INTRODUCTION

Intensive poultry production has been identified as one of the means of attaining animal protein sufficiency in the diet of the average Nigerian (Ani and Adiegwu 2005). Nigeria poultry industry is, however, facing tremendous setback and is on the verge of collapse arising from high cost of poultry feed, which accounts for 70-80% of the total cost of poultry production. The high cost of poultry feed has been traced to the increasing cost of maize, soybean and groundnut which are the main conventional sources of energy and protein, respectively (Effiong et al., 2013). A possible solution to the escalating cost of these ingredients is to explore the potentials of alternative feedstuffs as partial or total replacement for the expensive conventional feed ingredients.

The alternative vegetable protein being considered in this study is the horse eye bean (Mucuna urens) meal. Studies on the nutrient composition showed that the bean is a good source of protein (25-35%), carbohydrate (50-80%) and fat (8-11%). Effiong and Umoren, (2011) reported Glutamic acid, aspartic acid and leucine as the major amino acids in the horse eye bean. Umoren et al., (2007) had reported that raw horse eye bean did not support growth of broilers and rats. This, they attributed to the presence of some anti nutritional factors which were present in the raw and cooked beans. The anti-nutritional factors in the horse eye bean meal include trypsin inhibitor, lectins, phytates, phenols, cynogenic glycosides, tannins and L-3, 4 dihydroxyacetone (Effiong and Umoren, 2011). Effiong and Umoren (2011) had recommended a multi-processing technique (combined soaking and cooking for 48 hours and 90 minutes, respectively and toasting) as processing method in eliminating the anti nutritional factors in the horse eye bean. They noted that the adopted processing methods reduced the levels of phytates, tannins, phenols, HCN and oxalates by 49, 30, 87 and 63%, respectively.

The objective of this study was therefore to determine the optimum replacement level of the soybean meal by the processed horse eye bean meal (HEBM) in the diet of pullet chicks at brooding and rearing phases.

MATERIALS AND METHODS

Processing of the horse eye bean
The horse eye bean was processed using methods that

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local farmers can easily adopt. The methods were Soaking cracked beans in fresh clean water for 48 hours at room temperature (37°C), cooking for 90 minutes on open fire at 100°C (timing started from the point of boiling), and toasting sun-dried bean in frying pot, on open fire for 15 minutes. The beans were then milled using 4mm screened hammer mill and thereafter used for feed formulation.

Experimental diets

Six (6) diets each were formulated during brooding and growing phases to provide 20 per cent crude protein and approximately 2,800 kcal ME/kg of metabolizable energy and 15 per-cent crude protein and 2700 kcal ME/kg of metabolizable energy, respectively (Table 1). Diet 1 was the control, containing soybean meal as sole plant protein. Diets 2 to 6 contained the HEBM, replacing 15, 30, 45, 60 and 75 per cent of soybean meal (SBM), respectively in the diets. The diets were presented in the form of mash.
**TABLE 1:** Composition of the experimental diet (%)

| Ingredients                  | Replacement levels (%) (Starter mash) | Replacement levels (%) (Grower mash) |
|------------------------------|---------------------------------------|--------------------------------------|
|                              | 0          | 15         | 30         | 45         | 60         | 75         | 0          | 15         | 30         | 45         | 60         | 75         |
| Maize                        | 53.0       | 51.0       | 48.6       | 45.6       | 42.1       | 37.6       | 57.0       | 56.2       | 55.3       | 54.5       | 52.5       | 50.5       |
| Fish meal                    | 4.0        | 4.0        | 4.0        | 4.0        | 4.0        | 4.0        | 2.5        | 2.5        | 2.5        | 2.5        | 2.5        | 2.5        |
| Soybean meal                 | 24.5       | 22.5       | 20.2       | 17.5       | 14.2       | 10.0       | 8.3        | 7.8        | 7.1        | 6.0        | 5.1        | 3.7        |
| Horse eye bean meal          | -          | 4.0        | 8.7        | 14.4       | 21.2       | 29.9       | -          | 1.4        | 3.0        | 4.0        | 7.7        | 11.1       |
| Palm kernel cake             | 4.0        | 4.0        | 4.0        | 4.0        | 4.0        | 4.0        | 6.0        | 6.0        | 6.0        | 6.0        | 6.0        | 6.0        |
| Wheat offal                  | 11.0       | 11.0       | 11.0       | 11.0       | 11.0       | 11.0       | 22.0       | 22.0       | 22.0       | 22.0       | 22.0       | 22.0       |
| Vitamin/mineral premix       | 0.5        | 0.5        | 0.5        | 0.5        | 0.5        | 0.5        | 0.5        | 0.5        | 0.5        | 0.5        | 0.5        | 0.5        |
| Bone meal                    | 2.0        | 2.0        | 2.0        | 2.0        | 2.0        | 2.0        | 3.0        | 3.0        | 3.0        | 3.0        | 3.0        | 3.0        |
| Salt                         | 0.5        | 0.5        | 0.5        | 0.5        | 0.5        | 0.5        | 0.4        | 0.4        | 0.4        | 0.4        | 0.4        | 0.4        |
| Lysine                       | 0.3        | 0.3        | 0.3        | 0.3        | 0.3        | 0.3        | 0.2        | 0.2        | 0.2        | 0.2        | 0.2        | 0.2        |
| Methionine                   | 0.2        | 0.2        | 0.2        | 0.2        | 0.2        | 0.2        | 0.1        | 0.1        | 0.1        | 0.1        | 0.1        | 0.1        |
| Total                        | 100        | 100        | 100        | 100        | 100        | 100        | 100        | 100        | 100        | 100        | 100        | 100        |

