Laying Performance and Egg Quality Evaluation of Pullets Fed Diets Containing Graded Levels of Processed Horse Eye Bean (*Mucuna urens*) Meal

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Abstract

This study was designed to evaluate the laying performance and egg quality of pullets fed diets containing graded levels of processed horse eye bean meal (HEBM). The processed beans were used to formulate six layer mash diets with the test sample replacing soybean meal in the control diet. Two hundred and ten (210) pullets at point of lay (22 weeks old) were used for the study. Birds on 15 per cent HEBM diet had a significant (p<0.05) higher percentage hen day production. Average egg weight increased significantly with the highest recorded in birds eating 60% HEBM. The feed efficiency and egg quality parameters were not significantly influenced by the treatments. The birds on 15% HEBM recorded the highest returns on investment (₦1196.68). The study concludes that the processed HEBM could replace soybean meal up to 60% in laying birds diet without deleterious effect on the laying performance and egg quality.

Keywords: horse eye bean, anti nutrients, egg quality, egg size, laying pullets

1.0 Introduction

The need to produce more animal protein in the country has become increasingly urgent in view of the ever rising population. The human population in Nigeria is projected to grow at an annual rate of 2-5% to the year 2025. Population growth has surpassed food production and the nation is already facing chronic food insecurity. Poultry meat and eggs have been recommended among the livestock products to bridge this protein gab because of their short generation interval, high rate of productivity, quick turn over rate, higher feed efficiency and low labour and land requirement (Ojedapho, 2008). In poultry feeds, maize and other cereals constitute between 60-70% of the ration. As at 1983, poultry feed alone constituted about 95% of the finished animal feeds produced in Nigeria. Several workers (Iyayi *et al*., 2005; Onyimonyi and Ugwu, 2007 and Ani, 2008) have stressed the need for the utilization of alternative feed ingredients, which are far removed from human and industrial interests to reduce the cost of feeds and hence the cost of poultry products. A feedstuff that could be considered as replacement for the expensive ingredients like groundnut cake, soybean, must not be a stable item of human food, should be readily available and inexpensive to produce and process.

The alternative vegetable protein being considered in this study is the horse eye beans (*Mucuna urens*). *Mucuna urens* is an important legume in many parts of the world with the foliage frequently fed to grazing animals and the beans sometimes eaten by humans and animals in the southern and Eastern States of Nigeria. (Osaniyi and Eka, 1978, Umoren *et al*., 2007). However, there is a low sustained interest in mucuna cultivation due to its low utilization as food and feed and subsequently the lack of market for the beans. Besides, the use of mucuna either as human food or as animal feed is limited because the raw seed contains such anti-nutritional factors as trypsin inhibitors, tannins, cynogenic glycosides, phytates and others (Umoren *et al*., 2007). The nutritive value of the bean has been reported to improve by combining soaking, cooking and toasting, which inactivate, reduce or destroy the inherent anti-nutritional components (Effiong and Umoren, 2011).

1.1 Objective of Study

This study was therefore designed to evaluate the Laying performance and egg quality of pullets fed diets containing graded levels of processed horse eye bean (*Mucuna urens*) meal.

2.0 Materials and Methods

2.1 Study Location and Source of the Experimental Material

The experiment was conducted at the teaching and research farm unit of the Department of Animal Science, University of Calabar, Nigeria, located between latitude 04.57^{o}N and longitude 08.20^{o}E. The horse eye beans used for the study were purchased from the local farmers in Akamkpa Local Government Area of Cross River State.

2.2 Processing of the Horse Eye Bean

The horse eye beans were cracked using stone, soaked in fresh water for 48 hours at room temperature (37^{0}C), peeled, rinsed, cooked for 90 minutes on open fire at 100^{o}C (timing started from the point of boiling), rinsed in clean water and sun-dried. The dried beans were toasted in frying pot, on open fire until they turned brown at 30 minutes, approximately. The processed beans were milled on 4mm screened hammer mill and analysed for its proximate composition prior to feed formulation. The processing techniques adopted were such that could be easily replicated by local farmers.

