PHYTOCHEMICALS AND PROXIMATE EVALUATIONS OF RAW AND PROCESSED AFRICAN STAR APPLE *(CHRYSOPHYLLUM ALBIDUM)* KERNELS

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SUMMARY

Effect of different processing methods on phytochemical and proximate compositions of African star apple (*Chrysophyllum albidum*) kernels was investigated. Raw African star apple kernels were collected from African star apple fruit farmers in Osogbo, Osun state, Nigeria for the study. Four different processing methods (boiling, fermentation, soaking and roasting) were carried out. All the processed kernels were milled and taken to the laboratory for phytochemical and proximate analyses. The data generated were subjected to statistical analysis software package, to compare the means composition of the processed kernels. Significance was accepted at $P < 0.05$. Result of the study shows that raw african star apple kernels contains 93.21% dry matter, 12.03% crude protein, 5.10% crude fibre, 1.45% ether extract, 1.85% ash and 72.78% NFE and very high in gross energy (400.10 Kcal/100 g). It also contains some anti-nutritional factors such as saponin (5.00mg/100g), tannin (7.33g/100g), oxalate (12.41mg/100g) and phytate (10.06mg/100g). Processing significantly reduced (P<0.05) crude protein in all the methods except boiling. Boiling and roasting significantly increased the energy content of the kernels. Anti nutritional factors were significantly reduced (P<0.05) by the processing methods although boiling gave the highest percentage reduction of anti nutritional factors. It was concluded that African star apple kernel should be processed through boiling before being included in the diets of monogastric animals.

Key words: african star apple kernels, raw, processing, proximate, phytochemicals

INTRODUCTION

Nutritionally, *Chrysophyllum albidum* seeds have been reported to contain 14.66 % moisture, 10.13% crude protein, 1.22 % crude fibre, 9.72 % lipid and 7.25 % ash (Agbabiaka *et al*., 2013). However, presence of antinutritional components restricts its use by interfering with digestion of carbohydrates and proteins. Phyates, oxalates, saponin, polyphenols form insoluble complexes with essential dietary components like vitamins, minerals rendering them unavailable to the body (Agbabiaka *et al*., 2013). Studies have however shown that processing can be used to reduce anti-nutritional substances (Jiya, 2012). Different traditional processing methods such as roasting, cooking, soaking and fermenting were reported to reduce anti-nutritional factors and raise bioavailability of nutrients in pigeon pea (*Cajanus cajan*) seed meal (Ahamaefule *et al*., 2008), Flamboyant tree seed meal (Alemede *et al*., 2010), Tallow (*Detarium microcarpum*) seed meal (Jiya, 2012) and *Daniella oliveri* seed meal (Obun and Adeyemi, 2012). This study was therefore carried out to determine the effect of different processing methods on proximate and phytochemical compositions of African star apple kernel.

MATERIALS AND METHODS

Experimental site

This experiment was carried out at the Teaching and Research Laboratory, Department of Animal Production, School of Agriculture and Agricultural Technology, Federal University of Technology, Minna, Niger State, Nigeria. Minna is located within latitudes 4°30' 09°30' and 09°45'N and longitudes 06° 30' and 06°45 'E with an altitude of 1475 m above sea level (Ovimap, 2016). The area falls within the southern guinea savannah vegetation zone of Nigeria with average annual rainfall of between 1100 and 1600 mm and a mean temperature of between 21^0C and 36.5^0C (Ovimap, 2016). Minna experiences two distinct seasons (dry, from November to March and wet or rainy season, from April to October).

Sample collection and preparation

The seeds of African star apple used for this research were collected from African star apple fruit farmers in Osogbo, Osun State, Nigeria. The seeds were washed thoroughly with water, sundried and dehulled to expose the mesocarp (kernel). The mesocarp was divided into 5 batches as follow:

(1) Raw - One kilogram of African star apple kernels were air dried, milled using a hammer mill with a sieve size of 3mm and labeled as raw African star apple kernel meal.

(2) Fermentation - One kilogram of African star apple kernel was fermented in water for 72 h at the rate 1 kilogram kernel to 5 litres of water as described by Agbabiaka *et al*. (2013). Kernels were poured inside a jute bag and immersed inside the water and covered for 72 h. Thereafter, the jute bag was removed and the fermented kernels were air dried for three days. The kernels were later milled using hammer mill with a sieve size of 3mm and labeled as Fermented African star apple kernel meal (FASAKM).

