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Effects of Varying Nutrient Densities on the Production Performance of Aseel Layers

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ABSTRACT

The present study was carried out to find the effect of feeding different diets with varying nutrient densities on the production performance of the Aseel, a native chicken breed of India during 25 to 40 weeks of age. At 24 weeks of age, 90 birds were randomly distributed into three groups (30 birds with six replicates of five birds in each group) and reared individually in California cages. Three diets with different nutrient densities viz. Low density (LD: 2400 kcal/kg ME and 14% CP), medium density (MD: 2600 kcal/kg ME and 15% CP) and high density (HD: 2800 kcal/kg ME and 16% CP) were formulated using maize and soybean as the main feed ingredients and fed to the birds till they attained 40 weeks of age. Results revealed no significant effects of variation in nutrient density on egg production, feed conversion ratio, egg weight, egg quality traits, liveability, immune competence traits and serum biochemical parameters (serum protein and total cholesterol). However, BW gain (25 to 40 weeks) was significantly higher ($P<0.05$) in the HD as compared to the LD diet. Based on the overall performance, it is concluded that the diet containing 2400 kcal/kg ME and 14% CP was adequate for Aseel breed of chicken to elicit optimum performance during 25-40 weeks of age.

Key words: Aseel, Chicken, Nutrient density, Growth, Production

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INTRODUCTION

About fifteen recognized native chicken breeds are known to exist in India as per NBAGR breed registration database (NBAGR, 2013). Aseel is one of the important native breeds of chicken and is known for its fighting ability, hardiness, lean meat, a better flavour of meat and eggs, etc. Of the seven varieties of Aseel breed, Aseel (Peela)-brown is a prominent one (Panda and Mohapatra, 1989). Aseel chickens are being used to develop newer varieties/crosses of chicken for rural or backyard farming in India. Although Aseel birds have higher BW as compared to the other native chickens, their egg production potential is relatively low (Haunshi *et al.,* 2011; 2013). Thus, there is a need to improve the egg production potential of Aseel birds through genetic selection. In order to obtain optimum performance and efficient utilization of feed ingredients, there is a need to work out the requirements of major nutrients for these birds as the practice of providing commercial layer chicken diet may not be economical and ideal to bring out the optimum performance. As per our knowledge, there is little information available in the literature on the nutrient requirement of Aseel birds during the egg layering period, although ME and the CP requirement of Aseel chicken during juvenile phase has been studied recently (Haunshi *et al.,* 2012). Feeding trial with native chickens of other tropical countries revealed that reducing dietary CP content to 14% during 25 to 49 weeks of age did not affect BW, egg production, egg quality and serum biochemical parameters in Egyptian local Sinai laying hens (Hussein *et al.,* 2010). Therefore, the present study was conducted to investigate the effect of high-, medium- and low- density diets (in terms of ME and CP) on the production performance and growth of Aseel chickens during 25 to 40 weeks of age.

MATERIALS AND METHODS

The experiment was carried out during July to October months on the experimental farm of the Directorate of Poultry Research located at Hyderabad (17^o 20’ N, 78^o 30’ E), India.

Experimental design

Ninety birds, at 24 weeks of age, were individually weighed and distributed randomly into three treatment groups in such a way that every treatment group had thirty birds each with six replicates having five birds in each replicate (Table 2). Three diets with varying nutrient densities viz. Low density (LD: 2400 kcal/kg ME and 14% CP), medium density (MD: 2600 kcal/kg ME and 15% CP) and high density (HD: 2800 kcal/kg ME and 16% CP) diets were formulated using maize and soybean meal as main feed ingredients (Table 1). Each diet was fed to the respective group of birds from 25 to 40 weeks of age. Birds were provided with *ad libitum* feed and water throughout the experiment and were reared in individual cages in open-sided high rise house from the onset of lay till the completion of the experiment. Similar management and health care practices were followed across different treatment groups.

Growth and production traits

Individual BWs were recorded at 24, 32 and 40 weeks of age, while BW gain was calculated for 25 to 40 weeks of age. The shank length of birds was also measured at 40 weeks of age. Feed intake was recorded weekly basis and the average daily feed intake per bird during 25 to 40 weeks of age was calculated. Total as well as average ME and CP intake per bird per day during 25 to 40 weeks of age was also calculated. Feed conversion ratio (kg egg mass to kg feed intake) was calculated. Hen day egg production (HDEP) was recorded up to 40 weeks of age and hen housed egg production (HHEP) % was calculated for the duration of 25 to 40 weeks.

