Nigerian J. Anim. Sci. 2019, 21 (3): 266-273

Laying performance and cost-benefits of feeding ISA brown layers with raw or processed tropical sickle pod (*Senna obtusifolia*) seed meal based-diets

Augustine, C[*1]., Kwari, I.D[2]., Igwebuikwe, J.U[2]., Adamu, S.B[2]., Faci, A.D[3]., Ahmed, S[3]. Garba, Y.M[4] and Mojaba D. I[1].

[1]Department of Animal Production, Adamawa State University, Mubi, Adamawa State, Nigeria; [2]Department of Animal Science University of Maiduguri, Borno State, Nigeria; [3]Department of Home Economics, College of Education, Hong, Adamawa State, Nigeria; [4]Department of Agricultural Education, College of Education, Hong, Adamawa State, Nigeria

Corresponding author** audaggai@gmail.com, **Phone number: +2348132946167

***Target audience:** Feed miller, Animal Scientists, Agronomists*

Abstract

A feeding trial was conducted for 16 weeks to evaluate the effects and cost-benefits of feeding raw or processed Senna obtusifolia seed meal based-diets on the laying performance of ISA brown laying hens. Six experimental diets were compounded to contain 0% S. obtusifolia seed meal (T1) and 20% each of the raw, boiled, soaked in water, sprouted and fermented S. obtusifolia seed meals designated as T2, T3, T4, T5 and T6, respectively. One hundred and eighty (180) ISA brown laying hens aged 36 weeks were housed in battery cages (5 birds/0.95 m^2) and assigned to the six (6) dietary treatments in group of thirty (30) laying hens in a completely randomized design. Data was collected on feed intake, hen-day egg production (HDEP), hen-house egg production (HHEP), egg weight, egg mass, feed conversion ratio per egg mass, feed cost per kilogram, feed cost per egg mass and mortality. The results indicated that the group of hens fed raw S. obtusifolia seed meal based-diet recorded the lowest HDEP (52.42%), egg weight (53.08 g) and egg mass (2782.45 g). Among the laying hens fed the processed S. obtusifolia seed rneal based-diets, those fed the fermented S. obtusifolia seed meal based-diet indicated significantly (P<0.05) better HDEP (64.05%), egg weight (59.75 g) and egg mass (3826.98 g). On economic grounds, the use of raw S. obtusifolia seed meal is not cost effective but the processed ones showed some economic advantage. In conclusion, 20% of fermented S. obtusifolia seed meal can be incorporated in the diets of laying hens with little or no depreciation in laying performance and economic-benefits.

***Key words:** Laying hens, laying performance, processed sickle pod, cost-benefits.*

Description of problem

Adequate intake of quality animal protein such as poultry meat and egg is among the efficient measures of handling malnutrition in Nigeria. Average Nigerian does not consume enough protein of animal origin which is more efficient than plant protein in providing the amino acids necessary for tissue development, repair and function (1). Poultry production has great potential for improving the animal protein intake of Nigerian populace (2). It was reported that commercial layer production is the most significant sources of quality protein and income in Nigeria as compared with other livestock production activities (3). Despite this great socio-economic potential in the layer chicken industry, the high cost of conventional feed ingredients and poultry diets still remain a major problem of poultry production in Nigeria. This was further buttressed by (4) who reported that availability of high quality feed is constrained by the phenomenal increase

in the cost of major ingredients which is due to competition from direct consumption of these materials by human beings. A way forward to address this problem; is to harness the nutritional potentials of lesser-known legumes in the feeding of poultry. (5) suggested the need to focus on the exploitation of lesser-known or non-traditional plant resources that are not subject to competition between man and livestock. In this context, *S. obtusifolia* seeds seems to be such an alternative feed resource. A study conducted by Augustine *et al*. (6) revealed that pullets fed 20% of boiled and fermented *S. obtusifolia* seed meal based diets indicated better growth performance.