2.3 Experimental Diets

Six (6) layer mash diets were formulated to provide 16.5 per cent crude protein and the metabolizable energy of about 2,650kcal/kg. Diet 1 was the control, containing no horse eye bean meal (HEBM), while diets 2 to 6 contained the HEBM, replacing 15, 30, 45, 60 and 75 per cent of soybean meal (SBM) in the respective diets.

2.4 Experimental Birds and Management

Two hundred and ten (210) pullets at point of lay (22 weeks old) were selected from the flock for the study. They were randomly distributed into six groups, with thirty (30) birds per group. Groups were randomly assigned to one of the six experimental diets described earlier. Each treatment was replicated three times with ten birds per replicate. The birds were housed in a deep litter system, with nesting boxes provided in each pen. Water and feed were provided *ad libitum.* Routine medication and vaccination, typical of laying hens were strictly followed. The experiment lasted for 12 weeks.

2.5 Experimental Design

The design used was a Completely Randomized Design (CRD) with the following model:

$$Xij = \mu + Ti + eijk$$

Where:

Xij= Observation on the parameter egg. The jth egg weight of a hen receiving the ith diet.
Ti = Treatment effective, that is the effect of the ith diet
Eijk = Random error of the kth observation in the ij sub-group.
μ = Population mean

2.6 Measurement of Relevant Parameters

The daily feed intake of each replicate was determined by the different between feed given in a day and the left over in the following morning. Feed efficiency ratio (kilogram of feed per kilogram of egg), percentage hen day production and egg quality parameters (egg weight, shell weight, yolk weight, albumen weight, shell thickness, yolk height, albumen height, yolk diameter and albumen diameter) were measured.

The percentage hen-day production was calculated as:

$$\frac{\text{Number of eggs produced}}{\text{Number of hens x Numbers of days}} \times \frac{100}{1}$$

The weight of eggs and the egg shell were measured with the sensitive electronic weighing scale to the nearest 0.01g. Shell thickness was measured by breaking the egg shell into smaller pieces, the shell membrane removed and the thickness of the eggshell measured using micrometer screw gauge expressed in millimeters. Yolk weight (g) was determined by separating the yolk from the albumen using a plastic egg separator and thereafter weighed on electronic sensitive scale to the nearest 0.01g.

The yolk diameter (cm) was measured around the widest horizontal circumference using Vanier caliper. The yolk index was determined by dividing the yolk height by the yolk diameter. Albumen height was measured by using a tripod micrometer calibrated in 0.01millimiter. The dimension measured was taken between the yolk edge and the external edge of the thick albumen. The egg weight and albumen height were used to compute the Haugh unit using the simple formula: $H.U = 100\text{Log}(H + 7.5 - 1.7W^{0.37})$ (Haugh, 1937).

Where, HU = Condition of the thick albumen in haugh units

H = Height of thick albumen in mm

W = Weight of egg in gram

3.0 Results and Discussion

Table 3 shows the effect of treatments on the laying performance and egg quality characteristics of the hens.

3.1 Percentage hen Day Production

Comparatively, birds on 15 per cent HEBM diet recorded a significant ($p<0.05$) higher percentage hen day production of 83.33. Values between birds fed control diet and those on diets with 30, 45, 60, and 75% HEBM were however not significant ($p>0.05$). The lower values observed among pullets on the control diet and those eating higher levels of HEBM could be attributed to the reduced feed intake, resulting in relatively lower nutrient intake. This translates to lower nutrient availability for egg production (Togun *et al*., 2006). The birds thus reduced egg production because the only available nutrients would also be required for other physiological needs of the birds. Togun *et al*. (2006), Fafiolu *et al*. (2006) and Eniolorunda *et al.* (2007) reported an average percentage hen day production of 94.34, 76.38 and 55.32, respectively whereas, Adebimpe *et al*. (2007) and Madubuike and Obidimma (2009), reported 55.32 and 35 – 82.1 as the percentages hen day production. Values reported by these authors were comparable with those obtained in this experiment.

