POTENTIAL OF *Entada africana* Guill. & Perr. SEED MEAL AS FEED INGREDIENT IN THE DIET OF BROILER CHICKENS†

[POTENCIAL DE LA HARINA DE SEMILLAS DE *Entada africana* Guill. & Perr. COMO INGREDIENTE ALIMENTARIO EN LA DIETA DE POLLOS DE ENGORDA]

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SUMMARY

Background. The demand and cost of feed ingredients for broiler chicken production have increased in many African countries. This has necessitated the search for alternative feed sources. **Objective.** An experiment was conducted to evaluate the effect of graded levels of *Entada africana* seed meal (EASM) on growth performance, carcass characteristics and organ weight of broiler chickens. **Methodology.** A total of 150 day-old broiler chicks were randomly allocated to five experimental diets formulated to contain 0, 5, 10, 15 and 20% EASM and designated as T1, T2, T3, T4 and T5 respectively. There were 30 birds in each treatment which was replicated three (3) times with ten (10) birds per pen in a completely randomized design. Throughout the experimental period, feed and water were provided *ad libitum* for all treatment groups. **Result.** Average body weight gain (40.01-44.36 g/d), average feed intake (90.47-94.33 g/d) and FCR (2.09-2.33) were not influenced by dietary treatments at both starter and finisher phases of the study (P>0.05). The carcass parameters and organ weight measured across the treatment groups were similar (P>0.05) except back (14.85-17.80 %) and breast (16.45-19.87 %) weights (P<0.05). **Implication.** *Entada africana* seed is a rich source of protein that will serve as alternative feed resource in broiler feeds. **Conclusion.** Therefore, up to 20 % processed EASM could be included in the diets of broiler chickens without adverse effect on growth performance, carcass characteristics and organ weight of the birds.

Keywords: *Entada africana;* processing; boiling; roasting; broilers; performance.

RESUMEN

Antecedentes. La demanda y el costo de los ingredientes para alimentos para la producción de pollos de engorde han aumentado en muchos países africanos. Esto ha obligado a buscar fuentes de alimentación alternativa. **Objetivo.** Se realizó un experimento para evaluar el efecto de diferentes niveles de harina de semilla de *Entada africana* (EASM) sobre el crecimiento, las características de la canal y el peso de los órganos de pollos de engorde. **Metodología.** Se asignó al azar un total de 150 pollos de engorde de un día de edad a cinco dietas experimentales formuladas para contener 0, 5, 10, 15 y 20% de EASM y designadas como T1, T2, T3, T4 y T5 respectivamente. Había 30 aves en cada tratamiento que se repitió tres (3) veces con diez (10) aves por corral en un diseño completamente aleatorizado. Durante todo el período experimental, se proporcionó alimento y agua *ad libitum* para todos los grupos de tratamiento. **Resultados.** La ganancia de peso corporal promedio (40.01-44.36 g/d), la ingesta promedio de alimento (90.47-94.33 g/d) y la ECA (2.09-2.33) no fueron influenciado por los tratamientos dietéticos tanto en la fase inicial como en la final del estudio (P> 0.05). Los parámetros de la canal y el peso de los órganos medidos en los grupos de tratamiento fueron similares (P>0.05), excepto los pesos de la espalda (14.85-17.80%) y de la pechuga (16.45-19.87%) (P<0.05). **Implicación.**

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La semilla de *E. africana* es una rica fuente de proteínas que servirá como recurso alimenticio alternativo en los alimentos para pollos de engorde. **Conclusión.** se podría incluir hasta un 20% de EASM procesado en las dietas de los pollos de engorde sin efectos adversos sobre el crecimiento, las características de la canal y el peso de los órganos de las aves.
Palabras clave: *Entada africana*; Procesamiento; hervido; tostado; pollos de engorde; rendimiento