Egg quality traits

At 40 weeks of age, a total of 102 eggs (34 eggs from each treatment) were used to study different external and internal egg quality traits such as egg weight, length, width, yolk, albumen and shell weight, shape index, yolk index, Haugh unit, etc. Haugh unit and color of yolks were measured as per standard procedure. Digital Vernier calipers (least count, 0.01 mm) (Mitutoyo, Kawasaki, Japan) was used to measure the length and breadth of eggs and yolk. Yolk-to-albumen ratio, percentages of albumen, yolk, and shell weight were also calculated.

Immunological and biochemical traits

At 40 weeks of age, two ml of blood was collected from the brachial vein of two birds from each replicate belonging to each treatment. For humoral immune response, antibody body titres to two antigens such as Newcastle disease (ND) virus antigen (vaccine strain) and sheep red blood cells (SRBCs) were assessed. To measure the serum antibody titre against the ND virus antigen (vaccine strain) four haemagglutination units of ND virus and one percent chicken RBCs were used by HI method. For antibody response to SRBCs, two birds from each replicate (A total of 12 birds from each dietary treatment group) were injected with 0.1 ml of 0.5% SRBC suspension into the brachial vein at 40 weeks of age. Subsequently, blood samples were collected on the fifth day of post-inoculation and antibody titre against SRBCs was estimated (Wegmann and Smithies, 1966). The antibody titres of ND (HI) and SRBCs titre were expressed as $\log_2$ values. The *in vivo* T-cell mediated immune response to phytohaemagglutinin-P (PHA-P) was measured as per the method of Cheng and Lamont (1988). Total serum protein and cholesterol levels were also estimated at 40 weeks of age using diagnostic kits (Qualigens, Mumbai, India) as per manufacturer's instructions.

The data were analysed using the general linear model procedure of SAS (SAS Institute, 2008). Significant effects of different dietary nutrient densities on various traits were tested using one-way analysis of variance and means of the parameters were compared using Tukey's multiple mean comparison test. The differences in means were considered significant when $P < 0.05$.

RESULTS AND DISCUSSION

Nutrient requirement of a bird depends on its genotype, sex, stage of growth, production level, environment, etc. Indian native chickens are poor layers with compact body size and broodiness traits. It is obvious that the nutrient requirements of native chickens must be different from those of layers, broilers or breeders. The present study attempted to assess the effect of feeding diets with different nutrient densities on growth traits of Aseel chicken revealed no significant (P>0.05) differences among different treatments for BW recorded at 32 and 40 weeks of age. Similarly, there was no significant effect on shank length measured at 40 weeks of age (Table 2). However, the overall BW gain (25 to 40 weeks) was significantly (P<0.047) higher in the high nutrient density diet (HD) when compared to the low nutrient density diet (LD). There were no significant differences among three groups for feed intake during different feeding periods, including that from 25 to 40 weeks of age. Similarly, there was no significant difference in average daily feed intake during 25 to 40 weeks of age among various dietary treatments. The total and average daily intake of ME and CP by birds fed with HD diet was significantly (P<0.001) higher than those in the LD diet (Table 2). Significant increase in BW gain of the high density diet (HD) fed birds is explainable from the fact that significant increase in intake of ME and CP might have resulted in the increased fat deposition. This high intake of ME and CP might have led to higher BW gain of birds fed with the HD diet as compared to the LD diet. Studies involving native chickens particularly of Indian origin in feeding trials are limited in literature to compare the present findings.

With regards to egg production, feeding with diets differing in nutrient densities did not affect egg numbers to 40 weeks of age, the rate of egg production (HHEP %), FCR (egg mass to feed intake). There was no incidence of mortality in any of the treatment groups (Table 3). Since there was no mortality of birds the values of HDEP and HHEP% within treatments were identical. There was no influence of varying sexual maturity of birds on egg production as there was no significant difference among three treatment groups in age at sexual maturity before the start of the feeding trial at 25 weeks of age. It appears that the ME and CP content used in MD diet were sufficient for optimum hen housed egg production, HHEP or HDEP%, FCR and laying house liveability in Aseel birds. Reid (1976) reported that the dietary protein requirement of laying hens for optimum egg production, egg weight and egg output was 14.6% when hens were laying at 77% egg production. In the present study, Aseel birds were laying at approximately 52 to 54% and therefore, the lowest CP content of 13.84% (~14%) seems to be adequate for optimum egg production and egg weight during first 25 to 40 weeks of age. Furthermore, Hamilton (1978) observed that there were no significant differences between group of birds fed with 15 and 17% dietary protein on feed intake, BW, egg production, mortality, egg weight, Haugh unit, specific gravity and kg feed/dozen of eggs. Similar to the findings of the present study, Hussein *et al.* (2010) did not find significant differences in BW, egg production, the rate of egg production, FCR and total as well as average daily feed intake in Egyptian local Sinai laying hens fed with different dietary protein (at 14, 15, 16, 17 and 18% levels). However, they observed that provision of ME of 2750 kcal /kg was ideal for optimum productive and reproductive performance.