3.2 Feed Efficiency

Result of the feed efficiency (kg feed/kg egg) revealed that birds on 30% HEBM diet were more efficient in converting their feed to unit weight of egg followed by group fed 15% HEBM. The least feed efficiency was recorded by birds fed the control diet. The variation in feed efficiency was however not significant ($P>0.05$) among the groups. Yasmeen *et al.* (2008) reported feed conversion ratio/kg egg mass of 2.33 and 2.61 for pullets and spent layers, respectively; while Fafiolu *et al.* (2006) gave a range of 1.90 to 2.06 as feed efficiency (kg feed kg^{-1} egg) for laying hens fed diet containing sprouted malted sorghum. Values reported by these authors were lower than those observed in this experiment.

3.3 Average Egg Weight

The effect of treatment on average egg weight was significant ($P<0.05$). Egg weight increased as the inclusion level of HEBM in the diets increased. Bird eating 60% HEBM diet had the highest average egg weight of 59.95g, while the least egg weight of 54.99g was observed in birds fed the control diet. Birds fed 15 and 75% HEBM and 30 and 45% HEBM diets had average egg weights of which were statistically similar. Egg weight is a function of so many factors, notably; quality and quantity of feed, strain of the birds, stage of lay and management system. In the instant case, it seems there is a factor that increases egg weight as level of HEBM in the diets increased. It appears that the level of lysine increased with increasing level of HEBM in the diets. There is evidence (Onyimonyi and Ugwu, 2007), that each 0.1 unit of extra lysine increased egg weight by 1.16g.

3.4 Shell Weight

Variation in the shell weight was not significantly ($P>0.05$) influenced by increasing levels of HEBM in the diets. Values obtained in this experiment were similar to 6.27 – 6.54g reported by Onyimonyi and Ugwu (2006), but higher than the range (4.84 – 6.32g) and 5.8g reported by Fafiolu *et al*. (2006) and Karaman *et al*., (2008), respectively. Differences in the shell weight may be attributed to the age of the birds and the weight of eggs. A number of studies have shown that egg shell weight increases as the bird grows older (Suk and Park, 2001; Roberts 2004; and Yasmeen *et al*., 2008).

3.5 Shell Thickness

Egg shell thickness range from 0.32mm in birds fed 60% HEBM diet to 0.35mm for birds on 15% HEBM diet. The level of HEBM in the diets did not however affect this parameter significantly ($P>0.05$). This implies that the test diets did not contain any material whose toxicity could impair this egg quality index.

Lower value observed in group fed 60% HEBM diet could be due to the larger egg size. Olayeni *et al*. (2007) maintained that the shell thickness declined as egg size increased, thereby causing shell to be spread thinner, forcing shell quality to decline. The values obtained in this experiment were generally lower than the range 0.59 – 0.67mm (Onyimoyi and Ugwu, 2007) and 0.50 – 0.58mm (Iyayi and Taiwo, 2003), but similar to 0.34 - 0.37mm (Eniolorunda *et al.*, 2007), and 0.35mm (Olayeni *et al.*, 2007). It is estimated, that a shell thickness of 0.33mm is needed if the egg is to have a more than 50 percent chance of moving through normal market handling without breaking (Stadelman *et al.*, 1977).

3.6 Yolk Weight

Yolk weight ranged from 12.31g in birds fed control diet to 12.49g in birds on 15% HEBM diet. Yolk weight was not significantly (P >0.05) influenced by the treatments.

3.7 Albumen Weight

Value for the albumen weight was highest (26.66g) in group fed 60 per cent HEBM and lowest (23.00g) in birds fed control diet. The treatments did not significantly (P>0.05) influenced this parameter although the higher albumen weight observed among birds fed 60 per cent HEBM relative to the group fed control diet could be attributed to the higher egg weight. Albumen weight is known to increase with increase in egg weight.

3.8 Haugh Unit

The Haugh unit (Hu) is an expression of the relationship between egg weight and height of thick albumen (Haugh, 1937) and it is the most widely used research measurement of albumen quality (Togun *et al*., 2006). Its values had proved to be more significantly correlated to quality measurements than any other parameter (Ekweozor *et al*., 2002).

