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Effect of Varying Nutrient Density of Diets on Productive Performance in Dahlem Red Layers

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ABSTRACT

This study was conducted to optimize the nutrient requirement for Dahlem Red (DR) birds. Five diets were formulated i.e., one basal diet (BD) with optimum (100%) nutrients, two diets with lower (97.5 % and 95%) and two diets with higher (102.5% and 105%) nutrients as compared to the BD. A total of 240 number of DR layers of 23 weeks were selected and divided into 5 groups, each having 8 replicates and each replicate had 5 birds. The experiment was continued up to 70 weeks. Feed intake was higher (P<0.05) in groups fed the diet containing 95 and 97.5% of nutrient of the BD. The egg production and egg weight were higher (P<0.05) in groups fed the diet containing higher nutrient (102.5% and 105%) as compared to those birds fed lower nutrient dense diets (97.5 % and 95%) during the 23-42 weeks. The feed efficiency was better (P<0.05) among the groups fed diet containing higher nutrient density diets as compared to those groups fed lower nutrient density diets during the 23-42 and 59-70 weeks. However, egg components and egg quality parameters did not differ among the groups. Therefore, it seems that the diet with 102.5% nutrients would be more remunerative as the higher egg production and better feed efficiency was eobserved.

Keywords: Egg production, Egg quality parameters, Nutrient density

INTRODUCTION

Dahlem Red (DR) is a brown egg-laying chicken that is extensively used for producing variety suitable for the backyard chicken. The pullet attains sexual maturity at about 22-23 weeks of age and produces about 230 eggs/year with an average egg weight of 54 g at 40 weeks (Prakash *et al.,* 2014). The optimum performance of poultry is achieved through optimum nutrient intake. The poultry inclined to meet energy needs first and assumes all other essential nutrients are adequate. Therefore, CP and other nutrients should be in proportion with the ME (NRC, 1994). Feeding the diet with suboptimal nutrients hinders the performance and increase the production cost. Therefore, it is essential to determine the optimum nutrient requirements for maximizing the performance of layers, where all the nutrients are changed proportionately. It has been reported that the nutrient requirement of the brown egg-laying layers is suggested to be 10% greater than those of the white egg-laying layers (NRC, 1994). Considering the climatic variables the nutrient requirements studied for DR in temperate environment may not be applicable in tropical regions like India. The present study was therefore conducted to study the effect of various concentrations of ME, CP and amino acids (lysine and methionine) on productive performance, egg components and egg quality parameters in DR birds.

MATERIALS AND METHODS

Experimental diets, feeding and productive parameters: A total of 240 DR (23 weeks) layers were distributed into 5 groups, each having 8 replicates with 5 birds in each replicate. The hens were reared in individual cages under the open side housing system. Five experimental diets were formulated i.e., basal diet (BD) (100%) as per NRC (1994), two diets with lower (97.5 % and 95%) and two diets with higher (102.5% and 105%) nutrients of the BD for feeding the experimental birds up to 70 weeks (Table 1). Daily feed intake and egg production was recorded throughout the experiment.

Eight eggs were randomly chosen from each treatment during the last three consecutive days at the end of the experiment to determine the shell weight,

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shell thickness and Haugh unit (Egg Multi testers EMT-5200, Japan) and yolk colour. The cleaned eggshells were dried for 24 h, weighed and expressed as percent of whole egg. The shell thickness was measured at three different locations (middle, broad and narrow ends) using a micrometer gauge (Mitutoyo Code, 7027, Japan) and mean value was taken as thickness. The variations in data of different parameters were analysed using the general linear model procedure. The model included different dietary treatments as source of variation. Treatment means were compared using Tukey's test. The data of egg mass (EM), egg production (EP), egg weight (EW) and age of the birds (weeks) were analysed for linear regression analysis. The model included the EM, EP, EW were dependent variable and week as independent variable using SAS 9.2.

