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# EFFECTS OF CORN-WHEAT OFFAL'S REPLACEMENT OF CORN WITH SUPPLEMENTAL AMINO ACIDS CONCENTRATE ON LAYING PERFORMANCE AND EGG QUALITY CHARACTERISTICS

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**ABSTRACT:** *The objective of this experiment was to evaluate the effects of corn-wheat offal's replacement of corn with supplemental amino acids concentrate on laying performance and egg quality characteristics. Eight weeks feeding trial was conducted using three hundred and eighty-four hens which were about 75 weeks old at commencement of the experiment on battery cage system. The three hundred and eighty-four laying hens were randomly allocated to four dietary treatments, and each treatment had four replicates with twenty-four (24) hens each. Corn offal's and Wheat bran was used to replace maize with varying ratio. EXP A and EXP B had same ratio of corn offal's and wheat bran (i.e., 45% and 23% respectively) while EXP C was formulated 24.5% corn offal's and 47.85% wheat bran ratio for the replacement of corn. The experiment was completely randomized design, and data collated on laying performance and egg quality characteristics were analyzed using ANOVA on SPSS 20.0 version to determine the statistical differences. However, the results of this study showed significant ($p < 0.05$) increase in egg laying performance by 6.6% as against the control diet, improve feed conversion ratio by 5.5% especially the hens on 45% corn offal's and 22.85% wheat bran replacement of corn supplemental amino acids concentrate, while non-significant ($p<0.05$) difference in egg weight among control diet and experimental diets. Interestingly, there was non-significant effect ($p<0.05$) of corn offal's and wheat bran replacement of corn supplemented amino acids concentrate on the egg quality parameters, thus the least Haugh unit of 80% indicate the egg protein quality and degree of egg freshness at both farm and retail store of the experimental diets. Finally, the feed cost was reduced by 13.66% as against the control diet which represent about ₦15.61 per kg at raw materials cost. For feed manufacturers, the economic implication is that there will be increase in their gross margin and of course create more competitive advantage.*

**KEYWORDS:** corn-wheat offal, replacement of corn, supplemental amino acids, laying performance, egg quality characteristics

## INTRODUCTION

As human population continues to grow, there is need to ensure food safety for all, especially the more susceptible sector of human population. There is increasing need for land, for development of new neighbourhood, industries, recreational parks, and other facilities which has resulted to continuous increase of social vices in Nigeria. The consequence of this is a gaping need for food of both plant and animal origin, thereby increasing the cost of food and

feedstuffs, hence driving food out of reach of most people (Adeola and Olukosi, 2009). Cereal grains always make up more than 50% of the feed ingredients in poultry feed formulation. In Nigeria, the most popularly incorporated cereal content in feed is maize which supplies more than half of the metabolized energy requirement of poultry (Ravindra and Ravindra, 1988, Durunna et al.; 2000).

The high cost of maize due to competing demands by humans for direct consumption and for use in alcohol brewing contributes to the high cost of conventional feeds which contains maize as the main source of energy (Vantsawa, 2001; Agbede, 2002). The instability in the production of maize limits the expansion of poultry industry in Nigeria and in most developing countries of Africa (Fasuyi, 2005). There is competition for this limited food grain between man and the monogastric animals. Alternative cheaper energy sources must therefore be sort for if poultry industry must continue. Several studies have been conducted in this area. According to Creswell and Zainuddin (1980) industrial maize bran could replace maize on weight for weight basis in broiler diet without compensating for the lower energy content of the bran. Similarly, Fadugba (1989) showed that industrial maize offal is as good as maize in chicks, growers, and layers ration.

Many of these by-products are of industrial origin and their locations are usually far from the end users who in most cases cannot afford them due to added transportation cost (Vantsawa 2001). Because of the extensive consumption of maize by man, large quantities of maize offal are generated on daily basis in maize producing and consumption areas (Dafwang, 2006). This research was therefore conducted to evaluate the effect of the replacement of corn with combination of corn/wheat offal's supplemented with amino acids concentrate in the diets of laying chickens.