There were no significant differences in total serum protein and cholesterol levels (Table 4). Various factors affect the serum cholesterol level like breed, age, diet, stress, energy to protein ratio, etc. Since in this experiment, birds in all three treatment groups were similar for all these variables, it was expected that there would be no significant differences among different treatments for serum cholesterol level. This finding is supported by the earlier evidence that dietary energy levels *per se* do not significantly affect the serum cholesterol level in laying hens (Daghir, 1973). This finding was further supported by the observations of Hussein *et al.* (2010) who found no significant difference in Egyptian Sinai local laying hens fed with different dietary protein (14 to 18%) and ME (2600 to 2800 kcal/kg) for total serum cholesterol and serum protein levels. These observations indicate that 14% dietary protein seems to be adequate for normal serum protein in native chickens. A similar trend was observed in general immune competence traits (antibody response to SRBCs and in vivo CMI response to PHA-P) and also for the specific immunological trait (antibody titre to the ND antigen).

Egg weight recorded at different ages (28, 32, 36 and 40 weeks of age) did not reveal significant difference among different treatments. Egg quality study at 40 weeks of age also did not reveal any significant difference in external and internal egg quality traits among three treatment groups (Table 5). Similar observations were made by Marie *et al.* (2009), who observed that there were no significant differences in egg quality traits (shape index, yolk weight, albumen weight and shell weight) in Egyptian local laying hens fed with different nutrient density diets (2500 kcal/kg ME and 14.7% CP; 2619 kcal/kg ME and 15.6% CP, and 2743 kcal/kg ME and 16.4% CP). Furthermore, Hussein et al. (2010) observed that feeding Egyptian Sinai local laying hens with varying dietary protein level (14-18%) and ME (2600 to 2800 kcal/kg) did not affect egg quality traits like egg, albumen, yolk and shell weights, shell thickness, yolk index, Haugh unit, etc. Recently, it was reported that feeding varying nutrient density diets did not affect egg quality traits in Dahlem breed of chicken (Panda *et al.*, 2012). It appears that the ME and CP content used in MD diet were sufficient for optimum egg size and egg quality traits of Aseel chickens.

Conclusions

Considering the overall performance of Aseel birds fed with three different density diets, it was concluded that low nutrient density diet (LD) containing 2400 kcal/kg ME and 14% CP was economical and adequate for Aseel breed of chicken to elicit optimum production performance during 25 to 40 weeks of age (except for BW). However, further study is warranted to determine the precise ME and CP requirements and their interaction in Aseel as well as other native chicken breeds of India.

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Table 1. Feed and nutrient compositions of various diets used in the experiment

Attributes	MD	LD	HD
Feed ingredients (%)			
Maize	60	50	61.2
Soybean meal	12.4	8.3	19.5
Sunflower cake	13.5	10.92	6.83
Deoiled rice bran	3.34	20	0
Shell grit	8.96	8.96	8.96
Dicalcium phosphate	0.96	0.96	0.96
Common salt	0.4	0.4	0.4
DL-methionine	0.04	0.06	0.05
Choline chloride 50%	0.1	0.1	0.1
AB2D3K†	0.025	0.025	0.025
B –complex‡	0.025	0.025	0.025
Trace mineral mixture§	0.10	0.10	0.10
Antibiotic¶	0.05	0.05	0.05
Toxin binder¥	0.10	0.10	0.10
Refined sunflower oil	0	0	1.7
Nutrient composition (calculated)			
Metabolizable energy (kcal/kg)	2607	2411	2794
Crude protein (%)	14.93	13.84	15.89
Lysine (%)	0.66	0.59	0.78
Methionine (%)	0.32	0.30	0.34
Calcium (%)	3.46	3.45	3.45
Available phosphorous (%)	0.32	0.32	0.31
Energy: protein ratio	174.6	174	175.83
Cost 100 (Rs./kg)	1414	1304	1581

