

**NSAP****47th Annual
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**SECURING ANIMAL
AGRICULTURE AMIDST
GLOBAL CHALLENGES**

PROCESSING OF RAW AFRICAN STAR APPLE KERNELS USING ABSORBENTS PRECEDED BY PHYSICAL METHODS FOR REPLACING MAIZE IN FEED

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Abstract

In poultry diet, maize has the highest inclusion rate and causes an increase in the price of feed. Some alternative novel feed resources are available but their nutritional composition are yet to be ascertained for animal feeding. This study investigated the appropriate methods of detoxifying the secondary metabolites in the African Star apple kernels (ASAK) using different methods for use in poultry. The seeds of African star apple were obtained from the fruit and thoroughly washed to remove the foreign materials, immature or broken seeds. They were further dehulled using a hammer mill to obtain the kernels. The extracted raw kernels were initially pretreated in three different groups of soaking for 12 hours + boiling for 30 minutes, soaking for 24 hours + boiling for 1 hour and soaking for 48 hours + boiling for 2 hours. They were sundried and milled for phytochemical screening. The first group was selected for further processing as treatment 1 and the use of three different absorbents of activated charcoal, bentonite and polyethylene glycol by mixing thoroughly with the milled kernels and placed in tight sealed containers for seven days as treatment 2, 3 and 4 respectively in a complete randomized design of three replicates each for screening to determine the most effective absorbent for detoxifying the kernels. The result revealed that soaking and boiling was effective on the oxalate and glycoside levels in the ASAK meal. The use of absorbents led to a significant ($P < 0.05$) decrease in the residual secondary metabolites.

Keywords: African star apple, maize and processing method, soaking, boiling, activated charcoal, bentonite, polyethylene glycol.

Introduction

In any poultry diet, maize has the highest inclusion rate, this high inclusion level of maize causes an increase in the price of feed due to the increasing demand and seasonality in its availability for man and livestock (Agbede *et al.* 2002). Preston (1995) reported that the limiting factor to researchers in the tropics is inability to proffer novel feed resources for monogastric animals. Some alternative novel feed resources are available but their nutritional composition are yet to be ascertained for animal feeding (Shittu *et al.*, 2006). African star apple seed kernels are a potential alternative novel feed. The seed was reported to have high carbohydrate and protein levels (Ukana *et al.* 2012). African Star apple (*Chrysophyllum albidum*) originated from the Greater Antilles and the West Indies. It belongs to the sapotaceae family with a wide spread throughout the lowlands of Central America and cultivated in the entire Tropical areas including Southeast Asia. In Nigeria, *Chrysophyllum albidum* is known as *Agbalumo*, *Agwaluma*, *Udara* among the Yorubas, Hausas, and Ibos respectively (Adewusi and Bada, 1997).



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The tree together with the fruit seeds contains antinutritional factors such as saponin, cyanogenic glycoside, oxalate, phytate, tannin. These antinutritional diminish the availability of nutrients at high concentrations (Ojako and Igwe, 2008). Annongu *et al.* (2017) fed raw African star apple kernels to broilers and reported a deleterious effect on its growth performance as a result of the antinutritional factors present in the kernels. It is on this basis, that this study investigated the appropriate methods of detoxifying the secondary metabolites in the African Star apple kernels (ASAK) using different methods for use in poultry.

Materials and methods

Experimental site

The experiment was conducted in the Teaching and Research Farm/Animal Science Laboratory, Landmark University, OmuAran, Kwara State.

Collection of star apple seeds

The fruits of *C. albidum* for this study were collected from the various star apple plantations in Osun state, Nigeria. The seeds were obtained from the fruit and thoroughly washed to remove the foreign materials, immature or broken seeds. They were further dehulled using a hammer mill to obtain the kernels.

Physical treatment and chemical analysis of African star applekernel meal

The treatment of the kernels with three different absorbents namely activated charcoal, bentonite and polyethylene glycol were preceded by physical pretreatment of soaking and boiling to determine the group that will mostly reduce the antinutritional factors in the kernels before the treatment of the milled kernels with the absorbents. The kernels were partitioned into three groups which involved:

1. Soaking the kernels for 12 hours and boiling for 30 minutes
2. Soaking the kernels for 24 hours and boiling for 1 hour
3. Soaking the kernels for 48 hours and boiling for 2 hours

The soaked and boiled kernels were sundried, milled and subsequently taken to the laboratory for phytochemical screening. The best physical method of soaking and boiling was in the group of the kernels soaked for 12 hours and boiled for 30 minutes (S12;B30) as treatment 1 considering the fairest decrease in the secondary metabolites in relation to other groups. It was selected for further processing by using different absorbents (activated charcoal, bentonite and polyethylene glycol). The pretreated milled kernels were thoroughly mixed with activated charcoal at 5g/kg, bentonite at 20g/kg, polyethylene glycol at 20g/kg and placed in tightly sealed containers for seven days as treatment 2, 3 and 4 respectively in a complete randomized design of three replicates each before the phytochemical screening to determine the most effective absorbent.

Chemical analysis of the raw and processed African Star apple kernels

The phytochemical quantification of the raw and the processed African star apple kernel meal were carried out at Central Research Laboratory, Tanke, Ilorin. Quantification of the phytochemicals in the raw kernel meal was carried out using the methods described by Sofowora (1993).