Calculated analysis

- **Crude protein (%):** 20.00
- **ME (Kal/kg):** 2800

Determined analysis

- **% Crude protein:** 19.98
- **ME(Kcal/kg):** 2796

*Vitamin/ mineral premix containing the following per kg: Vitamin A 10,000,000 I.U; Vitamin D3 2,000,000 I.U; Vitamin E 20,000 IU; Vitamin K 2,250mg; Thiamine 1,750mg; Riboflavin B5,000mg; Pyridoxine B6 2,750mg; Anti oxidant 125g; Niacin 27,500mg; Vitamin B12 15mg; Panthotenic acids 7,500mg; Biotin 50mg; Choline chloride 400g; Manganese 80g; Zinc 50g; 1ron 20g; Ccopper, 5g; Iodine 1.2g; Selenium 200mg; Cobalt 200mg*
Experiment birds and design

A total of three hundred and sixty (360) one day-old, Lohman black pullet chicks were used for this study during brooding phase. The chicks were weighed and grouped according to their body weights into six (6) groups each of fifty (60) chicks. Within each group, they were further divided into three (3) replicates of twenty (20) birds each such that the overall mean weights and weight ranges were similar across the groups. Groups were randomly allocated to the six experimental diets in a completely randomized design. Each diet was fed as mash throughout the experimental period. Feed and water were provided ad libitum.

At growing phase, two hundred and seventy (270), 8 weeks -old pullets were selected, weighed and grouped according to their body weight into six (6) groups of forty-five (45) birds. Each group had three replicates of fifteen birds. Groups were randomly allocated to the six grower mash (test diets) in a completely randomized design. The experiment lasted for 56 days for the brooding phase and 12 weeks during the rearing/growing phase.

Data collection and analyses

Feed intake (pen basis) was measured daily; the weights of birds were taken weekly. Both the feed intake and weight gain were used to calculate the feed conversion ratio. Economics of feeding HEBM to growing pullets was evaluated.

Data generated from the experiment, were statistically analyzed, using the analyses of variance procedure. Significant means were separated by Duncan’s new multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Data for the performance of pullet chicks fed diet containing graded levels of processed horse eye bean meal are presented in Tables 2 and 3.

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**TABLE 2: Performance of pullet chicks fed diets containing graded levels of HEBM during brooding phase.**

| Parameters                        | 0   | 15  | 30  | 45  | 60  | 75  | SEM |
|-----------------------------------|-----|-----|-----|-----|-----|-----|-----|
| Initial weight/bird (g)           | 50.00 | 50.00 | 49.58 | 50.83 | 50.42 | 50.42 | ± 0.12 |
| Final weight/bird (g)             | 472.45 | 449.29 | 429.55 | 426.77 | 401.33 | 358.33 | ± 2.45 |
| Weight Gain/bird (g)              | 422.45 | 399.29 | 379.55 | 375.28 | 350.91 | 308.33 | ± 2.46 |
| Average daily weight gain/bird (g)| 7.54 | 7.13 | 6.78 | 6.70 | 6.27 | 5.51 | ± 0.46 |
| Average daily feed intake/bird (g)| 29.59 | 27.61 | 28.60 | 28.07 | 28.82 | 28.74 | ± 0.32 |
| Feed conversion ratio             | 3.96 | 3.87 | 4.22 | 4.19 | 4.60 | 5.22 | ± 0.19 |

Cost/kg feed (₦)                   | 84.94 | 79.74 | 79.34 | 78.02 | 78.15 | 78.02 | ± 0.63 |

Cost of feed consumed (₦)          | 140.74<sup>a</sup> | 123.29<sup>cd</sup> | 127.07<sup>e</sup> | 122.64<sup>ad</sup> | 126.13<sup>b</sup> | 124.41<sup>bc</sup> | ± 1.01 |

Cost/kg weight gain (₦)            | 333.15<sup>c</sup> | 308.77<sup>e</sup> | 334.79<sup>f</sup> | 323.12<sup>d</sup> | 359.44<sup>b</sup> | 403.49<sup>a</sup> | ± 2.26 |