Birds fed control diet recorded the highest Hu value of 84.04% while those fed 75% HEBM diet recorded the lowest Hu value corresponding to 75.09%. The levels of HEBM in diet did not however influence the Hu values significantly (P > 0.05). Haugh unit of 72% and above is regarded as an indicator of freshness in egg (Olayeni, 2007). None of the values obtained for different treatments showed value below 72, indicating that eggs from all the treatments were fresh.

3.9 Yolk Index

Values for yolk index ranged from 0.31 in birds fed 60% HEBM diet to 0.40 in birds fed 75% HEBM diet. Birds fed control and those on 15 and 45% HEBM diets recorded similar yolk index values. Values were statistically similar (P> 0.05) in all the treatment groups. The absence of significant changes in the yolk index showed that the processed HEBM did not contain any toxic material that could impair this egg quality index.

3.10 Mortality

No mortality incidences were observed in any of treatment group throughout the experimental period, indicating that the processed mucuna bean meal did not have any significant detrimental effect on the birds.

3. 11 Economic Efficiency of Feeding Processed Horse eye Bean Meal to Laying Pullets

The economic efficiency of feeding processed horse eye bean meal to laying pullets is presented in Table 3.

Birds fed 15% HEBM diet recorded the highest total feed intake of 7.50kg while those on control diet recorded the least total feed intake of 5.60kg. The variations in feed intake was however not significant (P > 0.05) among the treatment groups. Cost/kg of feed decreased as the dietary level of HEBM replacing soybean meal increased from 15 to 75%. The differences among the treatment groups were statistically similar. Birds fed 15% HEBM diet recorded the highest cost for the feed consumed amounting to ₦ 553.31 were as birds fed diet containing 45% HEBM recorded the least cost of feed consumption amounting to ₦ 404.90 variation in the cost of feed consumed differed significantly (p<0.05) among the groups. Cost of feed consumed by birds on control diet and those on 30, 60 and 75% HEBM were however statistically similar. Higher cost of feed consumed for birds fed diet containing 15% HEBM was due to the higher feed intake.

Total number of eggs produced/by birds on different treatment groups differed significantly (p<0.05), with the highest (70 eggs) recorded among birds fed 15% HEBM diet, while the least number of eggs (56) was reported for group fed control diet. Differences in the total number of eggs laid per bird between groups fed control diet and treatments containing 75% processed HEBM were the same statistically.

The revenue from sale of eggs was significantly ($p<0.05$) higher for birds fed diet containing 15 per cent processed horse eye bean meal as compared to the rest of treatment groups. Revenue from the sale of eggs for control diet group was the least (₦ 982.40). The birds on 15 per cent HEBM had significantly ($p<0.05$) higher returns on investment, followed by birds on 60 per cent HEBM, while birds on control treatment had the least returns on investment. Differences in returns on investment for treatment groups containing 30, 45, 60, and 75 per cent HEBM were statistically similar.

4.0 Conclusion

From the result of the study, it is concluded that horse eye bean meal could replace up to 60% of the soybean meal in the laying birds ration, without adverse effects on the laying performance and egg quality. The use of exogenous enzymes like non starch polysaccharides is being encouraged to enhance higher utilization of this novel feedstuff.

Table 1: Composition of the Experimental Diets Layer Mash

Ingredients	Replacement levels (%)					
	0	**15**	**30**	**45**	**60**	**75**
Maize	54.32	53.12	51.70	50.00	48.03	45.60
Fish meal	2.00	2.00	2.00	2.00	2.00	2.00
Soybean meal	15.38	14.09	12.60	10.80	8.67	6.00
Horse eye bean meal	-	2.49	5.40	8.90	13.00	18.10
Wheat offal	13.00	13.00	13.00	13.00	13.00	30.00
Palm kernel cake	7.00	7.00	7.00	700	7.00	7.00
Bone meal	2.40	2.40	2.40	2.40	2.40	2.40
•Vit./mineral premix	0.30	0.30	0.30	0.30	0.30	0.30
Lime stone	6.00	6.00	6.00	6.00	6.00	6.00
Methionine	0.10	0.10	0.10	0.10	0.10	0.10
Lysine	0.20	0.20	0.20	0.20	0.20	0.20
Salt	0.30	0.30	0.30	0.30	0.30	0.30
Total	**100**	**100**	**100**	**100**	**100**	**100**
Calculated analysis						
Crude protein (%)	16.50	16.50	16.50	16.50	16.50	16.50
ME (Kcal/kg)	2,678	2,680	2,682	2,684	2,686	2,688
Determined analysis						
% Crude protein	16.51	16.48	16.47	16.45	16.43	16.40
ME(Kcal/kg)	2663	2682	2688	2687	2689	2690

