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Phytochemical, nutritional and amino acid composition of *Citrullus lanatus* (Cucurbitaceae) seeds cultivated in South-South Nigeria

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Abstract
Medicinal plants are used in prevention and treatment of various health problems from simple to complex disease situations among rural and urban populations. Proximate, anti-nutrient, mineral, amino acid and phytochemical analyses of *Citrullus lanatus*, seed flour were carried carried using standard methods. The mean values of the various parameters of proximate composition were; moisture (4.0%), ash (4.0%), protein (19.62%), crude fat (70.0%) and carbohydrate (by difference) (2.35%). The anti-nutrients were determined to be saponin (1.45%), oxalate (0.27%), Phytic acid (0.37%), phytochemical analysis showed the presence of glycosides, saponins, flavonoids, terpenoids, reducing sugars and steroids. The mineral analysis (mg/kg) indicated that the seed has sodium (Na) (21.1), Potassium (K) (800), Zinc (Zn) (916.7), Lead (0.03), Cadmium (Cd) (0.01), Chromium was, however not detected. The amino acid result showed that watermelon seed contains glutamate, aspartate, cystine and methionine to the extent of 16.03 g/100 mg, 9.69 g/100 g and 945 g/100 g respectively. Considering the percentage of crude fat extracted, it can be concluded that watermelon seed contains a lot of oil which may have domestic and industrial application.

Keywords: Anti-nutrient, *Citrullus lanatus*, proximate composition, phytochemical, mineral analysis

Introduction
Citrullus lanatus (water melon) is of the Cucurbitaceae family. The plant is related to the cantaloupe, squash and pumpkin and other plants that grow on vines on the ground. *C. lanatus* is a good source of carotenoid and lycopene. Lycopene has been found to be protective against a growing list of cancer (Cho *et al.*, 2004) [1].
C. lanatus is delectable, thirst-quencher which helps quench the inflammable that contributes to conditions like asthma, atherosclerosis, diabetes, colon cancer and arthritis (Jian *et al.*, 2007) [2].
The fruit contained many smooth compressed seeds that thickened at the margin and of black or yellow-white colour (Sodeke, 2005) [3]. Achu *et al*., (2005) [4] reported high lipid level in five Cucurbitaceae oil- seeds from different regions in Cameroon. Oil provides concentrated energy in diet and enhanced palatability. It is worthy of note that major edible oils are from palm oil and peanut which are capital and labour intensive (Agatemor, 2006) [5] and therefore there is need to source for good, cheap and novel source of oils that would be useful domestically and perhaps industrially.
The aim of this research is to determine the proximate, mineral, amino acid, anti-nutrients and phytochemical compositions of the *C. lanatus* flour.

Materials and Methods
Sample Collection and Preparation
The matured fruits of the study plant (*Citrullus lanatus*) were purchased from Jattu market in Edo state, were cut open into pieces and the seeds extracted. The extracted seeds were sun-dried for several days and later in a hot-air oven at 105 °C for 1 hour. The dried seeds were de-shelled, blended into flour which was put into a plastic container with cover and stored in a refrigerator for further use.

Chemical Analyses
Moisture content, crude protein (N x 6.25), ether extract, crude fiber and ash were determined according to AOAC (2000) [6], while carbohydrate was calculated by difference.

Amino Acids Content
Amino acids composition was determined according to Cohen *et al.* (1989) [7].

Mineral Contents

The defatted seed flour was dry-ashed in a furnace at 550 ^{0}C. The ash obtained was dissolved in 10 ml HCI and transferred to a 100 ml volumetric flask which was filled to the mark. Sodium and potassium in the solution were determined using a flame photometer. All other metals were determined using Atomic absorption spectrophotometer.

Anti-nutritional Factors

Phytic acid was determined according to the method of Wheeler and Ferre, (1971) [8]. Tannins were determined by method described by Price *et al*. (1978) [9], while oxalate was determined according to the method described by Falade *et al.* (2004) [10]; alkaloids, saponins and total phenolic contents were determined according to the method described by Harborne, (1973) [11]; Obadoni and Ochuko, (2001) [12].

Phytochemical Screening

The Phytochemical screening of the seed flour extract was carried out as described by Trease & Evans (2000) [12a].

Result and Discussion

Results

Results obtained for all the analyses carried out are shown in Tables 1-5.

Table 1: Proximate Analysis of Watermelon seed flour

Parameter	Values (%)
Protein content	19.62
Moisture content	4.0
Fibre content	0.03
Ash content	4.0
Lipid content	70
Carbohydrate content	2.35

Table 2: Mineral composition of watermelon seed flour

Parameter	Values (mg/kg)
Sodium (Na)	21.1
Potassium (Na)	800
Calcium (Ca)	660
Magnesium (Mg)	48.1
Iron (Fe)	38.1
Copper (Cu)	3.7
Zinc (Zn)	26.7
Lead (Pb)	0.03
Cadmium (Cd)	0.01
Chromium (Cr)	----

Table 3: Amino Acid composition of watermelon seed flour (g/100g)

