EVALUATION OF GROWTH PERFORMANCE OF BROILERS FED DIET CONTAINING GRADED LEVELS OF PROCESSED AFRICAN STAR APPLE

S.O. AJIDE[1*], A.A. ANNONGU[2], E.S. INAPE[1], AND J.O. MAKINDE[3]
[1]Department of Animal Science, Landmark University, OmuAran, Kwara State.
[2]Department of Animal Production, University of Ilorin, Ilorin.
[3]Department of Animal Science, Federal University, Gashua, Yobe State.
*Correspondence:ajidesolomon@gmail.com, 08038905602

ABSTRACT
The study investigated the combination of physical and chemical methods for eliminating the secondary metabolites in the African star apple kernels (ASAK) for feeding poultry. The kernels obtained from the seed were soaked for 12 hours, boiled for 30 minutes and sun dried. They were milled, pretreated with the absorbents using activated charcoal at 5g/kg, bentonite at 20g/kg, polyethelene glycol at 20g/kg and placed in tightly sealed containers for seven days before inclusion in the diet at graded levels of 0, 5, 10, 15, 20, 25 and 30% respectively replacing maize in the feed. The diets were fed to 315 one week old cobb broiler chicks in a 3 x7 factorial arrangement of Completely Randomized Design having three replicates with five birds per replicate in a trial that lasted for 7 weeks. Soaking the kernels for 12 hours and boiling for 30 minutes was considerably effective by decreasing the saponins, phytate, oxalate and glycoside contents by 74.15, 88.06, 97.50 and 99.99% but increased the tannin level by 18.69%. The further processing of the kernels by absorbents exhibited similar action, leading to a general decline in the concentration of the saponins, phytate, tannins but elicited the levels of oxalate and glycoside by 94.21 and 99.61% respectively. The growth performance of the birds were significantly ($p<0.05$) affected despite the reduced concentration of the antinutritional factors after processing limiting the use for poultry.

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

Introduction
The presence of antinutritional factors in feedstuff/food revealed that it has deleterious effects when consumed in certain amounts. It has been proven by numerous authors in many *invivo* assays and different feeding trials that these secondary metabolites have deleterious effect on the animals (Sugano *et al.*, 1993). Anti-nutrients present in plant food or feedstuffs constitute a serious impediment to the use of alternative feedstuffs for animal production. The increasing threat to proper nutrition and health of humans and animals has earned the attention of researchers proffering solutions to the toxicities it causes (Soetan and Oyewole, 2009). Some of the approaches include the addition of physical binders or sequestering agents to feed in an attempt to reduce toxicity and reactivity of the bound toxins to prevent intestinal absorption. Some physical adsorbents used include silicates, organic polymers of esterified glucan, inorganic polymers such as cholestyramine, polyvinylpyrrolidore and activated charcoal (Edem, *et al*., 2011; Ukana *et al.*,2012). African star apple seed kernels are a potential alternative novel feed. The seed was reported to have high carbohydrate and protein protein levels (Ukana *et al.* 2012). Annongu *et al*. (2017) reported that the secondary metabolites in the raw African star apple kernels impacted negatively on the growth performance of broiler chickens. This study was aimed at determining the best processing method using different absorbents preceded by physical methods for detoxifying the antinutritional factors in kernels 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.

Processing of the African star apple kernels using physical and chemical methods

The seeds of the African star apple were threshed using a hammer mill to obtain the kernels. The kernels obtained from the seed were soaked for 12 hours, boiled for 30 minutes and sun dried. The sun dried kernels were milled, pretreated with the various absorbents using activated charcoal at 5g/kg, bentonite at 20g/kg, polyethelene glycol at 20g/kg and placed in tightly sealed containers for seven days before inclusion in the diet.

Experimental diet and design

Seven experimental diets were formulated made of a corn-soy control diet and six other diets containing processed African star apple kernel using activated charcoal ($ASAK^{AC}$), bentonite ($ASAK^{BN}$) and polyethelene glycol ($ASAK^{PEG}$) meal for replacing maize in the diets of the birds at graded levels of 0, 5, 10, 15, 20, 25 and 30% respectively. The diets were fed to 315 one week old cobb broiler chicks in a 3 x7 factorial arrangement of Completely Randomized Design having three replicates with five birds per replicate in a trial that lasted for 7 weeks.

Chemical analysis of the processed African Star apple kernels

The phytochemical quantification of the processed African star apple kernel meal were carried out at the Central Research Laboratory, Tanke, Ilorin using the methods described by Sofowora (1993). The feed composition of the dietary treatments is presented on Table 1.