## MATERIALS AND METHODS

This research was carried out in the poultry unit of the National Veterinary Research Institute, Vom, Plateau State, Nigeria. Total of three hundred and eighty-four (384) birds were used for the study. Each treatment was made up of four replicates with twelve (24) birds per replicate. The birds were about 75 weeks of age at commencement and the trial ran for eight weeks. The birds were on battery cage system which made the experiment more standardized. Simple complete randomized design was adopted for the study to evaluate the efficacy of the understudied amino acids concentrate on corn-wheat offal's-based layer diets as complete replacement of corn. Corn/wheat offal's were obtained from Grand Cereals Limited and Flour Mills Nigeria respectively which was subjected to proximate analysis for the feed formulation. The birds were weighed at the beginning and end of the trial. Eggs were collected twice daily, morning and evening. All the eggs collected during the period of the experiment were weighed. Feed intake recorded were 119g/bird/day throughout the trial period for the experimental diets and 118g/bird/day for the control diet.

Data collected on hen-day production, average feed intake and feed conversion ratio were subjected to one-way analysis of variance (ANOVA), and where significant treatment effects

were detected, Duncan's Multiple Range Test as outlined by Steel and Torrie (1980) was used to compare the treatment means. Similarly, data on egg quality characteristics (Haugh unit, yolk index, albumen index, shell thickness, yolk colour) for the treatment groups were subjected to analysis of variance (ANOVA) and their means compared using Duncan's Multiple Range Test as outlined by Steel and Torrie (1980). On the experimental diets, the control treatment was formulated with corn and sorghum as the energy source at about 20% each respectively, and the three experimental diets were formulated with wheat bran and corn offal's as replacement for maize and sorghum 23.3% and 45% respectively.

Table 1: Percentage Composition of Experimental Diets

| **Feed Ingredients** | **Control Diet** | **EXP A** | **EXP B** | **EXP C** |
|---|---|---|---|---|
| Limestone | 8.35 | 10.05 | 10.05 | 10.05 |
| Bone meal | 1.5 | - | - | - |
| Wheat bran | 32.3 | 23.3 | 22.85 | 47.85 |
| Salt | 0.4 | 0.4 | 0.4 | 0.4 |
| White Sorghum | 20 | - | - | - |
| White maize | 20 | - | - | - |
| Soya crude Oil | 0.8 | 1.5 | 1.5 | 1.5 |
| Toxin Blender | 0.22 | 0.22 | 0.22 | 0.22 |
| Lysine | 0.2 | - | - | - |
| Methionine 84% | 0.4 | - | - | - |
| Enzyme | 0.03 | 0.03 | 0.03 | 0.03 |
| Soya Cake | 15.5 | 16.3 | 16.3 | 11.8 |
| layer premix | 0.3 | - | - | - |
| AA's Concentrate | - | 0.7 | 0.7 | 0.7 |
| Palm Kernel Cake | - | 2.5 | 2.5 | 2.5 |
| Maize offal's | - | 45 | 45 | 24.5 |
| Monocalcium Phosphate | - | - | 0.45 | 0.45 |
| **Total** | **100** | **100** | **100** | **100** |
| | | | | |
| **Nutrients Composition** | | | | |
| Crude Protein (%) | 16.5 | 18.27 | 18.74 | 17.97 |
| Fat (%) | 5 | 6.4 | 7.21 | 6.42 |
| Moisture (%) | 10 | 7.01 | 7.02 | 7.07 |
| Calcium (%) | 3.5 | 3.52 | 3.78 | 3.51 |
| Ash (%) | 15 | 15.25 | 13.65 | 13.43 |
| Crude Fiber (%) | 10 | 8.85 | 8.56 | 8.25 |
| Metabolizable Energy (Kcal/kg) | 2700 | 2763 | 2873 | 2846 |
| Av. Phosphorus | 0.92 | 0.82 | 0.90 | 0.96 |
| Lysine | 0.90 | 0.88 | 0.88 | 0.82 |
| Methionine | 0.60 | 0.52 | 0.52 | 0.50 |
| Meth+cystine | 0.91 | 0.72 | 0.72 | 0.70 |

The amino acids concentrate (AA's Concentrate) were direct replacement of the synthesized methionine, lysine, and layer premix in the experimental diets. Here, the whole essence was to x-ray the true strength of the AA's concentrate in supplementing and supporting the non-maize diet. Another interesting aspect of the above designed trial was the inter-changed of maize offal's with wheat bran in Exp C to evaluate the relative impact on the egg laying performance.