Parameter	Values (%)
Glycine	3.03
Alanine	2. 56
Serine	3.28
Proline	2.92
Valine	4.08
Threonine	2.85
Isolucine	3.44
Leucine	7.35
Aspartate	9.69
Lysine	3.79
Methionine	9.45
Glutamate	16.03
Phenylanine	4.46
Histidine	2.88
Arginine	6.63
Tyrosine	2.80
Cystine	9.52

Table 4: Phytochemical screening of watermelon seed flour

Parameter	Values
Glycoside	++
Cardiac glycoside	--
Saponin	++
Flavonoid	++
Phenolic compound	++
Hydrolysable tannin (Blue black colour)	--
Condensation (brownish green)	--
Phlobatannin	--
Terpenoid	++
Alkaloid	--
Polysaccharide/starch	--
Reducing sugar	++
Steroid	++

Key: (++) = Positive, (--) = Negative

Table 5: Anti-nutrients composition of watermelon seed flour

Parameter	Values % (mg/100 g)
Alkaloid	0.34
Phytic acid	0.37
Oxalate	0.27
Saponin	1.45
Total phenolic	Not detected
Tannin	Not detected

Discussion

The proximate chemical composition of watermelon seed flour as shown in the table 1 above, has percentage protein of 19.62 which is comparable to the value reported for melon seed (23.4 ± 0.2%) (Ojieh *et al.*, 2007) [13] but much higher that than of orange (*Citrus sinensis*) seed (3.1%) (Akpata and Akubor, 1999) [14]. The crude fibre of watermelon seed (0.03%) was too low compared to the crude fibre value for *Citrus sinensis* (5.5%) (Akpata and Akubor, 1999) [14] and melon seed (12.0± 0.1%) (Ojieh *et al.*, 2007) [13]. The moisture content of watermelon seed (4.0%) was also low but almost of the same percentage as melon seed (4.6±0.3%) (Ojieh *et al*., 2007) [13]. The ash content was (4.0%) which is higher for the values reported for *citrus sinensis* (2.5%) (Akpata and Akubor, 1999) [14]. The lipid yield of watermelon seed flour was significantly high with a reported value of (70.0%) which is higher than the value reported for *Citrus sinensis* (54.2%) (Akpata & Akubor, 1999) [14].

The mineral composition for watermelon seed flour as shown in table 2 revealed that it contains a fairly high concentration of minerals, having Potassium with value of 800 mg/kg which is higher than the value reported for *Carica papaya* seed flour (17.03 mg/100 g) (Adesuyi and Ipinmoroti, 2011) [15]. Calcium was discovered to be 660 mg/kg which is also higher than the value reported for *Carica papaya* seed flour (4.14 mg/100 g) (Adesuyi and Ipinmoroti, 2011) [15]. Lead and cadmium were discovered to be relatively low while chromium was not detected.

The Amino acid composition for watermelon seed flour as shown in table 3 revealed that the following amino acids are present in watermelon seed flour which includes; glycine, alanine, serine, proline, valine, threonine, isoleucine, leucine, asparatate, lysine, methionine, glutamate, phenylalanine, histidine, arginine, tyrosine, and cystine. The watermelon seed flour contain eight (8) essential amino acids (Phenylalanine, valine, threonine, methionine, leucine, isoleucine, lysine, and histindine, but does not contain tryptophan).

Glutamate was found to be more abundant in the watermelon seed flour (16.03 g/100 g) compared to other amino acids, while it was discovered to contain relatively low amount of tyrosine, histidine, threonine, and proline.

Table 4 showed the phytochemical screening results as performed using generally accepted laboratory techniques. The constituents analyzed were Glycoside, cardiac glycoside, saponin, flavonoid, phiobatannin, terpenoid, alkaloid, polysaccharides/starch, reducing sugar, steriod, hydrolysable tannin and condensed tannin. Glycoside, saponin, flavonoid, terpenoid, reducing sugar and steroid appeared to be present in the watermelon seed flour, while cardiac glycoside, saponin, phlobatannin, alkaloids, polysaccharides/starch, hydrolysable tannin and condensed tannin appeared to be absent in the watermelon seed flour.

Table 5 shows the result for the anti-nutrient composition of watermelon seed flour. The value of phytic acid was 0.37 mg/100 g which is lower than the value reported for Africa yam bean (26.36 mg/100 g) (Fagbemi, 2011) [16], Oxalate was discovered to be 0.27 mg/100 g which is lower compared to the value reported for Africa yam bean (9.24 mg/100 g) (Fagbemi, 2011) [16], but also of the same value with that reported for guava seed (0.12 mg/100 g) (Fowomola *et al.*, 2014) [17]. The value of saponin was also low (1.45 mg/100 g) which is lower than the value reported for guava seed (6.96 mg/100 g) (Fowomola *et al.*, 2014) [17].

Conclusion

The proximate chemical composition, mineral composition, amino acid composition anti-nutrients and phytochemical screening of watermelon seed flour have been determined. It has high level of lipid content, as well as mineral elements, although lead (Pb) and cadmium (Cd) were discovered to be present but at relatively low concentrations. Watermelon seed flour also contains proteins and some reasonable amount of essential amino acids which could be of great health benefits. It was also ascertained that it contains ash, fibre, and a very low level of anti-nutrients

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