The chemical properties of the seed as revealed by (5) and (6) indicated that the seeds have good nutritional values (29.54 and 23.40% CP) as an alternative protein source for domestic chickens. The authors further revealed that the seeds contain some toxic factors such as tannins, phytates, oxalates and saponnins. These factors may be toxic when consumed by poultry. In view of the above, it has become necessary to subject the seeds to appropriate processing treatment(s) before it can be utilized as a feedstuff for poultry. At the moment, based-line information on the best processing method(s) that will enhance optimal utilization of the seeds as feed ingredient for laying chickens seems to be very meager, hence the need to conduct more studies in order to bridge this information gap. It was in view of this that an experiment was conducted to investigate the laying performance and cost-benefits of ISA brown laying hens fed raw or processed tropical *S. obtusifolia* seed meal based-diets.

Materials and methods

Location of the study area

The research was conducted at the Poultry Unit of the Department of Animal Production Livestock Teaching and Research Farm, Adamawa State University, Mubi. Mubi is located between latitudes $9°30^{1}$ and 11^{0} North of the equator and longitudes 13° and 13° 45' East of the Greenwich meridian (7). The dry season of the area commences early October and last up to April while the wet season begins from May and attains it peak at between July and August and declines in September. The average temperature and rainfall are 25.4^{o}C and 935 mm (8).

Experimental stock and their management

Thirty six week old ISA brown laying chickens were housed in battery cages. The chickens were fed with the experimental diets for a period of 16 weeks.

Experimental diets

Six (6) experimental layer diets were compounded to contain 0% *S. obtusifolia* seed meal (T1) and 20% each of the raw, boiled, soaked in water, sprouted and fermented *S. obtusifolia* seed meals designated as T2, T3, T4, T5 and T6, respectively. Diet T1 served as the positive control while diet T2 was the negative control. The composition of the experimental diets is presented in Table 1.

Experimental design

One hundred and eighty (180) laying hens were assigned to the six (6) experimental diets in a group of thirty (30) hens each in battery cages in three replicates of 10 hens each in a completely randomized design (CRD).

Parameters measured

Feed intake

Feed was offered to each treatment group and the quantity leftover the next morning was measured before supplying another feed. The quantity consumed for each day was obtained by subtracting initial quantity of feed offered from left-over feed.

Feed conversion ratio

Feed conversion ratio (FCR) was computed as:

$$FCR = \frac{\text{Quantity of feed consumed (g)}}{\text{Total egg weight (g)}}$$

Table 1: Ingredient composition and calculated analysis of the experimental layers mash

Ingredients	Level of inclusion of each of the raw or processed SOSM					
	T1 0% SOSM	T2 20% RSOSM	T3 20% BSOSM	T4 20% SKSOSM	T5 20%SPSOSM	T6 20%FSOSM
Maize	45.00	45.00	45.00	45.00	45.00	45.00
Roasted soya bean	16.00	7.00	7.00	7.00	7.00	7.00
SOSM	0.00	20.00	20.00	20.00	20.00	20.00
Fishmeal	2.10	2.10	2.10	2.10	2.10	2.10
GNC	8.00	8.00	8.00	8.00	8.00	8.00
Maize offal	18.00	7.00	7.00	7.00	7.00	7.00
Salt	0.35	0.35	0.35	0.35	0.35	0.35
Bone meal	3.00	3.00	3.00	3.00	3.00	3.00
Limestone	7.00	7.00	7.00	7.00	7.00	7.00
Methionine	0.20	0.20	0.20	0.20	0.20	0.20
Lysine	0.10	0.10	0.10	0.10	0.10	0.10
Premix*	0.25	0.25	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated analysis						
Protein (%)	17.08	17.13	17.01	16.49	17.06	17.63
Fibre (%)	4.35	5.45	3.79	4.21	3.79	4.07
Methionine (%)	0.48	0.67	0.55	0.60	0.65	0.67
Lysine (%)	0.84	1.50	1.16	1.14	1.26	1.32
Calcium (%)	3.75	3.76	3.77	3.76	3.77	3.78
Phosphorus (%)	0.89	0.95	0.95	0.89	0.96	0.95
ME energy (MJ/kg)	11.26	11.27	11.19	11.09	11.17	10.94

Metabolizable energy (ME) calculated according to the formula of (9) ME= 37 x % CP + 81 x % EE + 35.5 x % NFE, GNC = Groundnut cake, SOSM = *S. obtusifolis* seed meal, RSOSM = Raw *S. obtusifolia* seed meal, BSOSM = Boiled *S. obtusifolia* seed meal, SkSOSM = Soaked *S. obtusifolia* seed meal, SPSOSM = Sprouted *S. obtusifolia* seed meal and FSOSM = Fermented *S. obtusifolia* seed meal.

