Nigerian J. Anim. Sci. 2013, vol. 15:95-103

Evaluation of Two-Stage Cooked *Canavalia plagiosperma* (Piper) Seed Meal as Feed Ingredient in Layer Diets

[1]Esonu,B. O.,[1]Anumni,P. E.,[1]Udedibie, A. B.I.,[1]Emenalom,.O .O. Etuk, .B.,[1]Odoemelam, V and [2]Okorie, K. C.

[1]Department of Animal Science & Technology, Federal University of Technology Owerri, Nigeria. [2]Department of Animal Science & Fisheries, Imo state University, Owerri, Nigeria

Corresponding author: esonubabs@yahoo.com

Target audience: Animal Nutritionist, Livestock Farmers, Animal Scientists

Abstract

The evaluation of two-stage cooked Canavalia plagiosperma seed meal as feed ingredient in layers diets was carried out using two hundred and seventy (270) Shika brown layers that were four months in lay. Two-stage cooked Canavalia plagiosperma seed meal was used to formulate layers diets at 0, 10 and 20% dietary levels, respectively. The two hundred and seventy (270), Shika brown layers, were divided into three groups of 90 birds each and randomly assigned to the three dietary treatments in a Completely Randomized Design. Each group was further subdivided into three replicates of thirty (30) birds per replicate. The experiment lasted for 90-days. There was significant (P<0.05) difference in body weight gain of the layers but no significant (P>0.05) differences in feed intake, feed conversion ratio, egg weight, Hen-day production, shell thickness, yolk index and yolk colour among the treatment groups. It is evident therefore that two-stage cooking reduced the level of anti nutritional factors in raw Canavalia plagiosperma seed meal hence the comparable performance of layers on diets containing the test material and the group on the control diet. The results of this experiment suggests that Two-stage cooked Canavalia plagiosperma seed meal can be incorporated into layers ration at 20% level without adverse effect on the performance of the birds.

Keywords: *Canavalia plagiosperma, seed meal, layer, ingredient.*

Description of Problem

In most developing countries, there is a shortage of proteinous food particularly those of animal origin (1). The price of animal products has soared in the last two decades occasioned by increase in the prices of protein feedstuffs used in livestock feed formulation (2, 3). This is mainly due to the competition between man, industries and livestock for the available feedstuffs (4). This has necessitated a search for alternative feed ingredient which are unconventional, cheaper, readily available and free from human and industrial competition (5). This includes kitchen wastes, agroindustrial by- products and novel crops. One of such novel and indigenous crops is *Canavalia plagiosperma* seed. *Canavalia plagiosperma* belongs to the genus "Canavalia" which comprises of a small group of some 48 species that are distributed throughout the tropics (6). It is abundantly found in the eastern part of Nigeria where it is nick named "Ukpo Ghana" and grows wild as a trifoliate climber. *Canavalia plagiosperma* is a nutritionally rich but under-utilized tropical legume with a crude protein content of 24% (7). However, the use of raw *Canavalia plagiosperma* seed meal as protein supplement for non-ruminants is presently limited by its content of anti-nutritional factors. The identified anti-nutritional factors include saponins, cyanogenic glycosides, terpenoids and alkaloids (8, 9). Others include canavanine, canaline (10), canatoxin (11), alkaline amino acid, enzyme urease, trypsin inhibitor, cyanide, tannin, hemagglutinin and more importantly, concanavalin A (12). A number of processing methods like autoclaving, toasting, two-stage cooking etc have been reported (9, 13) to remove or reduce some of these anti-nutritional factors rendering the plant materials acceptable as feedstuff for feed formulation. This study was therefore conducted to evaluate two-stage cooked *Canavalia plagiosperma* seed meal as feed ingredient in layers ration.

Materials and Methods

The research was conducted at the Teaching and Research Farm of the School of Agriculture and Agricultural Technology, Federal University of Technology Owerri, Imo State, Nigeria. The *Canavalia plagiosperma* seeds used in this study were collected from Ikwuano, Umuahia area of Abia State of Nigeria. The seeds were cooked for 60 minutes and the water decanted. Fresh water was added and cooked again for another 60 minutes (two-stage cooking), water decanted and sun dried. The sun-dried *Canavalia plagiosperma* seeds was milled and incorporated at different dietary levels of 0, 10 and 20%, respectively. Sample of the test material was subjected to proximate analysis (14) and phytochemical analys isusing the method outlined by (14).

