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The Effect of Dehulling On the Phytochemical Composition of Roasted and Unroasted African Yam Bean Flour

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Abstract— The study examined the effect of dehulling on the phytochemical (phytate, tannin, saponin and cyanide) composition of roasted and unroasted African Yam bean flour. Two samples of African yam bean seeds were separately divided into two potions each, making it a total of four potions. For the roasted; one was dehulled and roasted in the oven, the other one was undehulled and roasted in the oven. For the Unroasted; one was dehulled and other was undehulled to obtain different samples of processed African Yam bean flours. The flours were analyzed to determine their level of phytochemical composition and it was observed that cyanide content of the samples ranged from 0.02mg/100 obtained from dehulled unroasted sample to 0.50mg/100 undehulled roasted, the saponin content ranged between 0.02% to 0.23% obtained from dehulled unroasted sample and undehulled roasted sample, the phytate content ranged from 0.03 to 0.93mg/100, while the tannin content ranged from 0.04 to 0.58% obtained from dehulled unroasted sample and undehulled roasted sample. The study showed that dehulling of African yam bean seeds before milling into flour had considerable influence on flours and heavy reduction in the phytochemical composition of the flours.

Key words: Dehulling, phytochemical composition, roasted, unroasted and African yam bean flour.

I. INTRODUCTION

Legumes are species diversity of crops that are included in flowering plants producing seeds in pods that are often cultured for food and feeds. Legumes ranked as 3rd largest family of flowering plants having more than 19500 species and over 750 genera [5]. *Sphenostylis stenocarpa* (ex. A. Rich.) Harms, commonly known as African yam bean (AYB), is a neglected and underutilized leguminous plant genetic resource of the subfamily Faboideae, family Fabaceae and a small genus represented by only seven species [12]. Legumes like African Yam bean are rich sources of carbohydrates, proteins, fats, minerals, fiber, antioxidants and vitamins; these beans are considered low in fat and are cholesterol free but some legumes are rich in oil such as soybean [4]. Legumes are low in fat and carbohydrate and high in protein, they can be used as substitute for animal protein, they are equally rich in magnesium, iron, copper and folic acid.

The presence of phytochemical content is one of the main drawbacks limiting the nutritional and food quality of legumes, especially African Yam Bean. The common phytochemcial/antinutrients found in grain legumes, before they are used in different food preparations, are usually dehulled. Dehulling of grain legumes is usually done after some kind of pre-hulling treatments to break the bond between the skin and cotyledons. A substantial portion of grain legumes is consumed after having been milled for removal of the hull or some other form of processing. The dehulling process of grain legumes involves abrasive removal of the outer skin of the kernel followed by air separation. Removal of the seed coat reduces the crude fiber and increases the protein content of the whole bean value.

The study therefore sought to systematically bridge the knowledge gap in AYB utilization through hulling processing method by identifying and comparing the phytochemical/antinutrients in the undehulled and dehulled.

II. METHODOLOGY

The African yam bean (*Sphenostylis stenocarpa)* seeds were purchased from main market Abakiliki, Ebonyi state in Nigeria.

Preparation of Roasted African Yam Bean Flour

African yam bean seeds were sorted to remove extraneous materials and damaged seeds. The African yam bean was divided into two portions and one portion was soaked in tap water for 24 hours to facilitate the dehulling of the seeds while the other was not dehulled. The seeds were roasted in the oven for 2 hours and milled then sieved to obtain flour.

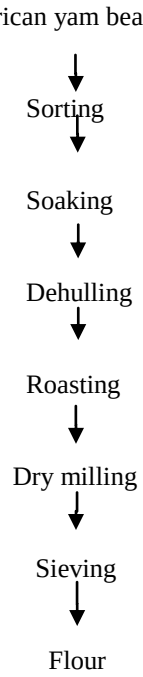

Figure 1: Flow Chart for production of flour from Roasted African Yam Bean

Preparation of Unroasted African Yam Bean Flour
African yam bean were sorted to remove extraneous materials and damaged seeds. The African yam bean was divided into two portions and one portion was soaked in tap water for 24 hours to facilitate the dehulling of the seeds while the other was not dehulled. The seeds were sun dried and milled then sieved to obtain flour.

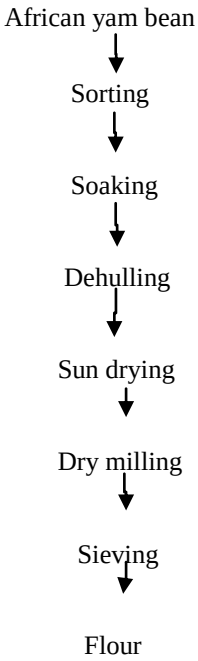

Figure 2: Flow Chart for production of flour from Unroasted African Yam Bean

Determination of Anti-nutrients/ Phytochemicals
Determination of Tannin by [15] method
500 mg of the sample was weighed into a 50ml plastic bottle. 50 ml of distilled water was added and shaken for 1 h in a mechanical shaker. This was filtered into a 50 ml volumetric flask and made up to mark. Then 5ml of the filtered was pipette out into a test tube and mixed with 2 ml of 0.1 M $FeCl_3$ in 0.1 N HCL and 0.008 M potassium ferrocyanide. The absorbance was measured at 120nm within 10min.