•Layer Vitamin/mineral premix containing the following per kg. Vitamin A 10,000000I.U; Vitamin D3 2,000000IU; Vitamin E 10,000IU; Vitamin K 2,000mg; Thiamine 1,500mg; Riboflavin B 4,000mg; Pyridoxine B6 1,500mg; Anti oxidant 125g; Niacin 15,000mg; Vitamin B12, 10mg; Panthotenic acids 5,000mg; Biotin 50mg; Choline chloride 400g, manganese 80g; Zinc, 20g; 1ron, 50g; copper, 20g; Iodine 1.5g; Selenium 200mg; Cobalt 200mgr; Folic acid 500mg; Vitamin C 100mg.

Table 2: Laying Performance and egg Quality Evaluation of Pullets fed Diets Containing Processed HEBM

Parameters	Replacement levels (%)						
	0	**15**	**30**	**45**	**60**	**75**	**SEM**
Hen day production (%)	64.67^b	83.33^a	69.25^b	72.34^b	72.27^b	68.02^b	± 2.09
Feed efficiency (kg feed/kg egg)	3.33	2.91	2.65	3.32	3.30	3.24	± 0.21
Average weekly egg weight (g)	54.99^b	57.07^{ab}	57.53^a	58.42^a	59.95^a	56.83^b	± 0.50
Shell weight (g)	6.71	7.07	6.52	6.58	6.54	6.83	± 0.08
Shell thickness (mm)	0.34	0.35	0.34	0.33	0.32	0.33	± 0.02
Yolk weight (g)	12.31	12.49	12.73	12.91	12.75	12.91	± 0.09
Albumen weight (g)	23.00	25.39	25.44	25.34	26.66	25.10	± 0.45
Haugh unit	84.04	81.52	75.12	76.94	79.13	75.09	± 1.35
Yolk index	0.34	0.34	0.33	0.34	0.31	0.40	± 0.07
Mortality	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Means with different superscripts within the same row are significantly ($p<0.05$) different
SEM- standard error of mean

Table 3: Economic Efficiency of Feeding Processed horse eye Meal to Laying Pullets

Parameters	Replacement levels (%)						
	0	15	30	45	60	75	SEM
Cost/kg of feed (₦)	74.57	73.78	72.88	71.79	70.50	68.87	± 0.79
Total feed intake/bird(kg)	5.60	7.50	5.82	5.64	6.32	6.05	± 0.26
Cost of feed consumed (₦)	417.59^{b}	553.31^{a}	423.94^{b}	404.90^{bc}	445.75^{b}	416.64^{b}	± 20.63
Total egg produced/bird	56.00^{b}	70.00^{a}	60.00^{b}	61.00^{b}	61.00^{b}	59.00^{b}	±1.75
Revenue from egg (₦)	1400.00^{b}	1750.00^{a}	1500.00^{b}	1425.00^{b}	1525.00^{b}	1475.00^{b}	±46.48
Profit (₦)	982.41^{bc}	1196.68^{a}	1076.06^{b}	1020.10^{b}	1079.25^{b}	1058.36^{b}	±27.11

Means with different superscripts within the same row are significantly ($p<0.05$) different
SEM- standard error of mean

References

Ani A. O. (2008). The feeding value of processed velvet beans (Mucuna pruriens) for pullet chicks. Journal of tropical agriculture, food, environment and extension, (7) 2: 149-155.