Hen-day egg production, hen house egg production and egg mass

Hen-day egg production, hen-house egg production and egg mass were calculated using the formula shown below:

Hen-day egg production (%) =

$$\frac{\text{Total no of eggs laid}}{\text{Total no of live hens}} \times 100$$

Hen-housed egg production (%) =

$$\frac{\text{Total no of eggs laid}}{\text{Total no of hens housed}} \times 100$$

Egg mass (g) = Hen-day egg production x average egg weight (g)

Statistical analysis

Data obtained were subjected to analysis of variance (ANOVA) of the completely randomized design using Statistix 8.0 (10). Least Significant Difference (LSD) was used to separate the treatment means where significant differences occurred. Significant difference was considered at 5% level of probability.

Results and Discussion

Laying Performance of Isa Brown Chickens

The results of feed intake, laying performance, feed conversion ratio and mortality of laying hens fed raw or processed *S. oblusifolia* seed meal are presented in Table 2. The feed intake recorded in this study is close to the value of 135 to 140 g reported by (11) for laying hens in the tropics. Better feed utilization and laying performance were observed in the laying hens fed neutral diet (0% SOSM) followed by those laying hens fed 20% fermented *S. obtusifolia* seed meal based-diet. The presence of anti-nutritional factors in the group of laying hens fed raw *S. obtusifolia* seed meal based-diet might have led to the poor feed conversion ratio per egg mass and hen-day egg production. A similar observation was reported by (12) and (13) who fed raw vetch seed meal and 22% of raw *Vicia sativa* seed meal based-diets to laying hens and observed poor feed conversion ratio per egg mass. Among the hens fed the processed *S. obtusifolia* seed meal based-diets, those laying hens fed fermented *S. obtusifolia* seed meal recorded better performance in term of feed conversion ratio per egg mass, hen-day egg production and hen-house egg production. This is an indication that fermentation was more effective in detoxifying the toxic components of *S. obtusifolia* seeds. This finding is in agreement with the report of (14) who pointed out that fermentation was very effective in reducing the levels of anti-nutritional factors in diets. It was also reported that biologically active by-products present in fermented fed such as probiotic bacteria and lactic acid may exert beneficial effects on poultry through the modification of the gastro-intestinal environment in a favourable manner (15). These might have been the reasons for better feed utilization and superior laying performance recorded in the group of laying hens fed fermented *S. obtusifolia* seed meal based-diet.

Egg weight and egg mass of the laying hens fed the experimental diets were significantly ($P<0.05$) influenced by the different experimental diets. The laying hens fed the raw seed meal based-diet showed the least egg weight compared to other treatment groups which recorded similar egg weights and egg mass. This may be attributed to the fact that anti-nutritional factors such as tannins and phytic acids present in the raw *S. obtusifolia* seed meal can form insoluble complex with protein consequently preventing the digestion and assimilation of nutrients hence reducing the protein available for egg production (16). Generally, the egg weights and egg mass from the laying hens fed the processed seed meal are very close to those fed the positive control diet (T1, 0% SOSM) which is an indication that the processing methods used effectively reduced the level of the anti-nutritional factors and improved egg weight and egg mass. Similar findings were reported by (17) and (18) who fed chickens with processed *Pisum sativum* and *Lablab purpureus* seed meals. The egg weights obtained in this study were within the standard weight (53 - 63 g) reported by (19).