Statistical Analysis

The generated data from the experiment was analyzed using the General Linear Model Procedure of SAS (2014). The Duncan's New Multiple Range Test was used to separate the means in the treatment groups where significant differences were observed.

Results

The residual phytochemicals in the treated milled kernels with absorbents and growth performance of the birds fed the processed African star apple kernels are presented in Table 2 and 3 respectively

The raw African star apple kernels revealed that the kernels has high concentration of saponins, phytate and tannins and appreciable levels of oxalate and glycoside. The physical method of treatment involving soaking for 12 hours and boiling for 30 minutes was considerably effective for detoxifying the saponins, phytate, oxalate and glycoside contents by 74.15, 88.06, 97.50 and 99.99% but rather increased the tannin concentration by 18.69% limiting the treatment by only physical method of soaking and boiling respectively. The further processing of the kernels by absorbents using activated charcoal, bentonite and polyethylene glycol exhibited similar action by bringing about a general decline in the concentration of the saponins, phytate, tannins by 50.95, 99.80 and 99.33%, however elicited the levels of oxalate and glycoside by 94.21 and 99.61% respectively in relation to the soaking and boiling method. The growth performance (final weight, feed intake and feed conversion ratio) of the birds fed the processed African star apple kernels were significantly ($p<0.05$) affected in relation to their counterpart fed the control diet despite the reduced concentration of the residual secondary metabolites remaining in the treated kernels.

Table 1: Composition of the experimental diets (%) for broiler starter

Ingredients	**0**	**5**	**10**	**15**	**20**	**25**	**30**
Maize	56.46	53.63	50.81	47.99	45.17	42.34	39.52
$ASAK^{PM}$	0.00	2.83	5.65	8.47	11.29	14.12	16.94
SBM	38.04	38.04	38.04	38.04	38.04	38.04	38.04
Fish meal	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Lysine	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Methionine	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Bone meal	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Lime stone	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Salt	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Premix	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Total	100	100	100	100	100	100	100

Analysis							
CP	22.99	22.63	22.40	22.18	21.95	21.73	21.50
ME/Kg	3132.74	3118.63	3104.57	3090.52	3076.46	3062.35	3077.62
Cost/kg	105.98	104.75	103.17	101.52	99.88	98.23	97.26

$ASAK^{PM}$ = Processed African star apple kernel using activated charcoal, bentonite and polyethylene glycol

Table 2: Residual antinutritional factors present in the processed African star apple kernels

	T R E A T M E N T S						
	1	2	3	4	5	SEM	Pvalue
Parameters	Raw	S12;B30	$ASAK^{AC}$	$ASAK^{BN}$	$ASAK^{PEG}$		
Saponins	12.15^{a}	3.14^{b}	1.38^{d}	1.27^{d}	1.98^{c}	0.0515	0.0001
Phytate	$1,308.7^{a}$	156.25^{b}	0.31^{c}	0.26^{c}	0.37^{c}	0.5018	0.0001
Tannins	$1,037.47^{b}$	$1,276.04^{a}$	8.30^{c}	8.69^{c}	8.37^{c}	13.3386	0.0001
Oxalate	0.80^{a}	0.02^{b}	0.29^{b}	0.31^{b}	0.44^{b}	0.0144	0.0001
Glyscoside	0.78^{a}	0.00007^{e}	0.02^{c}	0.0048^{d}	0.0291^{b}	0.0006	0.0001

SEM= Standard error of mean;=P<0.05;^{a,b,c,d}Means with different superscript along the same rows are significantly; S12;B30=soaked for 12 hours & boiled for 30 minutes; $ASAK^{PM}$= Processed African star apple kernel using activated charcoal/bentonite/polyethylene glycol

Table 3: Growth performance of broiler chickens fed processed African star apple kernels