INTRODUCTION

Entada africana Guill. & Perr. belongs to the family *Fabaceae* which is popularly known as legumes and it is the third largest order of seed-plants containing about 600 genera with 12,000 species (Sharma and Kumar, 2013). It is a small tree which is mostly found in tropical and subtropical regions (Nielsen, 1992). In Nigeria, it is commonly known as "Tawatsa" in Hausa Language and "Ogurobe" in Yoruba (Burkill, 1995). It can be used as food, medicine and fibre. Nutritionally, the seed of *Entada africana* was reported (dry matter basis) to contain 39.81 % crude protein, 80.00 % dry matter, 15.50 % crude fibre, 17.50 % ether extract, 4.88 kcal/kg metabolizable energy, 39.00 % acid detergent fibre and 53.00 % neutral detergent fibre (Belewu *et al.,* 2008). The authors further reported the mineral contents of the seeds to be 7.66 % calcium, 0.20 % sodium, 4.54 % magnesium, 4.49 % potassium and 0.17 % iron. Similarly, Olanrewaju and Ahmed (2014) reported that *Entada africana* leaves contain 4.20 % moisture content, 13.30 % ash, 10 %crude lipid, 18.56 % crude fibre, 14.60 % crude protein and 38.44 % carbohydrate. Previous study on the potential of *E. africana* in livestock feed revealed that the seed meal can replace soybean meal in the diet of growing West African Dwarf goats without impairing performance (Belewu *et al.,* 2007). There is however, dearth of information on its use in poultry nutrition. This present study evaluated the effect of graded levels of processed *Etanda africana* seed meal on growth performance, carcass characteristics and organ weight of broiler chickens.

MATERIALS AND METHODS

The experimental was conducted at the Poultry unit of the Teaching and Research Farm, Federal College of Wildlife Management, New Bussa, Niger State previously described by Okunade *et al.* (2015). About 60 kg of *Etanda africana* seeds were obtained from the College Farm. The seeds were handpicked so as to eliminate all unwanted particles. The seeds were then air-dried for 48 hr at 25ºC and divided into 2 lots; (i) raw and (ii) boiled and roasted. About 30 kg seeds were boiled at 100ºC at a seed: water ratio of 1: 10 w/v. for 10 min in an aluminium pot on a Gallenkamp thermostat hot plate (Makinde *et al.,* 2019). The water was drained and the boiled seeds were air-dried at 25ºC for 72 hr. The boiled seeds were further roasted in an open pan under the controlled temperature at 65ºC for 15 minutes. The seeds were continuously stirred until the seeds cracked and their endosperm turned brown with toasty sweet odour. All the seed samples (raw and processed) were ground to pass through a 2 mm sieve and taken to the laboratory for nutrient and anti-nutrient analysis.

Experimental Design and Management of Birds

One hundred and fifty day old unsexed broiler chicks were purchased from a reputable hatchery in Ibadan, Nigeria. The birds were raised on deep litter pen with wood shaving as litter material. They were fed on a common diet for the first (1) week of the study after which they were randomly allocated into five experimental treatments of thirty birds per treatment, while each treatment was replicated three times (10 birds per replicate) in a completely randomized design (CRD). Feed and water were supplied *ad-libitum.* Management practices and vaccination programme were followed strictly. Data were collected on average daily weight gain, average daily feed intake and feed conversion ratio.

Experimental diets

Five experimental diets were formulated to meet nutrient requirement standards of broilers (NRC, 1994). Diet 1 (0 % processed EASM) served as the control while diets 2, 3, 4 and 5 contained 5, 10, 15 and 20 % processed EASM respectively. The gross composition of the experimental diets is presented on Table 1.

Carcass and organs weight determination

At the end of the study, two birds per replicate were selected at random and starved for about 12h to empty the crops. They were then slaughtered, scalded, plucked and eviscerated. The carcass and internal organs (liver, heart, kidney, gizzard and intestines) were removed, weighed and expressed as a percentage of live weight.

Data Analysis

No mortality was observed during the trial. Data generated were subjected to Analysis of variance (ANOVA) using the general linear model of statistical analysis system, Version 9.3 (SAS, 2015). Significance was accepted at $P < 0.05$.