Statistical Analysis

The generated data from the experiment was analyzed using the General Linear Model Procedure of SAS (2016). The Duncan's New Multiple Range Test was used to separate the means in the treatment groups where significant differences were observed.

**Results**

Table 1 presents the secondary metabolites in the raw together with the soaking/boiling intervals of the African star apple kernels. It was observed that there was a decrease in the level of saponin, phytate, oxalate and glycoside in group 1 in which the kernels was soaked for 12 hours and boiled for 30 minutes in relation to group 2 and 3 respectively. However the level of tannin increased in all the groups in relation to the tannin content in the raw kernels. The saponin, phytate, oxalate and glycoside content in the raw ASAK meal decreased by 74.16%, 88.06%, 97.50% and 99.99%, whereas there was an increase in the tannin content by 18.69% after soaking and boiling for 12 hours and 30 minutes respectively but significantly ($P < 0.05$) led to a reduction in the level of oxalate and glycoside compared to the use of absorbents. The residual secondary metabolites in the processed African star apple kernel using activated charcoal, bentonite and polyethylene glycol is presented on Table 2. It was observed that, there was a further decrease in the saponin, phytate, and tannin content using the absorbents and a slight increase in the oxalate and glycoside contents across the treatments. The trend revealed that the absorbents were target specific for the secondary metabolites in ASAK as activated charcoal and bentonite were significantly ($P < 0.05$) effective for detoxifying saponin and phytate, they all exhibited similar effect on the phytate and tannin contents.

Table 1: Secondary metabolites in the raw versus the soaking/boiling intervals of the African star apple kernels

	T R E A T M E N T S					
	1	2	3	4	SEM	Pvalue
Soaking time (hr)	0	12	24	48		
Boiling time (min)	0	30	60	90		
Saponins	12.15 ^a	3.14 ^b	3.12 ^b	3.14 ^b	0.2667	0.0001
Phytate	1,308.70 ^a	156.25 ^b	155.23 ^b	154.77 ^b	2.7570	0.0001
Tannins	1,037.47 ^d	1,276.04 ^c	1375.00 ^a	1,312.50 ^b	10.1533	0.0001
Oxalate	0.80 ^c	0.02 ^d	2.83 ^b	7.13 ^a	0.0227	0.0001
Glycoside	0.78 ^a	0.00007 ^b	0.00004 ^b	0.00005 ^b	0.0247	0.0001

SEM= Standard error of mean;LOS= Level of Significance;*= $P < 0.05$; ^{a,b,c,d}Means with different superscript along the same rows are significantly ($P < 0.05$);NS=Non Significant ($P > 0.05$).

Table 2: Residual secondary metabolites in the processedsoaked and boiled African star apple kernel meal using three absorbents

	T R E A T M E N T S					
	1	2	3	4	SEM	Pvalue
Parameters	S12;B30	ASAK ^{AC}	ASAK ^{BN}	ASAK ^{PEG}		
Saponins	3.14 ^a	1.38 ^c	1.27 ^c	1.98 ^b	0.0515	0.0001
Phytate	156.25 ^a	0.31 ^b	0.26 ^b	0.37 ^b	0.5018	0.0001
Tannins	1,276.04 ^a	8.30 ^b	8.69 ^b	8.37 ^b	13.3386	0.0001
Oxalate	0.02 ^b	0.29 ^b	0.31 ^a	0.44 ^a	0.0144	0.0001
Glycoside	0.00007 ^d	0.02 ^b	0.0048 ^c	0.0291 ^a	0.0006	0.0001

SEM= Standard error of mean;LOS= Level of Significance;*= $P < 0.05$; ^{a,b,c,d}Means with different superscript along the same rows are significantly ($P < 0.05$);NS=Non Significant ($P > 0.05$); S12;B30=soaked for 12 hours & boiled for 30 minutes;ASAK^{AC}= Processed African star apple kernel using activated charcoal, ASAK^{BN}= Processed African star apple kernel using bentonite; ASAK^{PEG}= Processed African star apple kernel using polyethylene glycol.



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Discussion

The raw ASAK meal was very high in phytate, tannins and saponins necessitating the need for proper processing methods for its suitability in animal feeding. The increase in the tannin content of the soaked and boiled kernels compared to the raw kernels were as a result of metabolic changes that occurred during soaking and boiling. This assertion could be supported by the findings of Vidal-Valverde *et al.* (1992), who reported that some metabolic reactions could occur during soaking which in turn affects some constituent compounds. The decline in the antinutritional factors in ASAK meal using absorbents is in line with the reports of George *et al.* (2000) that activated charcoal adsorbs toxins and enhances the intake of poisonous plants. Phillips *et al.* (2002) reported the usefulness of bentonite as a good anti-nutritive agent and acts as an excellent adsorptive material for heavy metals and germs (Katsumata *et al.*, 2003). In the same manner, the reports of Getachew *et al.* (2000) corroborates the findings of this study that novel feed resources attributed to tannins could be ameliorated using tannin-binding agent such as polyethylene glycol (PEG) without compromising the nutritional value of the formulated diet.

Conclusion and Recommendation

It can be concluded that the use of the absorbents further led to a decline in the residual secondary metabolites in the physical method of soaking and boiling for 12 hours and 30 minutes respectively and the absorbents were target specific on the antinutrients in the African Star apple kernel meal. The inclusion level of the absorbents could be increased as well as combining the absorbents for detoxifying the antinutrients in the ASAK.

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