Two hundred and seventy (270) Shika brown layers, four months in lay were divided into three groups of 90 birds each and randomly assigned to the three dietary treatments in a completely randomized design (CRD).Each treatment group was further subdivided into three replicates of 30 birds each and housed in a compartment measuring 8m x 10m. Feed and water were offered *ad-libitum*. The birds were weighed at the beginning and end of the trial, feed intake recorded and feed conversion ratio computed. The trial lasted for 90 days. Eggs were collected twice daily (9.00am and 3.00pm).

Table1: Composition of experimental layers ration

Ingredients (Kg)	Dietary inclusion levels (%)		
	0	**10**	**20**
Maize	50.00	50.00	49.50
Soyabean meal	20.00	10.00	10.00
Canavalinplagiosperma meal	0.00	10.00	20.00
Wheat offal	11.50	11.50	5.00
Fish meal	3.00	3.00	3.00
Palm kernel cake	6.00	6.00	3.00
Oyster shell	5.00	5.00	5.00
Bone meal	4.00	4.00	4.00
Vitamin/trace mineral premix*	0.25	0.25	0.25
Salt	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**
Calculated analysis			
MetabolizableEnergy (Kcal/kg)	2702.90	2750.90	2787.10
Crude protein	17.90	17.50	17.92
Crude fibre	4.48	3.84	2.85
Ether extract	3.96	3.60	3.0
Calcium	0.17	0.15	0.13
Phosphorus	0.39	0.39	0.29

*Biomix Layer premix supplied the following per kg diet. Vitamin A: 10,00000 I.U.;Vit. D3: 20,0000 I.U.; Vit. E: 100 I.U.; Vit. K: 20mg; Thiamine B1: 15mg; Riboflavin B2: 40mg; Pyridoxine B6: 15mg; Niacin: 150mg; Vit. B12: 0.0mg; Pantothenic acid: 50mg; Folic acid: 5mg; Biotin: 0.2mg; Choline chloride: 12mg; Anti-oxidant: 1.25g; Manganese: 0.8g; Zinc: 0.5g; Iron: 0.2g; Copper: 0.05g; Iodine: 0.12g; Selenium: 2mg; Cobalt: 2mg.

The egg size (Oblong and horizontal circumferences) were measured using a thread and a well calibrated meter rule. The yolk height, width, albumen height and width were measured using Venier calipers. The yolk and albumen indices were calculated using spherometer and Venier calipers, respectively. The shell thickness was obtained using a micrometer screw guage after removing the membrane. The Haugh unit was calculated by substituting the value of albumen and egg weight as outlined by (15). Twenty (20) eggs from each treatment were used in the determination of Haugh unit, yolk index, albumen index and shell thickness values. After weighing, the eggs were broken and the content poured out on a smooth tray, the albumen and yolk height and diameter measured. This was done away from the chalaza at a point mid-way between the inner and outer edges of the thick egg white using a spherometer (tripod micrometer) and Venier calipers. Haugh units were calculated using the following formulae as outlined by (15):

$$\frac{G(30W0.37\ -100)}{100}+1.0$$

Hu = 100log (H -
Where:
HU =Haugh unit

H = Observable albumen height in millimeter
W = Observed weight of the egg in grams
G = Gravitational constant (32.2)
Or H = 100 Log (H + 7.57 – $1.7W^{0.37}$)

The diameter and height of the yolk and albumen were measured without removing the yolk from the albumen. The yolk height and average length of the short and long yolk diameter were taken with the use of a spherometer and Venier caliper, respectively. The ratio of the yolk height to average of the short and long yolk diameter was taken as the yolk index while the ratio of the diameter was also taken as the albumen index. Shell thickness was measured with a micrometer screw gauge. The membrane from each egg shell was removed and the measurements were taken from points on each shell. The thickness value for each egg was the average value for the three measurements. Scaling of yolk coloration was done by visual observation, comparing the egg yolk colour with the HolfmanIa Roche fan scale (16). Data collected from the trial were subjected to analysis of variance (17). When analysis of variance indicated significant effects, means were separated using Duncan's new Multiple Range Test (DNMRT) as outlined by (18).

