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Study on High Dense Feed in Commercial Layers to Alleviate Physiological Stress During Transitional Phase

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Abstract

A study was carried out to review Bureau of Indian Standards recommendations (BIS) for layer pullet feed and study its efficacy of pre-lay feeds on haematology and serum protein. Commercial layer chicks were fed from 0 to 14 weeks of age as per BIS. At 15 weeks, pullets were randomly assigned to each of five pre-lay diets namely, T1 (BIS control), T2–16/2700, T3–18/2700 (%CP / kcal ME/kg); T4–Same as T2+lysine and methionine by 10% higher than BIS and T5 – same as T4 with 2 per cent oil. Significantly higher values of Packed Cell Volume, Haemoglobin, Red Blood Cell count and Heterophil/Lymphocyte ratio obtained in the present study from pullets fed with high dense pre-lay diet indicated that pullets were healthy with a normal metabolic rate. Significantly higher H/L ratio of the control group indicated that birds seemed to be under stress due to nutritional deficiency during the critical pre-lay periods, also haemoglobin level was lower in this group although it was within normal metabolic range. Total serum protein was high in pullets fed with higher pre-lay protein level of 18 per cent. Hence, it is concluded that pullets nearing lay are under metabolic stress and pre-lay diet containing 2700 kcal/kg of dietary energy and 18 per cent CP is advisable for pullets before sexual maturity as against the BIS recommendation of 2500/16 dietary energy and protein level to lower the stress and to make pullets entering into layer house with sufficient nutrient reserves.

Key Words: Transitional phase, physiological stress, high dense feed, commercial pullets, haematology, serum biochemistry

Introduction

There has been considerable interest in recent years in the use of pre-lay diets, which are often used as a way of introducing a transition phase in terms of calcium metabolism and to manipulate body size (Leeson & Summers, 1997). Pre-layer diet has been based on the assumption that the bird's nutrient requirements changes during this critical period of its life when the pullet increases body weight (200-300 g) quite dramatically, which is at about 2-3 weeks before sexual maturity. There are major changes that occur in the bird's metabolism, which relate to ovary and oviduct development, thus making this time the basis for a specialised diet. Haematology and biochemistry assay of livestock suggests the physiological disposition of the animals to their nutrition. Haematological constituents reflect the physiological responsiveness of the animal to its internal and external environments which include feeds and feeding. Hence, concept of pre-lay feed was introduced in the existing traditional feeding system of Bureau of Indian Standard for layers and an experiment was designed and conducted to study the effect of pre-lay feed in the BIS recommendations for layer during transition period (15 weeks to sexual maturity) on haematology and serum protein was studied.

Materials and Methods

An experiment was conducted at the University Research Farm, Madhavaram Chennai-51. 165 day old commercial layer chicks (Bovans') belonging to a single hatch were purchased and they were placed in deep litter in a brooder cum grower house up to 13 weeks of age. On the 14th week, 150 pullets were shifted to cages and randomly divided into five groups of 30 birds per treatment, each with five replicates of six birds per replicate. All 165 birds were provided with a starter diet containing metabolizable energy level of 2600 kcal/kg and protein of 20 per cent from 0 to 8 weeks of age and a grower diet having metabolizable energy level of 2500 kcal/kg and protein of 16 per cent from 9 to 14 weeks of

age as per BIS recommendations. At the age of 15th week, pre-lay pullets were randomly allotted to five dietary treatments, viz., T1 (BIS control): Diet formulated with crude protein of 16 per cent and metabolizable energy of 2500 kcal/kg; T2 (High energy diet): Dietary treatment with crude protein of 16 per cent and metabolizable energy of 2700 kcal/kg; T3 (High energy + high protein diet): Dietary treatment with crude protein of 18 per cent and metabolizable energy of 2700 kcal/kg; T4 (High energy with 10% extra methionine and lysine): Dietary treatment with crude protein of 16 per cent supplemented with synthetic lysine and DL-methionine by 10 per cent higher than BIS recommendations and metabolizable energy of 2700 kcal/kg; T5 (High energy , 10% extra methionine and lysine with 2% oil): Dietary treatment with crude protein of 16 per cent supplemented with synthetic lysine and DL-methionine by 10 per cent higher than BIS recommendations and metabolizable energy of 2700 kcal/kg with two per cent addition of rice bran oil to meet this energy level. Experimental feed ingredient and nutrient composition is presented in Table 1.