RESULTS AND DISCUSSION

Table 2 shows the proximate and anti-nutrient compositions of the raw and processed *E. africana* seed. There were significant differences (P<0.05) in all the proximate parameters determined except dry matter content of the seed (P>0.05). The crude protein, crude fibre, ash and ether extract contents of the seeds were decreased (P<0.05) while the NFE content of the seeds increased (P<0.05) by the processing methods. The dry matter content of the seed (91.30-92.00%) observed in this study were higher than the values of 80.00% and 87.24% earlier reported by Belewu *et al.* (2008) and Gidado *et al.* (2013) for *E. africana* seeds. The crude protein (CP) content of the raw *E. africana* seed (40.18%) was similar with the value of 41.00% reported by Jurgens (2002) for mechanically extracted cotton seed meal. This indicates that *E. africana* seed is very rich in protein and could be used as a protein source in livestock feed. The significant reduction in the values of crude protein from 40.18% to 34.86% as observed in this study was attributed to the burning off of some nitrogenous compounds during processing (Emenalom and Udedibie, 1998). Similar observation was made by Makinde *et al.* (2019), who evaluated the effect of

Table 1. Dietary composition of experimental starter and finisher diets.

	Starter					Finisher				
Ingredients	**T1**	**T2**	**T3**	**T4**	**T5**	**T1**	**T2**	**T3**	**T4**	**T5**
Maize	56.00	53.00	51.00	50.00	48.50	59.50	58.50	54.50	51.00	48.50
Wheat offal	6.50	6.50	6.50	6.50	6.50	9.00	9.00	9.00	9.00	9.00
GNC[1]	27.00	25.00	22.00	16.00	15.00	22.00	18.00	17.00	15.50	13.00
EASM[2]	0.00	5.00	10.00	15.00	20.00	0.00	5.00	10.00	15.00	20.00
Fish meal	3.00	3.00	3.00	3.00	3.00	2.50	2.50	2.50	2.50	2.50
Blood meal	2.00	2.00	2.00	2.00	2.00	1.50	1.50	1.50	1.50	1.50
Bone meal	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Oyster shell	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100	100	100	100	100	100
Calculated nutrients										
CP (%)	22.95	22.90	22.87	22.80	22.76	20.86	20.75	20.71	20.64	20.58
Met. Energy (Kcal/kg)	2816	2811	2807	2805	2802	3024	3019	3015	3012	3005
CF (%)	3.56	3.62	3.74	3.75	3.77	3.95	3.99	4.05	4.09	4.11
Lysine (%)	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
Methionine (%)	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48
Proximate composition (%)										
Dry matter	89.59	89.05	86.75	88.55	88.93	88.19	88.21	87.85	88.79	89.15
CP	22.91	22.83	22.64	22.32	22.25	21.75	20.55	20.09	19.89	19.73
Ash	2.45	2.38	2.34	2.30	2.29	2.18	2.10	2.03	2.01	2.00
Crude fibre	3.10	3.16	3.37	3.41	3.85	3.88	4.08	4.04	4.62	4.34
Ether extract	4.52	4.32	4.25	4.45	3.27	4.78	4.19	4.66	4.76	3.99
NFE	56.62	56.36	54.16	56.07	57.28	55.61	57.30	57.03	57.50	59.10

[1]GNC=Groundnut cake. [2]EASM=*Etanda africana* seed meal. CP=Crude protein. CF=Crude fibre. NFE=Nitrogen free extract

*Composition of vitamin premix per kg is as follows: Vitamin A, 8000 iu; Vitamin D_3, 1600 iu; Vitamin E 5 iu, Vitamin K 0.200 mg; Vitamins B, Thiamine B_1 0.5mg; Riboflavin B_2 4mg; Pyridoxine B_6 0.015 mg; Niacin 0.015mg; B_{12} 0.01mg; Pantothenic acid 0.5mg; folic acid 0.5mg and Biotin 0.020 mg; Chlorine chloride 0.02 mg; Anti-oxidant 0.125g and Minerals (Mn, Zn, Fe, Cu, I, Si, Co) 0.156g.

Table 2. Proximate and Anti-nutrient compositions of raw and processed *Entada africana* seed meal.

Parameters, %	Raw	Processed	SEM[1]	P-value
Dry matter	91.30	92.00	0.41	0.7321
Crude Protein	40.18[a]	34.86[b]	1.06	0.0025
Crude fibre	13.50[a]	9.00[b]	0.90	<.0001
Ash	3.50[a]	2.00[b]	0.18	<.0001
Ether extract	4.75[a]	3.50[b]	0.31	<.0001
NFE[2]	29.37[b]	42.64[a]	2.65	0.0401
ME[3] (Kcal/kg)	2917.85[a]	3377.70[b]	25.41	<.0001
Tannin	1.98[a]	0.75[b]	0.15	<.0001
Saponin	2.10[a]	0.49[b]	0.09	<.0001
Phytate	5.47[a]	2.15[b]	0.42	0.0489
Oxalate	3.56[a]	0.84[b]	0.14	0.0050

