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Nutrients and Phyto-Chemical Assay of African Star Apple Kernel (*Chrysophyllum africanum*) as Potential Feedstuff in Fish and Livestock Production

L. A. Agbabiaka[1*], L. O. Eke[2] and C. F. Nwankwo[2]

[1]Department of Animal Science and Fisheries, Imo State University, Owerri, Nigeria.
[2]Department of Food Technology, Federal Polytechnic, Nekede-Owerri, Nigeria.

Authors' contribution

This work was carried out in collaboration between all authors. Author LAA design the work, wrote the draft/protocol and carried out the proximate analysis, while Authors CFN and ELO carried out the laboratory work on phyto-toxin and statistical analyses respectively. All authors read and approved the final manuscript.

Research Article

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ABSTRACT

Nutrients assay of raw and fermented African Star Apple seeds were evaluated. The proximate analyses differ ($p<0.05$) significantly between the raw (RSA) and processed (FSA) *Chrysophyllum africanum* seed in crude protein, lipid, dietary fibre and soluble carbohydrate. Protein value was 10.13±0.02%, Ash 7.25±0.01%, Crude fat 9.72±0.02% and Soluble carbohydrate 69.45±0.84% for RSA. However, the values of 5.55±0.01%, 14.49±0.76%, 4.94±0.07%, 1.19±0.01% and 51.04±0.08% were recorded for Ash, Crude protein, Crude fat, Crude fibre and Soluble carbohydrate in FSA respectively. Nevertheless, similar observations were recorded in the concentration of phyto-chemicals which decreased in all the parameters in FSA ($p<0.05$) compared with RSA. The FSA contained relatively higher concentration of minerals than RSA ($p>0.05$). Generally, there was a significant loss of nutrients in processed seed except crude protein, however, the reduction in the phyto-toxin in FSA may be an encouragement coupled with rich nutrients as a component of animal feed to replace the expensive orthodox energy feedstuff.

**Corresponding author: E-mail: adegokson2@yahoo.com;*

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1. INTRODUCTION

The nutritional value of any ingredient or feed can be evaluated by biological, chemical and physical scores [1]. Chemical score has proven to be a vital tool in food chemistry because it tends to assess the nutritional value based on the proximate composition of the food/feed which includes the protein, carbohydrate, lipid, moisture, ash and dietary fibre contents respectively.

Plants are primary sources of medicine, food and shelter used by human on daily basis, their roots, leaves, fruits and seeds often provide food for humans [2]. The fruits are main source of minerals, fibre and vitamins which are inevitable for human health [3].

African star apple (*C. africanum*) popularly called "Agbalumo" among the Yoruba tribe of Western Nigeria is also known as "Agwaluma" or "Udara" in Hausa and Igbo languages respectively. It is primarily cultivated for its sweet fleshy fruits which had been reported as an excellent source for vitamin C, Iron, thickener or jam and flavours to diets and raw materials to some manufacturing industries such as resin as reported by Adisa and Fajola [4]. Star apple is believed to be originated from low-lands of Central America and West Indian. It is common in both urban and rural centre in Nigeria especially during the months of December through April, when most orthodox cereals for feed formulation are usually scarce. The ripe fruit is highly perishable, and deteriorate within 5 days of harvest [4].

There has been dearth of work on the potential of the seeds/kernels which are often discarded after leaking the fleshy fruit. This experiment was conceived at investigating the nutritional potential(s) of the African star apple seeds with the aim of providing baseline information on its suitability or otherwise as animal feedstuff.

2. MATERIALS AND METHODS

2.1 Sample Collection and Preparation

The fruits of African star apple used for this research were collected within the college premises of Federal Polytechnic, Nekede, Owerri, Nigeria. The fruits were washed thoroughly under tap, skin peeled and the pulp (edible portion) was removed to expose the seeds. The seeds were dehulled to expose the mesocarp (kernel). The mesocarp was divided into 2 batches; one portion was sundried as raw star apple (RSA), while the other portion was added water (3 times the volume of the seed) and allowed to ferment for 3 days. Thereafter, the supernatant water was decanted and sundried for 4 days until crispy.

The sundried samples were passed through a metal blade blender to produce star apple meals, packed in air tight bottles and labeled as RSA and FSA for raw and fermented star apple meals respectively. These samples were subjected to laboratory analyses to determine the chemical composition and phyto-toxins according to AOAC [5] and Enujiugha and Olubunmi [6] respectively.

3. RESULTS AND DISCUSSION

The results of the proximate and mineral composition of raw and fermented star apple kernel is shown in Tables 1 and 2 respectively, while Table 3 presents the anti nutrients of the test ingredients.