(3) Roasting - One kg of African star apple kernel was roasted at 70 ^{0}C for 30 minutes using fire wood with iron pot mixed with sand according to the method described by Sola-Ojo *et al.* (2013). During roasting, the kernels were stirred continuously to ensure uniform roasting and to prevent charring until the kernels turned crispy brown. The roasted kernels were then spread out to cool after which they were milled into roasted African star apple kernel meal (RASAKM) using a hammer mill with a sieve size of 3mm.

(4) Soaking - One kilogram of African star apple kernel was soaked in cold water for 24 h at the rate 1 kilogram kernel to 5 litre of water as described by Saulawa *et al*. (2014). Thereafter, water was drained off by means of 10mm sieve and the soaked kernels were air dried for three days. The dried kernels were later milled using 3mm hammer mill and labeled as Soaked African star apple kernel meal (SASAKM).

(5) Boiling - One kilogram of African star apple kernel was subjected to boiling at 100 °C for 15 minutes at the rate 1 kilogram kernel to 5 litre of water as described by Ahamefule *et al*. (2008); Jimoh *et al*. (2014) after which water was drained off by means of 10mm sieve and the boiled kernels were air dried for three days. The dried kernels were milled using 3mm hammer mill and labeled as Boiled African star apple kernel meal (BASAKM). Samples were subjected to laboratory analysis to determine the proximate and phytochemical compositions according to AOAC (2006). The gross energy was determined using Gallenkamp Ballistic Bomb Calorimeter (Model 1266, Parr Instrument Co., Moline, IL.) and benzoic acid as an internal standard.

Data Analysis
Data generated were subjected to one way Analysis of variance (ANOVA) using the general linear model of statistical analysis system, Version 9.3 (SAS, 2015).

RESULTS AND DISCUSSION

Proximate composition - The results of the proximate and phytochemical composition of raw and differently processed African star apple kernel are shown in Tables 1 and 2 respectively. There were significant differences (P<0.05) between raw and differently processed African star apple kernels for all the components considered on dry matter basis. The crude protein values ranged from 8.08% (DM) for fermented kernel to 13.26% (DM) for boiled kernel. The crude protein value of 12.03% observed in this study was higher than 10.13% reported by Agbabiaka *et al.* (2013) for raw star apple kernel. However, the value of 8.08% CP observed for fermented star apple was lower than 14.49% CP reported by Agbabiaka *et al.* (2013). The value of 10.81 % CP observed in this study for roasted star apple kernel is similar to the 10.95 % CP reported by Jimoh *et al*. (2014) for roasted star apple seed. The differences in these values may be attributed to variation in soil, climate, variety and processing methods. It was also observed that only boiling method improves the crude protein content of the kernels. Saulawa *et al.* (2014) had earlier reported that boiling gave the best result when baobab seeds were processed with different methods (boiling, toasting, soaking, soak and boiling and sprouting). The lowest CP content (7.95%) was observed in soaked star apple kernel. The reduction in crude protein from 12.03% to 10.95 % observed in the roasted Star apple kernels in this work is in agreement with previous findings of Amaefule *et al*. (2003) and Emenalom and Udedibie (1998) who obtained similar results with different legumes. This may be partly due to the burning off of some nitrogenous compounds during roasting (Emenalom and Udedibie, 1998). However, Emiola *et al*. (2002) reported increase in crude protein content of raw kidney beans when subjected to roasting. The crude fibre value ranged from 5.10% for raw to 6.20% for fermented kernels. Fermentation significantly (P<0.05) increased the crude fibre content compared with other processing methods. The NFE values ranged from 71.57 % for boiled kernels to 74.82 % for fermented kernels. These values are higher than the range of 51.04 to 69.45% recorded for fermented and raw kernels respectively (Agbabiaka *et al*., 2013). Also, Abdullahi (2012) reported a range of 76.37- 79.85% NFE for differently processed mango seed kernels. This is an indication that African star apple kernel contained a moderately high level of calorie compared to some conventional feedstuff.