*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[1]= Standard error of mean, P = Probability value. NFE[2]= Nitrogen Free Extract =100-(%CP+%CF+%EE+%Ash). ME[3]=Metabolizable energy= 37 x % CP + 81.8 x % EE + 35.5 x %NFE (Panzenga, 1985)

different processing methods on the nutrient and anti-nutrient compositions of African star apple (*Chrysophyllum albidum*) kernel. The ether extract content of 4.75% observed for raw *E. africana* seed decreased to 3.50% in the processed seed. This could possibly be due to volatilization of lipid related compounds during the processing period. These values indicate that *E. africana* seed is not an oil seed when compared to soya bean seed that has up to 20.2% ether extract content (Jurgens, 2002). The reduction observed in crude fibre and ash contents of the seed was as a result of the effect of heat treatment used during the processing of the seed. There were significant differences (P<0.05) in all the anti-nutritional factors determined. Generally, processing methods significantly reduced the anti-nutrient contents of the seed. The higher percentage reduction of all parameters observed in the processed seed in this study confirms earlier report by other authors (Ajibade *et al.* 2018; Makinde *et al.* 2019) that heat treatment of seed was effective against saponin, tannins, phytate and oxalate.

Table 3. Growth performance of broilers fed processed *Entanda africana* seed meal (1-4 weeks).

Parameters						SEM[1]	Prob.
	T1	T2	T3	T4	T5		
Initial weight, g/b	59.57	59.54	59.67	59.52	59.80	0.72	0.9883
Final weight, g/b	986.20	972.90	960.30	993.28	959.58	105.44	0.2534
ADWG, g/b/d	33.09	32.62	32.17	33.35	32.14	3.78	0.2566
ADFI, g/b/d	52.59	50.83	51.19	50.10	51.04	1.71	0.0739
FCR	1.59	1.56	1.59	1.50	1.59	0.15	0.2871

abc= means with different superscripts on the same row are significantly different (P<0.05), SEM[1]= Standard error of mean, P = Probability value. ADWG=Average daily weight gain, ADFI=Average daily feed intake, FCR=Feed conversion ratio

Table 4. Growth performance of broilers fed processed *Entanda africana* seed meal (5-7 weeks).

Parameters						SEM[1]	Prob.
	T1	T2	T3	T4	T5		
Initial wt, g/b	986.20	972.90	960.30	993.28	959.58	105.44	0.2534
Final wt, g/b	2086.67	2200.00	2020.00	2040.00	2233.33	107.21	0.1199
ADWG, g/b/d	52.40	58.43	50.46	49.84	60.65	5.99	0.3155
ADFI, g/b/d	148.25	145.42	149.20	144.29	152.05	2.96	0.1650
FCR	2.83	2.49	2.96	2.90	2.51	0.34	0.6672

abc= means with different superscripts on the same row are significantly different (P<0.05), SEM[1]= Standard error of mean, P = Probability value. ADWG=Average daily weight gain, ADFI=Average daily feed intake, FCR=Feed conversion ratio.

The results of the effect of graded levels of *E. africana* seed meal on growth performance of broiler chicks (1-4weeks) and broiler finishers (5-7weeks) are presented in Table 3 and 4 respectively. The results show that body weight gain, average feed intake and FCR during starter and finisher phases were not significantly (P>0.05) influenced by the dietary treatments.

The observations on feed intake, body weight gain and FCR of broiler chickens in this study showed that inclusion of processed EASM up to 20% in broilers diet had no adverse effect on growth performance of birds. The similarities observed in most of the performance evaluation traits in both the starter and finisher phases implied that there was no intake limitation when processed EASM increased in the diets from 0 to 20% and there was acceptability and palatability as well as better utilization of the feed by the birds. This observation could be attributed to the reduction of anti-nutritional factors in the processed seed and the nutrient balance of the experimental diets at both the starter and finisher phases (Yagoub *et al.*, 2008; Ari *et al.*, 2012). Our result confirms the assertion of Alagbaoso *et al.* (2015); Makinde *et al.* (2019) that heat treatment of seed is effective in reducing anti-nutritional factors inherent in most legumes. Also, Kanyinji and Sichangwa (2014) observed that there was no significant difference in the performance parameters (feed intake, body weight gain and FCR) of broilers fed finishing diets with processed cotton seed meal as partial replacement for soybean meal. Our results however differ from the report of Wafar (2013), who observed a significant difference in feed intake, body weight gain and FCR of broilers when toasted sorrel seed (*Hibiscus sabdariffa)* meal as substitute for soybean meal increased to 20% in broilers diets. This variation may be attributed to the differences in the initial live weights, breed of broilers and nutrient content of seed and concentrates used for the study.