The percentage moisture content of the star apple kernel (RSA and FSA) ranged between 10.69 – 14.66±0.01%. These values were higher than (9.5%) reported for sweet maize [7] and 6% for mango seed kernel [8] but lower than the value of 68.42% reported for cassava by Bressani and Ortiz [9]. The moisture content of any food is an index of its water activity which is used to measure or predict the stability and susceptibility to microbial contamination [10,11].

The Crude fat (Ether extract) concentrations were 9.72±0.02% and 4.94 ±0.07% for RSA and FSA respectively. These values were higher than 3.9% recorded for sweet maize [7] and 5.08% recorded for raw mango seed kernel by Agbabiaka et al. [12]. This is an indication that African star apple seed / kernel contained a moderately high level of calorie comparable to some conventional feedstuff.

The Crude protein content of RSA was 10.13±0.12% which is lower than the value of 14.49±0.76% found in FSA. The higher Crude protein content of the FSA is attributed to the increase in build-up and effect of single celled microbes responsible for fermentation. Similar result was observed when cassava peel was fermented [13,14,15].

However, the crude protein values recorded in this experiment also showed that African star apple seed is endowed with crude protein comparable to some orthodox energy feedstuffs such as maize and millet (CP = 9 – 10%) and tigernut (7 – 9.5%) according to Aduku [16]; Oladele et al. [17] and Agbabiaka et al. [18] respectively. Nevertheless, the Nitrogen free extract (soluble carbohydrate) decreased from 69.45% in RSA to 51.04±0.08% in FSA. The decline was due to the effect of fermentation process which allowed the microbes such as yeast and bacteria to use up the carbohydrate as source of energy [19] .

There were noticeable decline in all the values of the anti-nutritional factors found in FSA compared with RSA (Table 3), this may be due to the effect of fermentation and or leaching of some poly-phenols [20] . This experiment also revealed high concentration of macro and micro elements than RSA ($p>0.05$), which is attributed to the role of micro-organisms of fermentation [21].

Table 1. Proximate composition of African star apple (*Chrysophyllum africanum*)

Nutrients (%)	RSA	FSA
Moisture	14.66 ± 0.01	10.69 ± 0.01
Ash	7.25 ± 0.01	5.55 ± 0.01
Crude protein	10.13 ± 0.12	14.49 ± 0.76
Crude fat	9.72 ± 0.02	4.94 ± 0.07
Crude fibre	1.22 ± 0.02	1.19 ± 0.01
Nitrogen free extracts	69.45 ± 0.84	51.04 ± 0.08

RSA and FSA are the raw star apple and fermented star apple, respectively

Table 2. Mineral Composition of African star apple (*Chrysophyllum africanum*)

	Sample concentration (%)	
Constituents	**RSA**	**FSA**
Sodium	12.54 ± 0.02	17.83 ± 0.01
Potassium	31.32 ± 0.01	12.17 ± 0.03
Calcium	0.54 ± 0.01	0.86 ± 0.01
Magnesium	0.39 ± 0.02	0.71 ± 0.01
Zinc	0.25 ± 0.01	0.44 ± 0.01
Iron	0.16 ± 0.01	0.15 ± 0.02
Copper	0.02 ± 0.01	0.02 ± 0.01
Manganese	0.05 ± 0.01	0.12 ± 0.01
Phosphorus	0.44 ± 0.01	1.09 ± 0.01

RSA and FSA are the raw star apple and fermented star apple, respectively

Table 3. Anti-nutrients of African star apple (*Chrysophyllum africanum*)

	Sample concentration	
Chemical constituents	**RSA**	**FSA**
Tannin (mg/100g)	0.42± 0.01	4.87± 0.02
Phytate (mg/g)	12.37± 0.04	9.88± 0.12
Phytin phosphorus (mg/g)	3.48± 0.02	2.78± 0.01
Oxalate (mg/g)	4.10± 0.16	2.25± 0.06
Alkaloid (%)	0.48± 0.03	0.85± 0.07
Saponin (%)	0.74± 0.02	1.25± 0.13

RSA and FSA are the raw star apple and fermented star apple , respectively

4. CONCLUSION

The reduction in the phyto-toxin in FSA coupled with rich nutrients as found in this study which compared favourably with maize and millet suggests that processed Star apple kernel could be encouraged as a component of animal feed , to replace the expensive orthodox energy feedstuff primarily to provide cheap and affordable animal protein for the populace.

COMPETING INTERESTS

Authors have declared that no competing interest exists.

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