Results and Discussion

The performances of the layers are shown on Table 2. The control group recorded a significantly ($P<0.05$) higher body weight gain. The values were 20g, 10g, and 13g for the 0, 10 and 20% treatment groups, respectively. Values for feed conversion ratio, hen-day production, egg weight, shell thickness, yolk and albumen indices, Haugh unit and yolk colour were similar ($P>0.05$) among the treatment groups (Table 3). The comparable performance of the layers on the test material with the control group is in agreement with earlier reports by (9, 13, 19).

Table 2: Performance of layers fed different levels of two-stage cooked *canavalia plagiosperma* seed meal

	Dietary inclusion levels (%)			
Parameters	0	10	20	SEM
Initial body weight (g)	1700.00	1650.00	1650.00	1.05
Final body weight (g)	1720.00	1660.00	1663.00	8.55
Body weight changes (g)	20.00[a]	10.00[b]	13.00[b]	5.03
Feed intake (g)	55.30	51.20	50.60	4.50
Feed conversion ratio (feed/egg)	2.16	2.24	2.30	0.25
Hen-day egg production (%)	66.05	64.20	63.84	2.25
Egg weight (g)	56.48	56.58	55.47	0.20
Egg yolk colour	4.50	4.83	5.00	0.15

[ab] means within row with different superscripts are significantly ($P<0.05$) different.

The proximate composition of raw and Two-Staged cooked *Canavalia plagiosperma* seed meal is presented in Table 4. The crude protein value of raw *Canavalia plagiosperma* seed meal was higher than that reported for some other *Canavalia species,* 22.29-27.90% as reported by (4, 8). This protein value makes the seed a probable supplement to cereal-based diets with crude protein content of about 8.55% or below (20). The high fibre content of the seed meal might have resulted from the thick and tough seedcoat and other cellulosic constituents of the bean. Yet it does not make it undersirable as fibre is important in the diets of laying hens, acting as diluents. The ether extract values of the *Canavalia plagiosperma* seed meal is quite high (5.48%) compared to some other unconventional legumes like *Mucunacon chinchinensis* (4.52) and Sword bean (2.94) as reported by (4) suggesting that the seeds should be given some consideration as a potential oil seed. It compares favourably with groundnut cake and is higher than soyabean (3.5%) as reported by (21). From the Table of anti-nutritional composition (Table 5), the values for Concanavalin A were 28.8Hu/mg for raw seeds, 17.8Hu/mg for two-stage cooking.

Table 3: Effect of dietary levels of *Canavali aplagiosperma* seed meal on egg quality characteristics

	Dietary inclusion levels (%)			
Parameters	0	10	20	SEM
Haugh unit (HU	90.02	89.55	90.12	0.01
Shell thickness (MM)	0.366	0.360	0.364	0.01
Yolk index	0.41	0.41	0.39	0.10
Albumen index	0.	0.15	0.16	0.01
Horizontal Circumference (CM)	13.77	13.53	13.48	0.12
Oblong circumference (CM)	15.59	15.35	15.00	0.25