Means with different superscripts on the same row are significantly different (P < 0.05)

SEM - Standard Error of Mean

HEBM – Horse eye bean meal
Table 3: Performance of growing pullet chicks fed graded levels of processed horse eye bean meal

| Percentage levels of HEBM replacement Parameters | 0      | 15     | 30     | 45     | 60     | 75     | SEM  |
|------------------------------------------------|--------|--------|--------|--------|--------|--------|------|
| Initial weight/bird (g)                        | 472.45 | 472.29 | 470.50 | 470.77 | 469.44 | 469.75 | ± 0.47 |
| Final weight/bird (g)                          | 1135.83 | 1142.85 | 1191.53 | 1206.28 | 1376.28 | 10240.00 | ± 3.14 |
| Total weight gain/bird(g)                      | 663.38 | 670.56 | 721.03 | 735.51 | 906.84 | 554.25 | ± 43.3 |
| Average daily weight gain/bird (g)             | 7.90 a b | 7.98 a b | 8.58 a  | 8.76 a  | 10.79 a | 6.60 c  | ± 3.60 |
| Average daily feed intake/bird (g)             | 47.02 a  | 40.54 b | 46.08 a | 43.05 b | 35.92 a | 47.40 b | ± 7.05 |
| Feed conversion ratio                          | 6.32    | 5.39    | 5.5     | 5.20    | 4.48    | 6.25    | ± 0.26 |
| Cost/kg of feed (₦)                           | 66.94   | 61.74   | 61.34   | 60.02   | 60.15   | 59.37   | ± 1.03 |
| Cost of feed consumed (₦)                      | 88.36 a | 69.77bc | 79.13b | 72.62b | 78.00b | 59.96c | ± 3.39 |
| Cost/kg weight gain (₦)                        | 133.17a | 103.98b | 109.75b | 98.67bc | 86.00c | 108.23b | ± 5.80 |

Means with different superscripts on the same horizontal line are significantly (P<0.05) different

SEM: Standard error of means
HEBM – Horse eye bean meal

The results show that increasing dietary level of processed HEBM did not significantly (P> 0.05) influence the final body weight and the average daily weight gains of the chicks during brooding, but increased the weight gain significantly (P < 0.05) at growing phase. The results revealed that values were slightly depressed with increased level of HEBM in the diet at brooding phase, while at growing phase, the situation was reversed as birds on higher levels of HEBM performed better, except at 75% level of inclusion. This development shows the ability of the test sample to promote the birds’ growth. The average daily weight gain recorded in this study was similar to the value 7.13g reported by Amaefule and Obioha (2005) for pullet chicks fed diets containing processed pigeon pea seed meal as replacement for soybean meal.

Dietary level of HEBM in the diet did not significantly (P>0.05) influence the average daily feed intake during brooding phase, but significantly influenced the intake of birds at growing phase. The result of this experiment was, however, lower than the values reported by Ani (2008) for pullet chicks fed processed velvet beans diet. Variation in the average daily feed intake during growing phase did not follow any pattern and therefore could not be attributable to any dietary effects.

Efficiency of feed utilization by the chicks was poorer with increasing dietary level of HEBM at brooding phase. This may be attributed to the inability of the birds to effectively utilize the diets, probably due to the presence of Non starch polysaccharides (NSP) in the diets (Nadeem et al., 2005; Balamurugan and Chandrascharan, 2010). The significant improvement in the FCR during growing phase could be due to the facts that birds at this stage may have developed adequate digestive enzymes to effectively handle the feeds. Generally, High FCR values observed at growing phase could be attributed to a shift of attention of the pullets from growth to the reproductive organs development.

Cost/Kg of feed slightly decreased with an increase in the dietary level of horse eye bean meal (HEBM). Values were statistically similar across the treatment groups. Birds fed control diet had significantly (P<0.05) higher cost of daily feed intake than birds on the experimental diets during brooding phase but were statistically similar during rearing phase. Birds fed 15% and 30% HEBM diets had the least cost of feed consumption at brooding phase while birds on 75% HEBM diet recorded the least cost of feed consumption during rearing. The differences were significant (P<0.05) among treatment groups.

The cost/Kg weight gain was significantly different among the treatment groups. Chicks on treatment diets had the lowest cost/kg weight gain relative to the control group. Birds on 60% HEBM diet had the least cost/kg weight gain, followed by those fed 45% HEBM diet. The significant reduction in the cost of feed/kg weight gain of birds fed experimental diets during rearing phase maybe attributed to their outstanding growth.

CONCLUSION

The result of the feeding trial revealed up to 30% of the soybean meal (SBM) could be replaced by the processed horse eye bean meal (HEBM) at brooding phase while 60% of the SBM could be replaced by HEBM during rearing phase without any deleterious effects on the birds.

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