Phytochemical Composition - There were significant (P<0.05) differences between the raw and processed Kernels in all the parameters measured (Table 2). There was a general reduction in the content of anti-nutritional factors (saponin, tannin, oxalate and phytate) as a result of processing of raw Afriacn star apple kernels, though this reduction varies in degree with different processing techniques. The highest percentage reductions in saponin (93.40 %), tannin (91.68 %), oxalate (87.51%) and phytate (98.31%) were observed when the raw African star apple kernels were boiled followed by roasted and soaked. Fermentation gave the least percentage reduction of anti-nutrients. The higher percentage reduction of all parameters observed in boiling in this trial confirms earlier report by other authors (Abdullahi, 2012; Saulawa *et al*, 2014; McEwan *et al.*, 2014) that boiling method was very effective to reduce anti-nutrients in Mango seed kernels, baobab seed and Amadumbe (*Colocasia esculenta*) than any other processing methods.

All parameters observed in this study for raw kernels differ from what was earlier reported by Agbabiaka *et al.* (2013) who observed that raw kernels contain 0.48 mg/100g tannin and 12.37 mg/g phytate. The variation could be due to reasons reported by Ann and Neena (1982) that species may vary not only in composition of nutrient but in type and amount of toxins, thus results obtained with one specie may not necessarily be applicable to another. Even the length of storage time will also affect certain characteristics.

Table 1: Proximate Composition of raw and differently processed African star apple kernels

Nutrients,%	Raw	Boiled	Fermented	Roasted	Soaked	SEM	P-value
Dry matter	93.21[a]	92.83[b]	93.07[a]	93.09[a]	92.40[c]	0.08	0.0012
Crude Protein	12.03[b]	13.26[a]	8.08[d]	10.81[c]	7.95[d]	0.26	0.0001
Crude fibre	5.10[b]	5.20[b]	6.20[a]	5.10[b]	6.00[a]	0.18	0.0036
Ether extract	1.45[bc]	1.55[bc]	1.38[c]	1.70[b]	1.97[a]	0.10	0.0122
Ash	1.85[c]	1.25[e]	2.60[b]	1.55[d]	3.11[a]	0.10	0.0001
Nitrogen free extract	72.78[c]	71.57[d]	74.82[a]	73.93[ab]	73.38[bc]	0.39	0.0029
Gross energy (Kcal/100 g)	400.10[b]	401.20[a]	401.19[a]	401.21[a]	400.11[b]	0.02	0.0001
Metabolizable energy (Kcal/kg ME)	3147.23[a]	3157.96[a]	3067.36[b]	3163.37[a]	3059.70[b]	8.96	0.0002

*All values are means of triplicate determinations expressed in dry weight basis. abc= means with different superscripts on the same row are significantly different (P<0.05), SEM= Standard error of mean, P = Probability value.

Table 2: Phytochemical Composition of raw and Processed African star apple kernels

Antinutrients, mg/100g	Raw	Boiled	Fermented	Soaked	Roasted	SEM	P-value	*Critical level
Saponin	5.00[a]	0.33[d]	2.02[b]	1.33[c]	0.35[d]	0.06	0.0001	7.02
Reduction (%)		93.40	59.60	73.40	93.00			
Tannin	7.33[a]	0.61[e]	4.02[b]	3.10[c]	1.08[d]	0.37	0.0001	31.20
Reduction (%)		91.68	45.16	57.71	85.26			
Oxalate	12.41[a]	1.54[e]	5.00[b]	4.67[c]	2.00[d]	0.09	0.0001	2.50
Reduction (%)		87.51	59.45	62.37	83.88			
Phytate	10.06[a]	0.17[d]	3.33[b]	1.67[c]	0.17[d]	1.17	0.0001	0.50
Reduction (%)		98.31	66.89	83.39	98.31			

*All values are means of triplicate determinations. abc= means with different superscripts on the same row are significantly different (P<0.05), SEM= Standard error of mean, P = Probability value. *Source: Umar (2010).

CONCLUSION

This study has revealed that African star apple kernels could be used more as feed ingredient in animal feed, judging from the high carbohydrate, adequate protein and low lipid content. This study shows that the studied anti-nutrients, though showing a significant concentration in raw kernels, should not pose a problem in animal feed if the kernels are properly processed. Anti nutritional factors were significantly reduced (P<0.05) by the processing methods although boiling gave the highest percentage reduction of anti nutritional factors and increased crude protein content. It was concluded that African star apple kernel should be processed through boiling before inclusion as animal feed.

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