## RESULTS AND DISCUSSION

**Table 2: Effects of Corn offal's & wheat bran replacement of corn supplemented AA's Concentrate on Egg Quality**

| Parameters | Control Diet | EXP A | EXP B | EXP C | SEM |
|---|---|---|---|---|---|
| Egg weight(g) | 67.53$^{ab}$ | 71.51$^{a}$ | 65.81$^{ab}$ | 69.52$^{ab}$ | 0.76 |
| Egg length(mm) | 58.60$^{ab}$ | 59.90$^{a}$ | 58.40$^{ab}$ | 58.50$^{ab}$ | 0.32 |
| Egg width (mm) | 44.70$^{a}$ | 46.00$^{a}$ | 44.40$^{a}$ | 45.20$^{a}$ | 0.31 |
| Shape index (%) | 76.40$^{ab}$ | 76.83$^{ab}$ | 76.12$^{ab}$ | 77.31$^{ab}$ | 0.47 |
| Yolk weight (g) | 16.73$^{abcd}$ | 16.67$^{abcd}$ | 16.30$^{cd}$ | 17.56$^{abcd}$ | 0.22 |
| Yolk height (mm) | 14.40$^{ab}$ | 14.00$^{abc}$ | 13.30$^{c}$ | 14.80$^{a}$ | 0.04* |
| Yolk diameter(mm) | 39.10$^{c}$ | 38.40$^{cd}$ | 38.70$^{cd}$ | 38.30$^{cd}$ | 0.23 |
| Yolk ratio | 24.89 | 23.51 | 24.95 | 25.35 | 0.37 |
| Yolk index % | 36.86$^{ab}$ | 36.50$^{abc}$ | 34.38$^{c}$ | 38.68$^{a}$ | 0.04* |
| Yolk: Alb | 0.41 | 0.40 | 0.40 | 0.42 | 0.01 |
| Yolk colour | 6.20$^{a}$ | 3.00$^{b}$ | 3.00$^{b}$ | 3.00$^{b}$ | 0.03* |
| yolk pH | 6.28$^{a}$ | 6.20$^{ab}$ | 6.14$^{ab}$ | 6.13$^{ab}$ | 0.20 |
| Yolk % | 24.89 | 23.51 | 24.95 | 25.35 | 0.37 |
| Albumen weight (g) | 41.02$^{ab}$ | 44.01$^{ab}$ | 41.57$^{ab}$ | 42.45$^{ab}$ | 0.70 |
| Albumen height (mm) | 7.8 | 7.2 | 7.3 | 7.7 | 0.15 |
| Albumen length(mm) | 84.10$^{abc}$ | 88.10$^{ab}$ | 87.50$^{ab}$ | 83.80$^{abc}$ | 0.91 |
| Albumen ratio | 0.61$^{ab}$ | 0.61$^{ab}$ | 0.63$^{a}$ | 0.61$^{ab}$ | 0.10 |
| Albumen index % | 9.47$^{ab}$ | 8.32$^{b}$ | 8.37$^{b}$ | 9.27$^{ab}$ | 0.22 |
| Haugh unit (%) | 85.37$^{ab}$ | 80.61$^{b}$ | 83.59$^{b}$ | 84.83$^{ab}$ | 0.9 |
| Albumen % | 60.62$^{ab}$ | 61.23$^{ab}$ | 63.33$^{a}$ | 61.01$^{ab}$ | 0.65 |
| Albumen pH | 8.24$^{abc}$ | 8.50$^{a}$ | 8.31$^{ab}$ | 8.17$^{bc}$ | 0.04* |

The Haugh unit is a measure of egg protein quality based on the height of thick albumen. The higher value of Haugh unit corresponds to the degree of egg freshness, if other characteristics are good. Haugh unit varies with storage - <80% at farm, 77% for wholesale, 60% for retail. For an egg of poor quality Haugh unit ranges from 36 – 60%. Haugh unit below 80% at farm gate simply suggest that the egg is prone to spoil within a very shortest period. The corn-wheat offal's replacement of maize showed non-significant effect on the egg protein quality and degree of egg freshness at both farm and retail store. The significant difference ($p < 0.05$) seen

in yolk colour could be attributed to the fact that the amino acids concentrate was not fortified with colourant. This could be seen as a concentrate for both broiler and layer diets as the reason for not adding colourant. To improve the yolk colour from number 3 to 10 on the yolk fan, 30 grams of pigment is required per metric ton of feed. Finally, EXP A had higher Albumen PH and significantly different ($p<0.0$) from EXP C and like the control diet and EXP B. whereas, the hens on EXP C increased the yolk height and yolk index and were significantly different ($p<0.05$) from the hens on EXP B but like control diet and EXP A. This could be seen as regards to the ratio of wheat bran and corn offal's between EXP C and EXP B.

