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Influence of Varying Crude Protein Levels and Balanced Amino Acids on the Performance and Haematological Characteristics of Laying Hens at the Second Phase of Production

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ABSTRACT

Varying levels of dietary crude proteins and balanced amino acids were fed to layers for a period of eight weeks starting from the twenty-sixth week of age of birds and six weeks into egg production. Effects on performance and haematological characteristics were investigated at this second phase of production. Sixty Black Nera hens were randomly allotted into four (4) dietary treatments, containing the following levels of crude protein 14%, 15%, 16%, 17% and the metabolizable energy was iso-caloric for each treatment. The results showed that there were no significant differences ($P > 0.05$) observed for lymphocyte, Haemoglobin (Hb), Packed Cell Volume (PCV), Red Blood Cell (RBC) and White Blood Cell (WBC), these haematological parameters were within the range for healthy birds. Thus crude protein level of 14% can be used in diets of layers at the second phase of production provided that adequate amino acids are given, without adverse effect on egg laying, feed intake and measured blood parameters.

Keywords: Varying Crude Protein; Balanced Amino Acids; Laying Hen; Second Phase

1. Introduction

Poultry production is aimed at the massive production of meat and eggs for the teeming world population. The livestock industry in Nigeria had been appraised for its substantial contribution to the national wealth and for supplying the populace with important animal protein required for health and body maintenance [1]. However, the biggest constraint to poultry production in Nigeria is nutrition, especially the non-availability of feed ingredients all year round at economic prices.

Egg production in a poultry flock follows a pattern, this pattern is similar for most breeds of chickens, the specific numbers can vary significantly, especially with regards to age at first egg, peak production rate and egg weight. Egg production typically begins when the pullets reach 18 to 22 weeks of age, depending on the breed and season. Egg production, as a percent of hens housed, rises sharply till it reaches its peak about 6 - 8 weeks later. Peak production levels of 90% or higher are common with some of the egg-laying breeds (such as Leghorns), after which production gradually declines until it descends to a level where the hens are consuming more money in feed than is produced in eggs. At this point the flock is either terminated or put through a molt to start a second laying cycle [2].

With feed costs often representing about 70 percent of the production cost of a dozen eggs, feed costs per dozen eggs must always be the least-cost against expected egg revenue in order to maximize profits. Any savings in feed consumption will usually translate into increased profit margins. Several management factors can be implemented which will result in feed savings and added profits [3]. The objective of this study was to determine the effect of varying levels of dietary protein with balanced amino acid on laying performance and blood profile (which gives the picture of stress or otherwise due to production and balance of nutrition).

2. Materials and Methods

2.1. Experimental Birds and Management

A total of sixty Black Nera layers in their second phase of production were used in this experiment. They were randomly allotted to four treatments with five replicates in a completely randomized design. All the birds were individually weighed at the onset of the study and consequently every 4 weeks till the conclusion of the ex-

periment. Growth and productive performance criteria were evaluated as final weight (FW), weight gain (WG), feed intake (FI), feed conversion ratio (FCR) and Hen-day production were determined.

2.2. Experimental Diets

The experimental diets presented in **Table 1** were formulated to meet the nutrient requirements of the laying birds as stated by [4] while supplementing with additional methionine and lysine to ensure adequacy of these essential amino acids in a maize-soybean basal diet.

2.3. Blood Collection and Haematological Analysis

Blood was collected from three birds per replicate at the end of the study period. 5 mls of blood was collected from the birds with the aid of sterile syringes via the jugular vein. The blood samples were in two (2) sets per replicate that is test tube devoid of anti-coagulant (EDTA) and sera were subsequently extracted from this through centrifugation for serum analysis. The second sets which contained 1 ml of blood were collected into test tubes which already contained ethylene diamine tetra-acetic acid (EDTA). The blood sample was kept in fresh state (refrigerator) by this anti-coagulant to make possible hematological studies. The samples were analysed for Packed Cell Volume (PCV), Haemoglobin (Hb), White Blood Cell (WBC), and Red Blood Cell (RBC) counts.

The ethical standard for handling of live animals was followed as set by Nigerian Institute of Animal Science (NIAS).