Table 1. ingredient and chemical composition (%) of experimental rations

Ingredient composition	Pre-layer Feed (15 weeks - 5% Egg production)				
	T1 (BIS control)	T2	T3	T4	T5
Yellow Maize	24.00	38.97	38.50	37.00	28.00
Broken rice	13.00	10.00	10.75	10.00	12.00
Cumbu/Bajra	22.00	17.00	12.75	20.00	20.25
Deoiled rice bran	12.50	10.00	10.75	8.87	13.00
Wheat bran	8.00	2.00	1.00	2.00	3.50
Sunflower oil cake	4.80	4.00	1.00	4.00	2.50
Soybean oil cake	9.50	11.00	18.25	11.00	11.50
Dry fish	4.00	5.00	5.00	5.00	5.00
Rice bran oil	-	-	-	-	2.00
Mineral mixture*	1.55	1.55	1.55	1.55	1.55
Dicalcium phosphate	0.52	0.48	0.45	0.45	0.44
Lysine	-	-	-	0.05	0.02
DL-Methionine	0.05	0.05	-	0.08	0.09
Salt	0.08	-	-	-	-
Total	100	100	100	100	100
Chemical composition					
CP	15.94	16.06	18.33	15.93	16.23
ME (kcal / kg)*	2543	2715	2705	2716	2729
Calcium	1.23	1.05	1.33	1.11	1.08
Total phophorus (%)*	0.60	0.59	0.57	0.60	0.59
Lysine*	0.71	0.73	0.87	0.77	0.77

Methionine*	0.35	0.35	0.37	0.39	0.39
Crude fibre	7.41	6.15	5.93	5.99	6.55
Salt*	0.48	0.48	0.47	0.48	0.48

Composition of feed supplements: 100 g Ultra Vite-M contains Vit A-3,20,000 IU,Vit B2-0.1g, Vit D3- 69,000 IU, Vit B12- 0.6mg, Vit E -30 IU, Vit K-0.04g, Niacinamide-0.4g, Calcium pantothenate-0.1 g,Choline chloride-12 g, Calcium-30.4 g, Copper-0.08g, Iodine-0.08g Iron-0.8g, Manganese-2.2 g, Zinc-2.08 g and Cobalt-4 mg; **100 g Ultra Sil-TCF** contains Sodium Alumino Silicate-95.25 %, predigested protein -20 ppm, Cobalt and Organic acid-2 ppm; **100 g Ultra Phos –D3** contains Calcium-21.6 g, Phosphorus-15.6 g, Vit D3- 12,000 IU, Vit B12-80 Mcg, Manganese-1080 mg and Zinc-1040 mg; **100 g Ultra- B12-FS** contains Vit B12-10 mg, Elemental Cobalt -10 mg, Elemental Calcium -22.5 % and Protein Hydrolysate- 5 ppm

***Mineral mixture(TANUVAS) Composition** : Calcium- 23%, Phosphours-12%, Magnesium-6.5 %,Iron -0.5 %, Iodine -0.026 % ,Copper- 0.077 %, Manganese- 0.12 % , Cobalt -0.012 % ,Zinc -0.38 % , Sulphur-0.5%,Fluorine-0.07 (max) and Selenium- 0.3 ppm:

*Calculated values

Blood samples were collected randomly from eight birds from each group at five percent egg production. About 0.5 ml of blood was later used to estimate haemoglobin (Hb) concentration as per the method of Sahli's Acid hematin (Sahli, 1909), packed cell volume (PCV) using Wintrobe's microhaematocrit method (Mcinroy,1953), total erythrocytes count (TLC) and total leucocytes count (TLC) by using Nambiar's diluting fluid(Bancroft and Marilyn Gamble, 2008), differential count (DC) by using modified Leishman-Giemsa stain as per the method described by Bancroft and Marilyn Gamble (2008). Serum samples collected from experimental birds were subjected to estimation of total protein in A 15 Biosystem auto analyser by using commercial available AGAPPE kit based on Direct Biuret method (Gornall, *et al.*, 1949). The experimental data was analysed statistically (Snedecor and Cochran, 1994) by using the SPSS 10.0 program package (SPSS, 2001). The significance of the difference among the treatment groups was determined by Duncan's multiple range tests (Petrie and Watson, 1991).