Table 5 shows the effect of graded levels of processed *Etanda africana* seed meal on carcass characteristics of broiler chickens. There were no significant differences (P>0.05) in the parameters measured across the treatment groups except back and breast weights. Birds fed processed EASM diets were significantly comparable with those fed control diet in most of the carcass parameters measured. The similarity in the results of carcass parameters measured across the treatment groups is a true reflection of the

Table 5. Carcass Characteristics of broilers fed processed *Entada africana* seed meal (1-7 weeks).

Parameters	T1	T2	T3	T4	T5	SEM	P-value
Live weight, g	2166.71	2266.30	2100.00	2200.00	2233.32	154.92	0.0671
Slaughtered weight, g	1975.58	2033.13	1986.11	1966.67	2040.15	152.55	0.0748
Dressed weight, g	1768.31	1800.00	1764.17	1716.52	1883.46	151.84	0.1378
Dressing percentage, %	81.61	79.42	84.01	78.02	84.33	3.28	0.2821
Back weight, %	16.86^{ab}	14.85^{b}	16.19^{ab}	15.55^{ab}	17.80^{a}	1.21	0.0471
Thigh, %	12.08	11.17	11.09	12.08	11.54	1.15	0.1039
Wing, %	9.01	7.90	7.47	8.57	7.16	0.69	0.2434
Drumstick, %	9.43	8.52	9.04	10.00	9.12	1.68	0.2431
Breast, %	19.87^{ab}	17.87^{ab}	19.29^{ab}	16.45^{b}	21.11^{a}	1.80	0.0295

abc = mean with different superscripts within the same row are significantly (P<0.05) different. SEM=standard error of mean.

Table 6. Organ weight of broilers fed processed *Entada africana* seed meal (1-7 weeks).

Parameters	T1	T2	T3	T4	T5	SEM	P-value
Liver, %	1.40	1.32	1.23	1.35	1.32	0.15	0.1039
Heart, %	0.37	0.30	0.31	0.30	0.36	0.06	0.5288
Spleen, %	0.10	0.07	0.09	0.08	0.07	0.02	0.2132
Gizzard, %	2.86	2.53	2.91	2.64	2.52	0.42	0.0641
Intestine weight, %	3.89	2.34	2.69	2.89	2.35	0.33	0.1316

abc = mean with different superscripts within the same row are significantly (P<0.05) different. SEM=standard error of mean.

body weight performance indices and that of tissue development. This implied that the nutrients supplied by processed EASM diets were adequate and met the nutrients required by broilers for efficient meat production that were similar to those fed control diet. Our results agreed with earlier report of Mishra *et al*. (2013), who fed commercial broiler chickens with diets containing roasted guar korma (*Gyamopsis tetragonoloba*) seed meal as partial replacement for soyabean meal and observed no significant difference in the carcass parameters measured.

The internal organs weights as shown in (Table 6) did not show significant difference (P>0.05) for liver, heart, gizzard, spleen and intestine weight. The similarity in the values obtained on these organs indicate that there were no metabolic abnormalities among birds fed both EASM and control diets and the residual anti-nutritional factors in processed *Entada africana* seed do not have observable effects on the organs.

CONCLUSION

This study showed that *Entada africana* seed is a rich source of protein that will serve as alternative feed resource in broiler feeds. Processing of the seed before been used as feed ingredient is thus an effective mechanism to avoid toxicity with no influence on performance traits of broilers. Therefore, boiling and toasting could be introduced as a safe and natural process for improving the utilization of *E. africana* seeds in broiler diets. From the result of this study, it can be concluded that up to 20% processed *E. africana* seed meal can be included in the diets of both starter and finisher broilers without adverse effect on growth performance, carcass yield and organ weight of birds.

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