3. Statistical Analysis

The data obtained were subjected to the statistical analysis using one way analysis of variance. The data were subjected to Duncan's multiple range test as described by [5].

4. Results

4.1. Performance

There were no significant differences ($P > 0.05$) observed for final weight, weight gain, feed intake and egg production. It was however observed that Diets 2 (−0.024 kg) and 4 (−0.073 kg) had negative weight change as presented in **Table 2**. Feed intake and total egg production were observed to have numerically higher values with birds on Diet 4.

Table 1. Percentage composition of the experimental diets fed to layers on graded levels of crude protein.

	T1	T2	T3	T4
Parameters (g)	**14% CP**	**15% CP**	**16% CP**	**17% CP**
Maize	53.00	52.00	51.00	50.00
Wheat offal	16.00	13.10	7.00	8.50
Soyabean meal	11.00	14.00	18.00	18.50
Palm kernel cake	9.5.	10.00	12.90	11.90
Oyster shell	7.70	8.00	8.20	8.50
Bone meal	2.00	2.00	2.00	2.00
Methionine	0.10	0.10	0.10	0.10
Lysine	0.20	0.20	0.20	0.20
Salt	0.25	0.25	0.25	0.25
*Premix	0.25	0.25	0.25	0.25
Calculated analysis				
M.E. (Kcal/Kg)	2527.04	2530.85	2539.57	2549.87
Protein (% CP)	14.00	15.06	16.10	17.00
Lysine	0.75	0.74	0.74	0.79
Methionine	0.34	0.35	0.37	0.33

*Premix supplied per kg of diet: Vit A, 10,000 IU; Vit D, 2800 IU; Vit E, 35,000 IU; Vit K, 1900 mg; Vit B12 19 mg; Riboflavin, 7000 mg; Pyridoxine, 3800 mg; Thiamine, 2200 mg; DPantothenic acid, 11,000 mg; Nicotinic acid, 45,000 mg; Folic acid, 1400 mg; Biotin, 113 mg; Cu, 8000 mg; Mn, 64,000 mg; Zn, 40,000 mg Fe, 32,000 mg; Se, 160 mg; Iodine, 800 mg; Cobalt, 400 mg; Choline, 475,000 mg; Methionine, 50,000 mg; BHT, 5000 mg; Spiramycin, 5000 mg.

4.2. Haematological Analysis

Results presented in **Table 3** showed no significant differences ($P > 0.05$) observed for all haematological parameters observed. Results however showed that the PCV of treatment 1 (27.00) had the highest mean while treatment 3 and 4 had the lowest means (25.33), for RBC treatment 2 had the highest mean of (1.73) and treatment 1 had the lowest mean of (1.553), for WBC treatment 1 had the highest mean of (26.20) while treatment 3 had the lowest mean of (20.10), for the lymphocytes treatment 2 had the highest value (62.00), while treatment 1 had the least value (55.00), for Heterophils treatment 1 had the highest value (38.33) while treatment 3 had the least value (26.33). Eosinophil levels were highest in treatment 2 and 4, (3.00) and the lowest value came from treatment 3 (1.00), while haemoglobin values were highest for treatment 1 (8.97) and lowest for treatment 3 (8.43) and finally Monocytes values were highest on treatment 1 (4.00) and lowest for treatment 2 (2.00).

5. Discussion

The research carried out by the department of Animal and Poultry Sciences at Virginia Tech, USA published in Zootecnica [6], indicated that lowering crude protein by 2 to 3 percentage points below recommended levels will result in production loss and hen weight loss. This is only true when the essential amino acids are not supplemented. Our findings showed that with supplementation lowering crude protein by 2 to 3 percent did not significantly affect production, though slight weight loss and drop in production were recorded which is not unlikely with layers at the second phase of production, where egg production peaks. The effect of protein on body weight changes obtained was in agreement with the work of [7-9]. [7] who reported that diets with reduced protein levels below the recommended levels and supplemented with essential

Table 2. Performance characteristics of layers fed varying levels of dietary crude protein.