Table 2: Laying Performance of Isa Brown Hens Fed Raw or Processed *Senna obtusifolia* Seed Meal Base-diets

Level of inclusion of each of the raw or processed *S. obtusifolia* seed meal							
Parameters	T1 0%SOSM	T2 20%RSOSM	T3 20%BSOSM	T4 20%SKSOSM	T5 20%SPSOSM	T6 20%FSOSM	SEM*
Daily feed intake (g/bird)	140.51[a]	120.18[c]	135.17[b]	121.09[c]	122.33[c]	138.92[b]	11.26
Total feed intake (g)	15737.12[a]	13460.11[c]	15139.04[b]	13562.08[c]	13700.96[c]	15559.04[b]	29.31
FCR/egg mass	3.76[b]	4.83[a]	4.28[a]	4.07[a]	4.01[a]	4.07[a]	0.15
HDEP (%)	69.87[a]	52.42[c]	60.05[b]	59.83[b]	60.39[b]	64.05[b]	8.98
HHEP (%)	67.87[a]	51.16[c]	60.02[b]	59.61[b]	57.59[b]	62.75[b]	1.67
Egg weight (g)	59.96[a]	53.08[c]	58.88[a]	55.96[b]	56.26[b]	59.75[a]	1.28
Egg mass (g)	4189.40[a]	2782.45[c]	3535.74[b]	3331.92[b]	3417.47[b]	3826.98[ab]	13.71
Mortality (number)	1.00	1.00	0.00	0.00	2.00	1.00	-

a, b, c = Means in the same row with different superscripts are significantly different * = Significant at 5% level of probability; SEM = Standard error of the means; FCR = Feed conversion ratio; HDEP = Hen-day egg production;
HHEP = Hen-house egg production; RSOSM = Raw *S. obtusifolia* seed meal; BSOSM = Boiled *S. obtusifolia* seed meal; SKSOSM = Soaked *S. obtusifolia* seed meal; SPSOSM = Sprouted *S. obtusifolia* seed meal;
FSOSM = Fermented *S. obtusifolia* seed meal

Hen-day egg production was significantly ($P<0.05$) affected by the dietary treatments. Better performance was recorded in laying hens fed 0% SOSM and 20% fermented *S. obtusifolia* seed meal. The poor performance observed in the laying hens fed 20% of the RSOSM may be attributed to the adverse effects of anti-nutritional factors present in the RSOSM. (20), observed that inclusion of processed pea seed meal in the diets of laying chickens resulted in an increased blood flow to the ovaries thereby leading to more ovarian follicular formation which ultimately increased egg production. This observation is in line with the outcome of this study suggesting that processing had reduced the toxic components in *S. obtusifolia* seeds which improved the physiology of the laying hens. The hen-day egg production (HDEP) obtained in this study is within the range of 52.42-69.28% reported by (21) for laying chickens fed 20% *Adansonia digitata* seed meal but lower than the range (78.10-79.10%) reported by (17) for laying hens fed processed pea seed meal. The HDEP of 64.05% recorded in the group of laying hens fed 20% fermented *S. obtusifolia* seed meal based-diet is however lower than the 87% HDEP recommended by (11). This was attributed to possible effect of residual anti-nutritional factors present in the fermented *S. obtusifolia* seed meal based-diet

Cost-benefits of feeding layers

The cost-benefits of feeding laying hens with processed *S. obtusifolia* seed meal is presented in Table 3. The result indicated that feed cost per kilogram of the diets were high in the control diet (0% SOSM) an indication that inclusion of *S. obtusifolia* seed meal had reduced the cost of feed. Similar observation was made by (22) and (18) who fed laying hens with processed sorrel and *Lablab purpureus* seed meal. However, feed cost per kilogram egg mass was observed to be high in the group of the hens fed the raw *S. obtusifolia* seed meal based-diets. This is an indication of the adverse effects of anti-nutritional factors on feed utilization and economic benefits of egg production.