Table 3: Effects of Corn offal's & wheat bran Replacement of Corn Supplemented AA's Concentrate on Laying Performance.

| Parameters | Control | EXP A | EXP B | EXP C | SEM |
|---|---|---|---|---|---|
| Bodyweight (g) | 1915.43 | 1881.63 | 1885.53 | 1905.67 | 19.13 |
| Egg weight (g) | $66.67^{ab}$ | $69.10^{a}$ | $69.43^{a}$ | $65.83^{b}$ | 0.05* |
| Hen-Day Production (%) | $72.09^{b}$ | $72.37^{b}$ | $76.85^{a}$ | $73.64^{b}$ | 0.05* |
| Feed Intake (g) | 118 | 119 | 119 | 119 | 0.49 |
| Feed Conversion Ratio | $1.63^{b}$ | $1.64^{b}$ | $1.54^{a}$ | $1.61^{b}$ | 0.04* |
| Feed Cost/kg (₦) | 114.27 | 96.88 | 98.66 | 99.04 | |

The replacing of corn with wheat bran and corn offal's supplemented with amino acids concentrate increased the egg laying performance ($p <0.05$). This explicitly shows that EXP B which has 4.5kg of MCP as the only differential factor from EXP A and contain about 20.5% of corn offal's more than EXP C were significantly different from the control diet and the two other experimental diets. Perhaps, the addition of MCP increased the availability phosphorus of EXP B to 0.90 as against the 0.82 of the EXP A with the MCP. Again, there was no significant effect of replacing maize with corn offal's and wheat bran supplemented with amino acids concentrate on bodyweight and feed intake, rather the corn offal's and wheat bran-based layer diets supplemented amino acids concentrate shows significant improvement on feed conversion ratio and relative impact on the egg weight.

In other words, 0.7% amino acids concentrate has proven its strong efficacy as catalyst in ensuring true digestion and unlocking of the fiber materials to access the hidden nutrients and absorption. This is evident on the egg laying performance, egg weight and feed conversion ratio of the corn offal's and wheat bran-based layer diets. In the light of the current economic realities around the inputs sector, this present study will provide the feed manufacturing industry a panacea for sustainability and survival options to manage the conventional feed stuffs like corn and soya bean. Finally, the feed cost was reduced by 13.66% as against the control diet with represent about ₦15.61 per kg at raw materials cost. For feed manufacturers, the economic implication is that there will be increase in their gross margin and of course create more competitive advantage.

## CONCLUSION AND APPLICATION

Although corn offal and wheat bran are essentially fibre materials, they are endowed with some amount of metabolizable energy. This energy has made some contribution to the total energy pool in the diets. Replacing maize with about 45% corn offal and 23% have no adverse effect on growth, feed intake and efficiency of feed utilization, but leads to a considerable reduction in feed cost. Thus, the results from this study showed significant ($p < 0.05$) increase in egg laying performance, feed conversion ratio and egg weight especially the hens on 45% corn offal's and 22.85% wheat bran replacement of corn supplemental amino acids concentrate. However, in case for full commercialization for feed manufacturers, clean and highly classified corn offal's must be sourced and crude soya oil to meet same performance recorded. The obtained result could imply that the amino acids concentrate have strong efficacy and potency to impact positively on the nutrient utilization and digestible energy from the fibrous materials used in the experiment.

On the egg quality characteristics, the result of this study showed that 45% corn offal's and 22.85% wheat bran replacement of corn supplemental amino acids concentrate will be good for poultry farmers as there was non-significant ($p < 0.05$) effects on egg quality characteristics. For Poultry farmers and feed manufacturers whose target are usually on increasing hen-day production of laying hens, least cost of feed, egg weight, Haugh unit, shell thickness and other qualities improvement for reduction on egg spoilage, breakages, and maximization of profit on egg scale. Therefore, this innovation come with great relieve from the scarcity of the most conventional due to the recent social vices such as banditry, farmers, and herders' clashes which has significantly affected the input sector.

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