Therefore cooking reduced the concanavalin A content in the raw seed by 38%. The result is advantageous in that concanavalin A is a lectin of legumes; apart from causing food poisoning, it lowers protein quality (22). The results on hemagglutinin were 20.1Hu/mg for the raw seed meal and 15.3Hu/mg for two-stage cooked seed meal indicated that two-stage cooking significantly reduced the hemaggluatinin content in the raw seed by 24%. In several legumes, hemeggulatinating activity has been shown to be one of the factors responsible for toxicity and growth retardation in animals (23). Therefore two-stage cooking seem to be a major processing method to detoxify *Canavalia plagiosperma* seed of concanavalin A. Trypsin inhibitor content of the seed were given as 63.00Tu/mg for the raw seeds. This result is lower compared to other closely related Canavalia species like *Canavalia ensiformis* (168.15 Tu/mg) and *Canavalia braziliensis* (166.22 Tu/mg) (24). Though the level seems to be relatively low, it could be deleterious to animals since trypsin inhibitors inhibit the activity of enzymes making them unavailable for their role in the breaking down of protein (25) resulting to growth retardation. The value recorded for two-stage cooked *Canavalia plagiosperma* seeds was 8.00Tu/mg. This reveals that there was a significant decrease (87.30%) effected by two-stage cooking. Cyanide content of the seeds were 0.088mg/100mls in the raw seeds and 0.0295mg/100mls for two-stage cooked seeds. There was therefore a significant ($P<0.05$) decrease (66.67%) in cyanide content as a result of the two-stage cooking of the seeds. This low cyanide content gives it an edge over some legumes like *Mucuna cochinchinensis* and cowpea since hydrogen cyanide when produced in excess, can inactivate the cytochrosome oxidase system and cause the death of animals within seconds (26). Tannin content was reduced from 6.02mg/100mls in the raw seed to 2.52mg/100mls in two-stage cooked seeds a reduction of 58%. Tannin is known to be generally resistant thereby leading to retarded growth of the animals (6)

Table4: Proximate composition of raw and two-stage cooked *canavalia plagiosperma* seed meal

Components(%)	Raw	Two-stage cooked
Dry Matter	80.65	79.05 (1.98%)***
Moisture	19.35	20.95
Crude protein (DM)*	36.11	26.25 (27.30%)***
Crude fibre (DM)	5.15	7.10
Ether extract (DM)	5.48	4.67 (14.78%)***
Ash (DM)	1.80	2.10
NFE (DM)**	51.46	59.88

*(%DM)-percentage dry matter. **(NFE)- Nitrogen Free Extract ***(% Reduction)

Table 5: Phytochemical composition of raw and two-stage cooked *canavalia plagiosperma* seed meal

Parameters	**Raw**	**Two-stage cooked**	**% Reduction**
Con A (Hu/mg)*[1]	28.80	17.80	38.19
Hemagglutinin (Hu/mg)	20.10	15.30	23.88
Tryspin (Tu/mg)*[2]	63.00	8.00	87.30
Cyanide	0.09	0.03	66.67
Tannin (mg/100mls)	6.02	2.52	58.14

*[1] (Hu/mg) – Hemagglutinating unit per milligram *[2](Tu/mg)- Trypsin unit per milligram

Conclusion and Application

The result of this study shows that:

1. Two-stage cooking reduced the level of anti nutritional factors in raw *Canavalia plagiosperma* seed meal to a thresh hold level for optimal performance of laying hens.
2. The optimal dietary inclusion level of *Canavalia plagiosperma* seed meal for layers is 20%.

References

1. Odunsi, A.A. (2003). Blend of bovine blood and rumen digesta as replacement for fish meal and groundnut cake in layer diets. *International-Journal of Poultry Science*, 2(1):58-61.

2. Adeniji, A.A. (2000). A survey on the prices of conventional feedstuffs compared with the un-utilized wastes *(unpublished work). Dept. of Animal Production, University of Ilorin.*

3. Esonu, B.O. Azubuike, J.C., Udedibie, A.B. I., Emenalom, O.O., Iwuji, T.C. and Odoemelam, V.U. (2011). Evaluation of the Nutritive value of mixture of fermented bovine blood and rumen digesta for broiler finishers.*J. Nat. Sci. Res.*,1(4):1-8.