Ingredients	**0**	**5**	**10**	**15**	**20**	**25**	**30**	**SEM**	**Pvalue**
Initial wt; $ASAK^{AC}$	127.14	127.14	127.14	127.14	127.14	127.14	127.14	-	-
$ASAK^{BN}$	127.14	127.14	127.14	127.14	127.14	127.14	127.14	-	-
$ASAK^{PEG}$	127.14	127.14	127.14	127.14	127.14	127.14	127.14	-	-
Final wt; $ASAK^{AC}$	2020.00	1170.00	900	759.97	684.98	639.98	684.98	1.92	0.0001
$ASAK^{BN}$	2028.50	1435.46	1078.46	858.47	818.47	806.97	788.44	1.92	0.0001
$ASAK^{PEG}$	2023.13	1323.09	863.10	733.11	698.11	683.11	673.10	1.92	0.0001
Feed intake;$ASAK^{AC}$	116.77	97.55	92.44	78.38	76.05	73.60	68.62	0.33	0.0001
$ASAK^{BN}$	118.11	97.65	90.02	76.39	74.00	72.71	70.93	0.33	0.0001
$ASAK^{PEG}$	118.29	95.39	92.13	79.30	75.72	73.15	70.48	0.33	0.0001
FCR; $ASAK^{AC}$	2.89	4.39	5.62	5.82	6.40	6.74	6.74	0.02	0.0001
$ASAK^{BN}$	2.91	3.50	4.44	4.90	5.03	5.02	5.04	0.02	0.0001
$ASAK^{PEG}$	2.93	3.74	5.88	6.15	6.23	6.18	6.06	0.02	0.0001

Discussion

The increase in the tannin content of the soaked and boiled kernels compared to the raw kernels were as a result of changes in the dry matter. This is in line with the findings of Valverde *et al*. (1992) that some metabolic reactions could occur during soaking which in turn affects some constituent compounds however contradicts the report of Balogun *et al.* (2001) that antinutritional factors in

legumes decrease after 30 minutes of cooking with regard to the tannin content but rather increased in the African star apple kernels. The *invitro* reduction in the phytochemicals present in ASAK using activated charcoal, bentonite and polyethylene glycol did reflect in the *invivo* growth performance of the birds. The most probable explanation for the depressed final weight, feed intake and poor feed conversion ratio in the birds fed beyond 5% inclusion of the processed ASAK meal is mainly attributed to the residual secondary metabolites still present in the ASAK after processing. These residual antinutritional factors may have constituted a hindrance to the bioavailability of nutrients to the birds. This negates the assumption by Annongu *et al.* (2017) that processing the kernels could enhance its inclusion in the diet of the birds.

Conclusion and Recommendation

The processing of the African star apple kernels by soaking, boiling and the further treatment by absorbents significantly eliminated the phytochemicals however the growth performance of the birds were significantly ($p<0.05$) affected despite the reduced concentration of the antinutritional factors thereby limiting the use for poultry.

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References

Annongu, A. A., Joseph, K.L, Adeyina, A.A., Sola-Ojo, F.E., Edoh, J.H. and Ajide, S.O. (2017). Utilization of African Star Apple (*Chrysophyllum albidum*) kernel meal in Broiler diets. *Journal of Agricultural Sciences*, Serbia, Europe. Vol. 62 (2) 2017:143-154.

Balogun, T.F., Kaankuka, F.G. and Bawa, G.S. (2001). Effect of boiling full -fat soyabean on its amino acid profile and on performance of pig. *Nig. J. Anim. Prod.*, 28: 4551.

Edem, C.A. and Miranda, I.D. (2011). Chemical evaluation of proximate composition, ascorbic acid and anti-nutrients content of African star apple (*Chrysophyllum africanum*) fruit. IJRRAS, 9 (1):146-149. www.arpapress.com/volumes/vol 9 Issue/IJRRAS_9_1_17. pdf.

SAS (2014). Statistical Analysis System Procedure guide for Personal computers. SAS Institute

Soetan, K.O. and Oyewole, O. E. (2009). The need for adequate processing to reduce the antinutritional factors in plants used as human foods and animal feeds: A review. *African Journal of Food Science* Vol. 3 (9), pp. 223-232.

Sofowora, A. (1993). Medicinal Plants and Traditional Medicine in Africa; John Wiley and Sons Ltd, pp 55-201.

Sugano, M., Goto, S., Yaoshida, K., Hashimoto, Y., Matsno, T., Kimoto, M. (1993). Cholesterol-lowering activity of various undigested fractions of soyabean protein in rats. *J. Nutr., 120(9)*:997-985.

Ukana, D.A., Aniekan, E.A. and Godwin, N.E. (2012). Evaluation of proximate compositions and mineral elements in the star apple peel, pulp and seed. *J. Basic. Appl.Sci. Res., 2(5)* 4839-4843.

Vidal-Valverde, C., Frias, J. and Valverde, S. (1992). Effect of processing on the soluble carbohydrate content of lentils. *J. Food Prot.*, 55: 301-304.