Results and Discussion

Influence of pre-lay dietary treatments on total serum protein and haematological parameters such as, haemoglobin, packed cell volume, red blood cell count, white blood cell count and differential count in pullets is presented in Table 2. The haematological parameters of pullets fed with high energy pre-lay diets varied significantly. The highest Hb, PCV RBC and per cent lymphocytes values of 11.83±0.21, 38.3±0.71, 3.33±0.27 and 70.33±0.33 respectively were recorded in 2700 kcal energy with 18 per cent protein pre-lay treatment group. The control (BIS) feed of 2500 kcal energy with 16 per cent protein recorded significantly ($P<0.05$) lowest respective values. However, the Hb, PCV and RBC values of BIS control group were comparable with 2700/16 and 2700/16+lysine and methionine groups. White blood cells count did not differ significantly between pre-lay dietary treatments; whereas H/L ratio was significantly ($P<0.05$) highest for control (BIS) group and it was significantly ($P<0.05$) lowest in 2700/18 group but was comparable with groups fed with two per cent oil and 2700/16 group. All other pre-lay treatment group had significantly ($P<0.05$) lower H/L ratio when compared to the control (BIS) group. Blood represents an important index of nutritional status of the organism (Awotwi, 1990 and Oladapo *et al.,* 2007). Any nutritional inadequacy causes metabolic stress to an animal which is reflected in blood composition. Pullets fed with a high dense pre-lay diet of 2700 kcal energy and 18 per cent had significantly ($P<0.05$) higher haemoglobin, packed cell volume, Red blood cell count and lower heterophil / lymphocyte ratio. Higher protein and energy might have influenced improved haematological parameters. On the other hand, pullets fed with BIS feed during pre-lay period had the lowest respective values and higher heterophil / lymphocyte ratio. However, all the values of haemoglobin, PCV and RBC counts obtained in the present study were within the normal range of established values (Mitruka and Ransley, 1977; Nworgu *et al.,* 2007, Ridddell, 2011) for healthy chicken. White blood cell count did not significantly

vary among treatments. A high nutrient dense diet had not influenced the bird's ability to fight disease invasion and phagocytosis. These results agreed with findings of Oke *et al.* (2003), Oladapo *et al.* (2007) and Afolabi *et al.* (2011). The H/L ratio was comparable among 2700 kcal energy groups with 18 and 16 per cent protein and oil in feed. H/L ratio of blood is an indicator of stress in birds. Pullets nearing lay are under metabolic stress and a good nutrition tends to lower the stress, but pullets on a lower nutritional plane were under stress and this caused an elevated H/L ratio.

Table 2. Effect of various pre-lay energy and protein diets on total serum protein (g/dl), Haemoglobin (Hb) (g/dl), Packed cell volume (PCV) (per cent), Total erythrocyte count (TEC) (×10^6/mm^3), total leucocyte count (TLC) (× 10^3/mm^3) and Differential count (DC) (per cent) of pullets at 5 per cent egg production

Pre-lay treatments	T1*	T2*	T3*	T4*	T5*
Parameters	----------Standard layer feed----------				
Total serum protein*	5.02^b±0.44	5.99^b± 0.62	7.15^a±0.30	5.66^b±0.41	5.16^b± 0.10
Hb*	9.17^c±0.42	10.42^{bc}±0.37	11.83^a±0.21	10.17^{bc}±0.47	11.17^{ab}± 0.47
PCV*	28.3^c±1.17	31.7^{bc}± 0.66	38.3^a± 0.71	31.5^{bc}± 1.47	34.8^b± 1.95
RBC*	2.03^c±0.10	2.70^{bc}± 0.11	3.33^a± 0.27	2.50^{bc}± 0.26	2.98^{ab}± 0.25
WBC^{NS}	25.75±0.57	23.66 ± 0.98	19.16± 0.66	23.91 ± 0.72	22.83 ± 0.38
Heterophil *	38.83^c±0.60	29.83^b± 0.47	28.00^a±0.36	29.66^b± 0.66	28.33^a± 0.33
Lymphocyte*	58.00^c±1.26	68.33^b± 0.61	70.33^a±0.33	67.83^b± 0.60	70.16^a±0.40
Eosinophil^{NS}	1.83 ± 0.60	1.50 ± 0.42	0.83 ± 0.30	1.16 ± 0.40	0.83 ± 0.30
Monocytes^{NS}	1.33 ± 0.33	1.00 ± 0.25	1.00 ± 0.25	1.00 ± 0.44	0.50 ± 0.22
H/L Ratio*	0.67^c± 0.20	0.43^{ab}± 0.37	0.39^a± 0.24	0.44^b± 0.26	0.40^a± 0.34

* Significant (P<0.05), NS-Not Significant, Mean values sharing any one common superscript in a row or column do not differ significantly.

Total serum protein was significantly (P<0.05) higher at sexual maturity in high dense pre-lay diet of 2700 kcal energy and 18 per cent protein. Significantly (P<0.05) lower total serum protein was observed in pullets fed BIS feed. No literature could be traced on total serum protein in chicken as influenced by pre-lay energy and protein levels. The present study agreed with findings of Oke *et al.* (2003) who observed higher plasma protein levels in guinea fowl as influenced by dietary protein and energy levels during pre-lay period (20-28 weeks). This may be correlated to dietary effect.

Based on the blood profile study, it is suggested for an effective pre-lay diet in the existing traditional method of feeding layer pullets (Bureau of Indian Standards). Under a humid tropical climate, both the dietary energy and crude protein levels need to be increased at-least three to four weeks before sexual maturity (transition period) so as to make her body fit to enter into productive laying life.

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