4. Akinmutimi, A.H. (2011). Evaluation of Sword Bean (*Canavalia galdiata*), as an alternative feed resource for broiler chicken. *Ph.D Thesis, College of animal science Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria.*
5. Etuk, E.B., Orili, A.G., Ohaji, J.N. and Odoemelam V.U. (2010). Evaluation of Soybean Hills in Grower Tunkey Diets.*Int. J. Agric. and Rural Devpt.,* 13(2):220-223.
6. Odoemelam, V.U. (2007). Proximate composition, Antinutritional properties and mineral assay of Raw and Processed *Canavalia plagiosperma* Seed. *M.Sc. Thesis. Department of Animal Production and Livestock Management Michael Okpara University of Agriculture, Umudike, Abia State.*
7. Odoemelam, V.U. and Ahamefule, F.O. (2006). Effect of de-hulling on proximate compositions, anti-nutritional properties and mineral content of *Canavalia plagiosperma. Trop. J. Anim. Prod.*,31(2): 167-175.
8. Udedibie, A.B.I. and Nkwocha, C.O. (1990). Comparative Study of jackbeen (*C. Ensiformis*) and sword bean (*C. Gladiata*) a protein supplements for young broiler chicks. *Niger. Agric*, 124:7-14.
9. Esonu, B.O. (1996). Studies on the methods of improving the nutritive value of the jackbean (*C. ensiformis)* for poultry industry. *Ph..D Thesis, Federal University of Technology Owerri, Nigeria.*
10. Rosenthal, G.A. (1972). Investigation of Canavanine Biochemistry in Jack bean Plant II Canavanine biochemistry in the developing plant. *Plant physiology*, 50:328-331.
11. Carlini, C.R. and Guimaraes, J.A. (1991), Plant and Microbial toxic proteins as hemilectin-emphasis on *Canatoxintoxicon*. 29:667-676.
12. Udedibie, A.B.I. and Mba, U.N. (1986). Effect of dietary boiled and toasted pigeon pea (*Cajanuscajan*) in layers diet. *J. Appl. Chem. Agric. Res.*, 1:1-5.
13. Udedibie, A.B.I, Esonu, B.O., Iwuoha M.C. and Unachukwu C.N. (1996). Two-stage cooking as a method for improving the nutritive value of jackbean (*C.ensiforms)* for broiler Chicks.*Nig. J. Anim. Prod.* Vol. 24.23:107-110.
14. A.O.A.C. (1995) Official methods of analysis, 7th edition, Washington D.C.
15. Oluyemi, J.A. and Robert, F.A. (2000). *Poultry Production in Warm Wet Climate*, 2nd Edition, pp. 48-60.
16. Vuilleumier, J.P. (1969). The Roche Yolk Colour Fan- an instrument for measuring yolk colour. *Poult Sci.,* 48:787-779.

17. Snedecor, G.W. and Cochran, W.G. (1980). Statistical methods 7thEdn. Iowa University Press USA.
18. Obi, I.U. (1990). *Statistical methods of detecting differences between treatment means,* Snap Press, Enugu, Nigeria.
19. Esonu, B.O., Anumni P., Obioma, K. and Eneremadu O.F. (1999). Evaluation of combination of maize/sorghum based brewers grains, cocoyam corms, and cassava root meals as substitute for maize in broiler finisher diets. *Indian Journal of Animal Science,*69 (2): 120.
20. Sagarika, E., Enol, R.J. and Baboo, M.N.C. (1999). Proximate composition, mineral and amino acid content of mature *Canavalia gladiate* seeds. *Food chemistry*, 66:115-19.
21. P. N. M.P. (1995). Pfizer Nutrient Master Plan, Ikeja, Lagos, Nig. Tropical Crops (Dicotyledon). Longman Publishers Longman Group Limited London.1stEdn. pp. 242-245.
22. Ukachukwu, S.N. and Obioha, F.C. (2000). Effect of Time Duration of thermal 7890-treatments on the Nutritive value *Mucuna cochinchinensis*. *Global J. Pure App. Sc.,* 6(1):11-15.
23. Iyayi, E.A. and Eghrevba J.I. (1998). Biochemical evaluation of seeds of underutilized legume (*Mucunautilis*).*Nig. J. Anim. Prod. ,*25(1):40-45.
24. Esonu, B.O. Udedibie, A.B.I and Ukorebi, B.A. (1998). Preliminary observation of the effects of two-stage cooking prior to microbial fermentation on the nutritive value of Jack bean (*Canavaliaensiformis)* for broiler birds AMBIO 25:8, 537.
25. Oke, D.B., Tewe, O.O. and Fetuga, B.L.A. (1995). The Nutrient Composition of Some Cowpea Varieties.*Nig. J. Anim. Prod.,* 22(1):32-36.
26. Agbabiaka, L.A. (1999). Comparative Performance of broilers fed diets containing variously Processed Jackbean meal, M.Sc. Thesis, Federal University of Technology Owerri, Nigeria.