RESULTS AND DISCUSSION

Feed intake was higher (P<0.05) among the groups fed the diet containing lower nutrient density (95 and 97.5%) compared to those groups fed the diet containing optimum (100%) or higher (102.5 and 105%) nutrient (Table 2). Nevertheless, the feed intake among the different groups did not vary during the 43-70 weeks of age. The higher feed intake is generally seen with decreasing the energy content of the diet (Wu *et al.,* 2007, Panda *et al.,* 2012, Prakash *et al.,* 2014). Therefore, when energy content of the diet is altered, the concentration of other nutrients should also be changed proportionately to optimize the intake of other essential nutrients. Nevertheless, the nutrient requirement also depends on other factors, such as strain, body weight and egg production (Harms *et al.,* 1999, Gomez and Angels, 2009).

Table 1. Ingredient composition of the experimental diets

Ingredients (%)	Diets (% of standard)				
	95	**97.5**	**100**	**102.5**	**105**
Maize	58.7	61.2	63.6	66.0	65.8
Soybean meal	8.87	13.0	18.1	23.0	22.9
Sunflower cake	20.0	15.2	7.6	0.06	0.00
DORB	2.39	0.00	0.00	0.00	0.00
Salt	0.40	0.40	0.40	0.40	0.39
Dicalcium phosphate	0.78	0.94	1.15	1.36	1.37
Shell Grit	8.56	8.64	8.72	8.80	8.92
DL-methionine	0.126	0.132	0.141	0.15	0.15
Premix[¥]	0.40	0.40	0.40	0.40	0.38
L-lysine HCL	0.217	0.144	0.051	0.04	0.08
Nutrient composition					
ME (kcal/kg)	2538	2605	2673	2739	2804
CP (%)	14.53	15.00	15.2	15.6	16.0
Lysine (%)	0.72	0.74	0.76	0.78	0.80
Methionine (%)	0.37	0.38	0.39	0.40	0.41
Ca (%)	3.31	3.39	3.48	3.56	3.64
NPP (%)	0.30	0.31	0.32	0.33	0.34

[¥]Supplied per kilogram of diet: 1 mg of thiamin, 2 mg of pyridoxine, 0.01 mg of cyanocobalamine, 15 mg of niacin, 10 mg of pantothenic acid, 10 IU of α-tocopherol, 10 mg of riboflavin, 0.08 mg of biotin, 2 mg of menadione, 2.75 mg of retinol acetate, 0.03 mg of cholecalciferol, 650 mg of choline, 8 mg of copper, 45 mg of iron, 80 mg of manganese, 60 mg of zinc, 0.18 mg of selenium, 50 mg of monensin sodium and 800 mg hydrated sodium calcium alumino silicates.

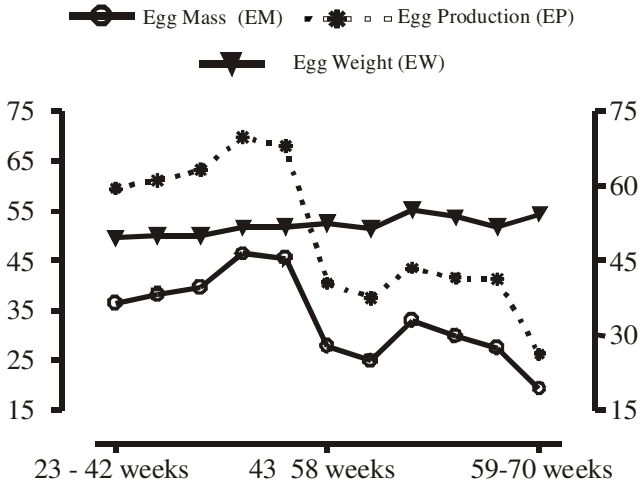
Table 2. Effect of feeding diets varying in nutrient density on feed intake, egg production, egg weight, FCR (feed conversion ratio) and egg mass in Dahlem red layers