Effiong, O. O. and Umoren, U. E. (2011). Effect of Multi- Processing Techniques on the chemical composition of Horse eye bean (Mucuna urens). Asian Journal of Animal Sciences. 5(5): 340 – 348.

Eniolorunda, O. O. Taiwo, B. B. A, Oyewumi, O. O. and Adeyemi, O. A. (2007). Performance of laying hens fed graded levels of indomie waste as replacement for maize in a humid tropical environment. Proceedings of the 32nd Annual Conference of the Nigerian Society for Animal Production. 32:264-267.

Fafiolu, A. O., Oduguwa O. O., Ikeobi, C. O. N., and Onwuka, C. F. I. (2006). Utilization of malted sorghum sprouts in the diet of rearing pullets and laying hens. Archiavos de zootecnia, diciembre, ano/vol. 55. numero 212: 361 – 371.

Haugh, R. R. (1937). The Haugh units for measuring egg quality. U. S. Egg Poultry management, 43: 552-555.

Iyayi, E. A. and Taiwo, V. O. (2005). The effect of diets incorporating mucuna (*Mucuna pruriens*) seed meal on the performance of laying hens and broilers. Tropical and Subtropical Agroecosystems, 1(2-3): 239-246.

Karaman, M., Yilmaz and Uluocak, A. N. (2006). Effects of different group sizes on egg production and quality in early laying stage of laying hens. Research Journal of Animal and Veterinary science, 1(1): 9-11.

Madubuike, F. N. and Obidimma, V. N. (2009). Brewers' dried grain as energy source on external and internal egg qualities of laying hens. Proceedings of the 34th Annual Conference of the Nigerian society of Animal Production, 34:362-365.

Olayeni, T. B., Farinu, C. O., and Ojebiyi, T. (2007). Replacement value of biscuit waste on the performance and egg quality parameters of laying hens. Proceedings of the 32nd Annual Conference of the Nigerian Society for Animal Production. 32: 313-315.

Osaniyi, C. B. and Eka, O. U. (1978). Studies on chemical composition and nutritive value of horse eye bean (Mucuna urens). West African Journal of biology and applied chemistry, 32:228-229.

Ojedapo. L.O., Akinokun O. Adedeji, T. A., Olayeni, T. B., Ameen, S. A., Ige, A. O. and Amao, S. R. (2008). Evaluation of growth traits and short-term laying performance of three different strains of chicken in the derived savannah zone of Nigeria. International journal of poultry science, 7 (1): 92-96.

Onyimonyi, A. E. and Ugwu, S. O. C. (2007). Performance of laying hens fed varying dietary levels of bambara (Voandzeia subterrennea thouars) offal. International Journal of Poultry Science, 6(3): 223-226.

Roberts, J. R. (2004). Factors affecting egg internal quality and egg shell quality in laying hens. Journal of Poultry Science, 41: 161-177.

Stadelman, W. J., and Owen J., Cotterill (1977). Egg science and technology (2nd edition.) AVI Publishing Company INC. WestPoint. Connecticut, 29.

Suk, Y. and Park, C. (2001). Effects of broiler breeder age and length of egg storage on albumen characteristics and hatchability. Poultry science, 80: 855-858.

Togun, V. A., Farinu, G. O., Ojebiyi O. O., Akinlade, J. A., and Laogun, T. A.O. (2006). Performance of brown egg-type pullets feed diets containing graded levels of wild sun flower (Tithonia diversifolia, Hemls. A. Gray) forage meals as replacement for maize. World Journal of Agricultural Science, 2(4): 443-449.

Umoren, U. E. Effiong, O. O. and Akpan, I. A. (2007). Nutritional Evaluation of the horse eye bean (Mucuna urens): Effect of processing on the chemical composition. Journal of food; Agriculture and environment vol.5 (2):128-131.

Yasmeen, F., Mahmood S., Hassan M., Akhtar, N. and Yaseen, M. (2008). Comparative reproductive performance and egg characteristics of pullets and spent layers. Pakistan Veterinary Journal, 28(1): 5-8.