Table 3: Cost-Benefit of feeding laying hens with processed *senna oblusifolia* seed meal based-diets

	Level of inclusion of each of the raw or processed *S. obtusifolia* seed meal						
Parameters	T1 0%SOSM	T2 20%RSOSM	T3 20%BSOSM	T4 20%SKSOSM	T5 20%SPSOSM	T6 20%FSOSM	SEM*
Total feed intake (kg)	15.73^{a}	13.46^{b}	15.13^{b}	13.56^{b}	13.70^{b}	15.56^{a}	2.90
Egg weight(g)	59.96^{a}	53.08^{c}	58.88^{b}	55.96^{b}	56.26^{b}	59.75^{b}	1.28*
FCR/egg mass	3.76^{c}	4.63^{a}	4.07^{b}	4.32^{b}	4.01^{b}	4.07^{b}	0.15*
HDEP (%)	69.87^{a}	52.42^{c}	60.05^{b}	59.83^{b}	60.39^{b}	64.05^{b}	8.98
Feed cost (₦/kg)	147.84	135.36	134.31	132.11	135.52	137.16	-
TF cost (₦)	2325.52	1821.95	2032.11	1791.41	1856.62	2134.21	-
Feed cost/kg egg mass (₦)	555.88	626.71	566.99	570.71	580.03	558.24	-

a, b, c, d = Means in the same row with different superscripts are significantly different (P<0.05); * = Significant at 5% level of probability; SEM = Standard error of the means; FCR = Feed conversion ratio; HDEP = Hen day egg production; TF = Total feed cost; RSOSM = Raw *S. obtusifolia* Seed meal; BSOSM = Boiled *S. obtusifolia* Seed meal; SKSOSM = Soaked *S. obtusifolia* Seed meal; SPSOSM = Sprouted *S. obtusifolia* Seed meal; FSOSM = Fermented *S. obtusifolia* Seed meal

Conclusion and Applications

The findings of this study revealed that

1. Processing *S. obtusifolia* has beneficial effects in improving the performance of ISA brown laying hens.
2. The group of laying hens fed the fermented *S. obtusifolia* seed meal based-diets showed better laying and economic performance compared to the layers fed other processed *S. obtusifolia* seed meal based-diets.
3. Even though the control or standard diet gave the best result but the group of layers fed the fermented *S. obtusifolia* seed meal base-diet indicated laying performance and economic benefits that are very close to the group of the layers fed the control diet (standard diet).
4. Fermented *S. obtusifolia* seed meal therefore had the weakest negative effects on egg laying performance and more economic benefits compared to

the other processed *S. obtusifolia* seed meals.

Acknowledgements

The authors are grateful to the Management of Adamawa State University, Mubi and the Tertiary Education Trust Fund (TET FUND) of the Federal Government of Nigeria for providing the first author with research grant.

References

(1) FAO (1994). The state of food and Agricultural series No 27. FAQ/UN, retrieved 20th April, 2016 from *Romehttp.//www. FA0. org/docrep/t4450e/T445E00.htm*.

(2) Tuleun C.D Carew S.N and Ajiji I. (2008). Feeding value of velvet bean (*Mucuna utilis*) for laying hens. *Livestock Research for Rural Development* volume 20 article *#81* retreived 7 August, 2013 from *http./www. Irrd2Ol 5/tule2008l. htm*.

(3) Ijaiya A.T Egena S.S.A and Omohain D. (2012). Egg production of Japanese quails (Coturnix coturnix japonica) fed dietary levels of fermented cassava (*Manihot spp.*) peal meal. *17th Annual Conference of Animal Science Association of Nigeria (ASAN)* Abuja, Nigeria. Pp377-380.

(4) Augustine C. Kwari I.D Igwebuike J.U Adamu S.B Doma U.D and Medugu C.I. (2017). Performance of growing pullets fed processsed sickle pod (*Senna obtusifolia*) seed meal. *Proceedings of the 6th Animal Science Association of Nigeria and Nigerian Institute of Animal Science Joint Annual Meeting*, September 10-14th, 2017, Abuja, Nigeria. Pp522-526.

