Calcium helps in teeth formation (Brody, 1994). Magnesium plays a significant role in enzyme activation. Phosphorus and Potassium contents were low in *C. albidum* compared to five studied melon seeds phosphorus is needed for proper functioning of the kidney. It is also used by the body to maintain acid alkaline balance. (Fallon, 2001). Potassium is an absolute necessary nutrient in human and plant nutrition, plays important role in the synthesis of amino acid and protein (Malik and Scivastava, 1982).

The result of the anti-nutrient analysis in Table3 showed the contents of oxalate and phytates. Small content of oxalate was observed were lower compared to reported values (26.4 mg/100 g) in almond seed (Abdul *et al*.1998). High value of oxalate in food causes mouth irritation, it affects the absorption of divalent minerals and the kidney (Hassan and Umar, 2005). Phytate content in the studied seeds were lower, this will increase the absorption of essential minerals in the human body.

The acid values of the five melon seeds were lower than the observation of Abiodun and Adeleke (2010) who reported values which ranged between 3.13 and 4.22 mgKOH/g and Ebuehi and Avwobobe (2006) who reported 4.26mgKOH/g for melon seed. Acid value content in *C. albidum* was very high than standard values for edible oil.

The peroxide values (21.69 ± 0.78 to 27.14±1.62 Meq/kg) were more than the standard value (10 Meq/kg) for refined vegetable oil and slightly above the maximum value (20 Meq/kg) allowed for unrefined olive oil (FAO/WHO, 1993). The slight differences can be removed during refining. *C. albidum* oil can easily be prone to deterioration. Free fatty acid content was low in the five melon seeds (1.13±0.62 - 2.39±0.55). Low free fatty acids and acid values indicate the good quality of the oils (Elinge*t al*., 2012).

**Table 3:** Anti-Nutrients.

| Minerals | *C. albidum* | *C. moschata* | *C. mannii* | *C. vulgaris* | *L. sicerari a* | *C. melo* |
|---|---|---|---|---|---|---|
| Oxalate | 0.68±0.05a | 0.21±0.01c | 0.27±0.32c | 0.25±0.01c | 0.35±0.04b | 0.33±0.03b |
| Phytate | 21.34±0.02c | 31.06±1.10a | 25.64±3.21b | 13.11±0.02e | 16.40± 1.01d | 18.32±0.67d |

**Table 4**: Chemical Properties of Extracted Oil.

| Parameters | *C. albidum* | *C. moschata* | *C. mannii* | *C. vulgaris* | *L. sicerari a* | *C. melo* |
|---|---|---|---|---|---|---|
| Acid value(mg/KOH/g) | 9.85±0.86 | 1.23±0.12 | 1.26±0.22 | 1.54±0.07 | 1.67 ±0.13 | 1.38±0.14 |
| Peroxide Meq/kg | 27.14±1.62 | 22.21±0.78 | 23.14±2.33 | 21.60±1.32 | 21.69±0.56 | 21.49±1.34 |
| Free fatty acid (%) | 23.77 ±3.44 | 1.13±0.62 | 1.68±2.19 | 2.39±0.55 | 2.05±0.96 | 1.26±2.33 |
| Saponification | 196.16±4.22 | 190.04±5.19 | 191.81±3.35 | 189.23±2.32 | 192.10±3.79 | 186.45±6.32 |
| Iodine value (wijs) | 119.46±2.16 | 104.10±3.36 | 106.13±2.11 | 103±4.52 | 102.00±2.48 | 93.34± 0.66 |

Saponification values of the six seed oils ranged from 186.45±6.32-196.16±4.22 which were similar to the values observed by Ebuehi and Avwobobe (2006). The saponification value is an important parameter in determining the suitability of oil in soap making (Asuquo*et al*., 2010).

Iodine values observed in the five melon seeds fall within standard value for edible oil. All the iodine values were higher than value (95.8 Wijs) observed in Tsama melon but higher than iodine content (124.0 Wijs) in Desert melon (Mabalaha*et al*., 2007). Higher iodine value in *C. albidum* signifies higher concentration of unsaturated fat and the greater the liability of the oil to become rancid by oxidation.

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