Determination of Phytate
This was carried out according to the method of [9], 10g of the sample was weighed into 250ml conical flasks. The sample was soaked in 10ml of 2% concentrated HCL for 3 hours the sample was latered filtered 50ml of the filterate was placed in 250ml beaker and 100ml distilled water was added to the sample 10ml of 0.3% ammonium thiocynate solution was added as indicator and titrated with standard iron (ii) chloride solution

$$\% \text{ Phytic acid} = \frac{(\text{Titrevaluex}0.00195\text{x}1.19\text{x}100)}{\text{sample analyzed}}$$

SaponinDetermination
The method used was that of [8]. The samples were ground and 20 g of each were put into a conical flask and 100 cm^3 of 20% aqueous ethanol were added. The samples were heated over a hot water bath for 4 h with continuous stirring at about 55 ^{0}C. The mixture was filtered and the residue re-extracted with another 200 ml of 20% ethanol. The combined extracts were reduced to 40 ml over water bath at about 90 ^{0}C. The concentrate was transferred into a 250 ml separatory funnel and 20 ml of diethyl ether was added and shaken vigorously. The aqueous layer was recovered while the ether layer was discarded. The purification process was repeated.

III. RESULTS AND DISCUSSION

Table 1: Result of the Phytochemical Composition of African Yam Bean

Parameter	Phytate(mg/ 100)	Tannin (%)	Saponin(%)	Cyanide(mg /kg)
ABC	$0.93^{a}\pm$ 0.01	$0.58^{b}\pm0.00$	$0.23^{a}\pm0.01$	$0.21^{c}\pm0.00$
BCD	$0.34^{c}\pm0.01$	$0.45^{c}\pm0.01$	$0.15^{c}\pm0.01$	$0.33^{b}\pm0.01$
CDE	$0.57^{b}\pm0.01$	$0.77^{a}\pm0.00$	$0.20^{b}\pm0.00$	$0.50^{a}\pm0.00$
DEF	$0.57^{b}\pm0.01$	$0.04^{d}\pm0.00$	$0.02^{d}\pm0.01$	$0.02^{d}\pm0.00$

Mean values with the sample superscripts in the same column are significantly different at ($P<0.05$)

Key:
ABC= Undehulled Roasted
BCD= Undehulled Unroasted
CDE= Dehulled Roasted
DEF= Dehulled Unroasted

The results of the phytochemical composition of undehulled- roasted and dehulled- roasted and their unroasted samples were shown in Table 1.

The results showed significant ($P<0.05$) variation in the phytate composition of the flour samples as the processing condition changes. The phytate content ranged from 0.03 to 0.93mg/100. The phytate content was observed to increase rapidly in the undehulled sample. This was also observed in the dehulled sample. [1] reported a decrease in phytate (88.65 - 44.88mg/100g) in Black Beans (*Phaseolus vulgaris*). Dehulling without roasting has shown to have more reducing effect of phytate composition of AYB flour, this is an indication that a large percentage of the phytochemical are contained in the seed coat, which has been removed in samples from dehulled samples. This means that foods prepared from dehulled samples will be more detoxified compared to those from undehulled samples, which agrees with the previous studies that dehulling reduces the antinutritional factors/ phytochemical composition, in addition to improving the cooking and protein quality, palatability and digestibility of pulses. [10] similarly reported that 48h roasting and cooking presoaked beans reduced phytates by 60.69% and44.85%, respectively.

Significant elimination of tannins was achieved by de-hulling implying that tannins were mainly in the seed coats. Dehulling was previously reported to substantially reduce the levels of tannin in beans [2,3]. However, beans that were de-hulled unroasted also had significantly lower tannin levels (0.04) than those which were roasted whole and roasted dehulled, although undehulled roasted had the highest value (2.23%). These observations were in agreement with that of [11] that studied the effect of dehulling on tannin contents where whole bean seeds had lower reduction in tannin content (5.83 to 4.50). Tannin levels were lower in flours from beans that were dehulled and roasted, compared to flours from beans that were roasted without dehulling, implying that dehulling caused a greater reduction in tannins compared to roasting. However, dehulling without roasting was more effective for reducing tannins than other methods applied. Dehulling without roasting was reported to reduce tannins in black grams, red kidney, and white kidney beans [13, 16] as well as in mung bean seeds (*Phaseolus aureus* L.). The saponin content ranged from 0.02 to 0.23% obtained for dehulled unroasted sample and undehulled roasted sample, this suggests that roasting do not have much effect on saponin content compared to the impact of dehulling, as could be seen in the dehulled unroasted. [7] also reported that a drop in saponin composition from1.971±0.060 to 1.353±0.041% with dehulled fermented seeds having the least and the raw mucuna seed having the highest. The high saponin content reduction of the dehulled unroasted sample in AYB samples could be as a result of high saopnin prevalence in the coats which when dehulled reduces the composition of the total saponin in the bean. In legumes, saponin have been reported to bind multivalent cations thereby reducing the bioavailability of mineral elements present in foods. They were also known to form complexes with protein and starch, thereby inhibiting the enzymatic digestion of starch and protein [6].

Hydrogen cyanide contents of the samples ranged from 0.02 obtained for dehulled unroasted sample to 0.50 undehulled roasted. These were within the range of cyanide content (0.24-0.86 mg/100g) reported by [14] for differently processed (*Tamarindus indica* L.) seed flours. The results obtained were relatively lower for all the flours but exceptionally lowest for the unroasted flour. This can be attributed to heat application which has been reported to reduce cyanogens' content. High concentrations of hydrogen cyanide can be very poisonous to human health if consumed.

IV. CONCLUSION AND FUTURE SCOPE

This study showed that removal of seed coat of AYB prior to milling into flour had appreciable influence on the milled flours. It also showed that dehulling resulted in heavy reduction in the anti-nutritional/phytochemical factors of the flours.

The dehulled unroasted sample was shown to be a product of low phytochemical factor, therefore, dehulling is recommended for processing of legumes in other to control its level of phytochemicals.

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