(5) Ingweye, J.N Kalio G.A Ubua J.A and Umoren E.P. (2010). Nutritional evaluation of wild sickle pod (*Senna obtusifolia*) seeds from Obanliku, South - Eastern, Nigeria. *American Journal of Food Technology*. 5:1-12.

(6) Augustine, C. (2016). Evaluation of sickle pod (*Senna obtusifolia*) seed meal as source of protein for domestic chickens. Ph.D thesis Department of Animal Science, University of Maiduguri, Borno State, Nigeria.

(7) Adebayo, A.A. (2004). *Mubi Region a Reograhical Sysnthesis* Paraclete publishers, Yola, Nigeria 133 Pp.

(8) Climate-Data. Org (2018). "Temperature, Climograph, Climate table for Mubi" . Climate-Data.org. Retrieved August, 11, 2018 from *https://en.climate-data.org/location/385530/*.

(9) Pauzenga U**.** (1985). Feeding parent stock. *Zootecnia International* Pp22- 25.

(10) Statistix, 2003. *Statistix for windows manual*. Analytical Software. Version 8.0.

(11) Ganiyu, 0. (2005). Poultry Care. *A Complete Guide to Chicken Production*. Ganob and Associate Limited Ibadan, Nigeria. 96Pp.

(12) Kaya., H. Ceiebi., S. Macit M and Geyikoigu F. (2011). The effects of raw and physically processed common vetch seed (*Vicia sativa*) on laying performance, egg quality, metabolic parameters and liver histopathology of laying hens. Asian-*Australasian Journal of Animal Science*, 24(10): 1425-1434.

(13) Gul M. Yoruk M.A Hayirii A. Turgut L. and Karaoglu M. (2005). Effects of additives on laying performance and egg quality of hens fed high level of common vetch seed (*Vicia sativum*) during peak period. *Journal of Applied Poultry Research*, 14:217 - 225.

(14) Engberg R.M Hammersoj M. Johnson N.F Abousekken M.S Steenfeldt S. and Jensen B.B, (2009). Fermented feed for laying hens: Effects on egg production,

egg quality plumage condition composition and activity of the intestinal microflora. British Poultry Science, 50(2): 228-239.

(15) Wang L.C Weng C. Jiang Z.Y and Zhou Y.M. (2012). Evaluation of partial replacement of high- protein feedstuffs with fermented soybean meal in broiler diets. *Journal of Applied Poultry Research, 21(4):849-855.*

(16) Akanji, A.M. and Ologhobo A.D. (2007). Effect of some raw tropical legume seeds on egg quality and laying performance of exotic hens. *American-Eurasian Journal of Agriculture and Environmental Sciences*, 2:648-654.

(17) Laudadio V. and Tufarelli V**.** (2012). Effect of treated field pea (*Pisum sativum L. cv spirale*) as substitute for soya beans extracted meal in wheat middlings-based diet on egg production and quality of early laying brown hens. Arch. Geflugelk, 76(1): 1 - 5.

(18) Ragab, HI Abdel ati KA Kijora C and Ibrahim S, 2012. Effect of different levels of the processed *Lablab purpureus* seeds on laying performance, egg quality and serum parameters. *International Journal of Poultry Science*, 11(2): 131 - 137.

(19) European Council Directive (2006). Certain marketing standards for egg grade EC 2295/2003. Brussel, Belgium.

(20) Fasuyi, A.O Dairo, F.S.A and Olujimi O.T. (2007). Protein supplementary quality of vegetable leaf meal (*Amaranthus cruentus*) in the diets of laying hens: egg quality performance, egg quality and haematological implication. *Journal of Food Agriculture and Environment*, 5:294 -300.

(21) Kwari I.D (2009). Evaluation of sorrel (*Hibiscus saddariffa*) seed meal as an alternative protein source in the diet of domestic chickens. Ph.D Thesis Department of Animal Science, University of Maiduguri, Maiduguri, Borno State, Nigeria.

(22) Sola- Ojo F.E Bolu S.A and Usman T.O (2011). Performance evaluation of layers fed baobab (*Adansonia digitata*) seed-meal based diets. *Journal of Applied Agricultural Research*, 3 1:113 -122.