†AB2D3K provided (mg/kg diet): menadione 2; retinal acetate, 16500 IU and cholecalciferol, 2400 ICU. ‡Provided (mg/kg diet): thiamin 0.8; pyridoxine, 1.6; cyanocobalamine, 0.008; niacine, 8; pantothenic acid, 8; tocopherol, 8; riboflavin, 10. § Provided (g/100 kg): zinc-8;

manganese-10; ferrous-11; copper-2.0; iodine-0.25; cobalt-0.09; selenium-0.1. [¶] Antibiotic provided (mg/kg) Furazolidone 1000. [¥]Bantox (Venky's, Pune, India)

Table 2. Effect of dietary nutrient density on growth and feed intake of Aseel breed of chicken

Traits	MD	LD	HD	SEM	*P* value
BW changes (g)				12.60	0.924
24 weeks	1588	1597	1586		
32 weeks	1736	1715	1781	17.57	0.277
40 weeks	1845	1811	1886	15.23	0.116
BW gain (25 to 40 weeks) *	257.3^{ab}	213.5^{b}	300.1^{a}	14.10	0.047
Average daily feed and nutrient intake (25-40 weeks)					
Feed intake (g/bird)	106.3	107.9	106.8	1.01	0.861
ME intake (kcal/bird)*	277.2^{ab}	260.1^{b}	298.5^{a}	3.49	0.001
CP intake (g/bird)*	15.87^{ab}	14.93^{b}	16.98^{a}	0.19	0.001

Means in a row with different superscript differ significantly (P<0.05), SEM: Standard Error of Mean

Table 3. Effect of dietary nutrient density on egg production and FCR of Aseel birds

Traits	MD	LD	HD	SEM	*P* value
Age at sexual maturity (days)	165.1	166.3	165.5	0.861	0.846
HDEP[†] (Numbers)	67.23	67.00	69.17	1.798	0.867
HDEP (%)	51.78	52.29	54.62	0.746	1.602
FCR (feed/egg mass)	3.80	4.04	3.82	0.11	0.641
Mortality	Nil	Nil	Nil		

[†]HDEP: hen day egg production

Table 4. Effect of dietary nutrient density on general immune competence and serum biochemical traits in Aseel breed of chicken

Traits	MD	LD	HD	SEM	*P* value
HI titre (log2)	10.17	10.09	10.09	0.12	0.956
SRBC titre (log 2)	8.83	9.17	9.22	0.38	0.917
PHA-P response (foot index)	0.55	0.47	0.54	0.03	0.473
Serum total protein (g/dl)	5.43	5.48	4.99	0.13	0.148
Serum total cholesterol (mg/dl)	89.2	112.9	114.2	6.32	0.177

† Haemagglutination inhibition titre against New Castle Disease virus

SRBC: sheep red blood cells, PHA-P: phytohaemagglutinin-P

Table 5. Effect of density of diet on egg quality traits in Aseel breed at 40 weeks of age

Traits	MD	LD	HD	SEM	*P* value
28 weeks egg weight (g)	43.65	42.09	43.39	0.345	0.144
32 weeks egg weight (g)	45.32	43.62	44.76	0.309	0.070
36 weeks egg weight (g)	47.87	45.68	46.19	0.724	0.434
40 weeks egg weight (g)	49.1	47.2	48.0	0.386	0.104
Shape index	76.59	75.64	75.92	0.295	0.397
Haugh unit	82.42	84.82	83.09	0.861	0.504
Yolk index	0.43	0.44	0.48	0.021	0.523
Yolk weight (g)	16.25	15.59	15.97	0.147	0.204
Albumen weight (g)	28.86	26.96	28.48	0.375	0.097
Shell weight (g)	4.54	4.50	4.37	0.057	0.429
Yolk percentage	33.02	32.38	32.51	0.179	0.783
Albumen percentage	57.76	58.05	58.42	0.181	0.788
Shell percentage	9.22	9.57	9.00	0.087	0.060
Shell thickness	0.35	0.36	0.35	0.004	0.343
Yolk to albumen ratio	0.57	0.56	0.57	0.005	0.899