Particulars	Diets (% of standard)					SEM	P value
	95	97.5	100	102.5	105		
Feed intake (g/d)							
23 - 42 weeks	98.67[a]	95.93[ab]	94.93[b]	91.99[bc]	90.91[c]	1.25	0.05
43 - 58 weeks	92.24	87.32	89.93	85.01	90.32	3.01	0.14
59 - 70 weeks	89.79	83.88	82.68	76.97	86.14	2.35	0.54
Hen day egg production							
23 - 42 weeks	59.51[b]	61.17[b]	63.13[ab]	69.67[a]	68.05[a]	1.64	0.03
43 - 58 weeks	40.45	37.58	43.54	41.55	41.19	2.24	0.88
59 - 70 weeks	26.20	28.50	28.42	29.72	34.89	2.60	0.34
Egg weight							
23 - 42 weeks	49.48	49.93	50.09	51.60	51.80	1.72	0.41
43 - 58 weeks	52.47	51.45	55.12	53.65	51.68	2.01	0.18
59 - 70 weeks	54.31[b]	55.03[ab]	56.23[a]	57.78[a]	57.36[a]	0.91	0.04
FCR (kg/dozen eggs)							
23 - 42 weeks	1.608[a]	1.508[ab]	1.441[b]	1.228[b]	1.238[b]	0.001	0.03
43 - 58 weeks	2.086	2.168	1.799	1.831	2.037	0.02	0.07
59 - 70 weeks	3.029[a]	2.567[ab]	2.483[ab]	2.151[b]	2.066[b]	0.001	0.05
Egg mass (g/hen/d)							
23 - 42 weeks	36.42[c]	38.12[bc]	39.60[b]	46.38[a]	45.65[a]	1.04	0.05
43 - 58 weeks	27.84	24.87	33.07	29.90	27.50	1.47	0.08
59 - 70 weeks	19.32[c]	21.58[bc]	22.46[b]	24.81[ab]	28.70[a]	1.14	0.04

The egg production was higher (P<0.05) in groups fed the diet containing higher nutrients (102.5% and 105%) as compared to those birds fed lower nutrient dense diets (97.5 % and 95%) during the 23-42 weeks. However, the egg production did not vary among the various groups during the later stages of the experimental period. The egg weight was higher (P<0.05) among the groups fed higher nutrient density diets compared to those groups fed lower nutrient density diets towards the end of the experiment. Though the difference was insignificant, the marginal increase in the egg weight was recorded in groups fed high

Table 3. Effect of feeding diets varying dietary nutrient density on egg components and egg quality parameters in Dahlem red layers

Diets (% of standard)	Egg components (%)			Shell thickness (mm)	Haugh unit	Yolk colour
	Albumen	Yolk	Shell			
95	61.29	29.69	9.02	0.42	71.25	6.25
97.5	61.74	28.92	9.34	0.40	81.50	6.50
100	60.42	29.79	9.79	0.40	72.25	7.25
102.5	59.87	30.64	9.49	0.42	75.75	6.75
105	64.17	26.94	8.89	0.42	74.25	6.75
SEM	2.82	0.71	0.23	0.01	1.37	0.25
P value	0.53	0.59	0.80	0.86	0.12	0.53



EM=51.69-0.47 × week; R^2=0.55 (P<0.01)
EP=87.82-0.975 × week; R^2=0.73 (P<0.01)
EW=45.09+0.184 × week; R^2=0.85 (P<0.01)

Fig. 1. Relationship between egg mass, egg weight and egg production

nutrient density diets as compared to those groups fed lower nutrient density diets during the 23-58 weeks of age. The feed conversion ratio and egg mass were improved (P<0.05) among the groups fed diet containng higher nutrient density diets as compared to those groups fed lower nutrient density diets during the 23-42 and 59-70 weeks. It has been reported that the decline in nutrient density decrease the feed efficiency and egg production (Panda *et al.,* 2012, Prakash *et al.,* 2014). However, egg components and egg quality parameters did not differ among the groups (Table 3).

It was recorded that the egg production and egg weight or egg mass were well related with the age of the birds (weeks). Based on the relationships, regression equation were derived to predict the egg mass, egg production and egg weight from the age of the laying (23-70 weeks) Dahlem Red birds (Fig 1). It has been reported by Shafey (1996) that the age of the hen is positively correlated with the production of higher egg mass.

CONCLUSION

Therefore, it is concluded that the diet with higher nutrient (102.5%) would be more beneficial higher egg production and better feed efficiency was recorded in the present experiment.

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