	T1	T2	T3	T4
Parameters (g)	**14% CP**	**15% CP**	**16% CP**	**17% CP**
Initial bird weight	1471	1530	1516	1620
Final bird weight	1498	1506	1580	1547
Weight change	27.00	−24.00	64.00	−73.00
Feed intake	3309.90	3518.80	3542.20	3542.50
Hen-day production (%)	69.40	73.80	71.80	76.10

Mean in the same row with different superscripts are significantly different ($P < 0.05$).

Table 3. Haematological parameters of layers fed varying levels of dietary crude protein.

	T1	T2	T3	T4
Parameters	**14% CP**	**15% CP**	**16% CP**	**17% CP**
PCV (%)	27.00	26.00	25.33	25.33
RBC (10^6/mm^3)	1.53	1.73	1.57	1.59
WBC (10^3/mm^3)	26.20	20.05	20.10	22.00
LYMPH (%)	55.00	62.00	56.33	59.33
HETERO (%)	38.33	33.00	26.33	34.00
EOSI (%)	2.67	3.00	1.00	3.00
Hb (g dL^{-1})	8.97	8.63	8.43	8.40
MONO (%)	4.00	2.00	3.00	3.67

Means in the same row with different superscripts are significantly different ($P < 0.05$).
PCV—Packed Cell Volume
RBC—Red Blood Cell
WBC—White Blood Cell
LYMPH—Lymphocyte
HETERO—Heterophils
EOSI—Eosinophils
Hb—Haemoglobin
MONO—Monophils

amino acid mainly methionine and lysine, usually support adequate weight gain. [10] however, reported decrease in growth performance of hen fed low protein diets. The results obtained were similar to the value of 17% CP suggested by [4]. The values for haematology obtained fell between the range of values of normal birds [11]. This shows that the birds were healthy and were not anaemic signifying that haemolysis did not occur in any of the birds in the four treatments. This shows that reduction of the crude protein with balanced amino acids did not impair dietary iron availability such as could cause anaemia. RBC varies depending on whether the bird is a juvenile or adult and the kind of bird being examined, and the results shown in all the treatments fall in the range of values for normal birds [11]. Monocytes which closely resemble the neutrophils in that they are actively motile and phagocytic in action, leaving the blood stream to ingest micro organisms and other foreign materials which may have been introduced into the tissues, had values slightly above the range for normal birds [11]. The high values obtained for monocytes suggest better resistance of the birds in disease conditions. The results of lymphocytes were highest in the birds fed 15% and 17% crude protein respectively, however they fell in the range values for normal birds [11]. Lymphocytes and heterophils are the most numerous WBC's seen in birds. The normal proportion of lymphocytes is 20% - 50% but it varies between species, the values obtained in the experiment suggested that the birds had strong immune system. The heterophil is the most common granulocyte found in birds. The normal percentage of heterophils is between 40% - 75%. Its changes in number and characteristic can occur with consideration to the bird's state of health since even subtle problems such as stress, low grade infection, and mild inflammation can occur. The values of heterophils obtained in the result fell in the range values of normal birds [11], this shows the birds had sufficient defense against infectious agents. The values of eosinophil obtained in the results of the trials showed higher value of eosinophil and fell in the range of values of normal birds [11] suggesting that the birds were free from parasitic infection. [1] stated that the purpose of investigating blood composition is to have a way of distinguishing normal states from a state of stress in an animal. Such stress factors can be inadequate nutrition, poor management, environmental or physical stress. Diets have been reported to have significant influence on haematological variables [12]. High lymphocyte values would be recorded in viral and bacterial infection such as coccidiosis, while high neutrophil values would be recorded in parasitic infection for instance in lice infestation, and high monocytes values in instances of injury to body tissues [13].

6. Conclusion

This study revealed that increasing crude protein in layer diets resulted in increased feed intake and egg production. The reduced production observed on lowered crude protein values which occurred despite amino acid supplementation, suggests that limiting amino acids may not have been added back in sufficient quantities and that maintaining the minimum level of crude protein was beneficial. However, diets which had CP just below the minimum recommendation (a reduction of approximately one percentage point) were able to maintain hen day performance.

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