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Article

Effect of dietary energy and protein levels on growth and carcass characteristics of straight run hilly chicken up to eight weeks of age reared in confinement

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Abstract: The experiment was undertaken to determine the effect of varying energy and protein levels on growth performance and carcass characteristics of hilly chicks at starting period. Three hundred twenty-four straight run day-old chicks were randomly allocated to three dietary treatments of varying energy and protein levels as 2850, 2950 and 3050 ME Kcal/Kg and 200, 210 and 220 g CP/kg DM for starting period. Feed intake, live weight gain, feed conversion, digestibility and dressing percentage were measured during the experimental period. Final body weight and body weight gain were not significantly affected (P>0.05) by the dietary regimes and its interaction. Birds consumed least amount of feed on the diet containing 2850 kcal/kg energy (P<0.01) and convert feed comparatively with better efficiency (P<0.05). However, protein efficiency was better (P<0.05) at the lower level of dietary protein (20% CP) and energy (2850 ME Kcal/kg). At 20% of CP level, increasing dietary energy from 2850 to 3050 kcal/kg ME resulted into a 29g decreases in weight gain. Conversely, at 2850 kcal/kg ME an increase in dietary protein from 20% to 22% CP resulted into a 27 g decrease in weight gain. Maximum weight gain was achieved at an ME: CP ratio of 142.5 which corresponded with the 2850 kcal/kg ME and 20% CP diet. Birds fed with 2850 kcal/kg energy diet had higher carcass weight (P<0.001) compared to other energy level. Fed on the diets with the lower energy level (2850 kcal/kg ME) yielded the heaviest breast meat (P<0.01) and thigh meat (P<0.05). The findings of present study therefore indicate that the 2850 kcal/kg ME and 20% CP dietary level, with ME: CP ratio of 142.5 could meet the growth performance of the indigenous hilly chicken.

Keywords: energy; protein; nutrient requirement; hilly chicken; native chicken

1. Introduction

Poultry is the most numerous species of farm animals. It is estimated that there are about 246 million chickens in Bangladesh (Bangladesh Economic Review, 2013) and being kept under traditional extensive management. These birds are mainly non- descriptive indigenous type. Although they contribute a significant proportion of egg requirements, the productivity is low. Poor nutrition is one of the reasons for the low productivity of indigenous chickens (Kingori *et al*., 2007, 2010). Indigenous chicken depend primarily on the scavenging feed resource base for nutrients. Scavenging is an uncertain method of feeding because the scavenged rations may be in adequate in nutrient supply (Birech, 2002; Kingori, 2004). Productivity of indigenous chickens can be achieved through improved nutrition by supplementation to supply the deficient nutrients (Birech, 2002; Kingori, 2004; Kingor *et al*., 2007). Productivity of indigenous chicken breeds maybe doubled with improved diets and management conditions (Chowdhury *et al*., 2006). Tadelle *et al*. (2003) and Kingori *et al.* (2007) observed that the Ethiopian and Kenyan indigenous chickens, respectively subjected to improved nutrition and management conditions can show a positive response in terms of their growth performance. Generally, cockerels grow faster than the pullets (Mukhafola *et al.*, 2012). The hilly chicken is superior to other native chicken in terms of body weight and by extension growth rate, probably makes it most suitable for improvement in meat production (Rahman *et al*., 2013). Most of the studies on hilly chicken had been on breeding concerned mainly with phenotypic and morph metric characterization, egg traits, hatchability and growth and reproductive performance (Faruque *et al.,* 2012). But the nutritional requirement of this bird has not yet been done. Therefore, the objective of this study was to estimate the optimum energy and crude protein (CP) levels for early growth performance and carcass yield of confined hilly chicken.

2. Materials and Methods

2.1. Location of the experiment

This study was conducted at Bangladesh Livestock Research Institute, Poultry research farm, Savar, Dhaka.

2.2. Preparation of the house

The experimental house was thoroughly cleaned with water and disinfected and then left to dry for seven days. All the equipment such as drinkers, feeders and wire nets were cleaned thoroughly and disinfected. The footbath was thoroughly cleaned and a new disinfected added daily.

2.3. Experimental procedures, dietary treatments and design

A total of 324 day old chicks were wing bended, weighed individually and randomly distributed into 9 groups. Each group had 36 chicks distributed into 3 replicates with 12 birds in each. Diets were three levels of ME (2850, 2950 and 3050 Kcal/kg) and three levels of CP (20, 21 and 22%) in a 3×3 factorial design (Table 1) were fed to the birds belonging to nine treatments groups. The birds were raised under standard husbandry practices; feed and water were supplied *ad libitum* throughout the experimental period. Vaccinations against Marek's, Gumboro, Infectious bronchitis, fowl pox and fowl typhoid were carried out following veterinary vaccination schedules. Birds were reared in 2.5 $m^2$of each pen in open sided house from 0-8 weeks of age.

2.4. Digestibility measure

Digestibility was measured when the birds were 49-56 days old. Digestibility was conducted in specially designed metabolic cages having separated watering troughs. 2 birds were randomly selected from each replicate of each experiment and transferred to metabolic cages for measurement of digestibility. A 3 days acclimization period were allowed prior to a 3 day collection period. Droppings voided by each bird were collected on a daily basis at 9.00 hours. Care was taken to avoid contamination from feathers, scales, debris and feeds.

2.5. Carcass traits

At the end of the experiment, three chickens from each replication were randomly selected and fasted for 12 hours. Birds were slaughtered following 'halal' method (Singh *et al*., 2003) by severing the jugular vein allowed to bleed completely and then plucked and weighed. After evisceration, the data on hot carcass and organ weight was recorded and expressed as a percentage of live body weight.

2.6. Data collection

Individual body weight measurements and feed intake per replicate were recorded weekly. FCR was calculated as total feed intake divided by body weight gain. Total protein intake and total ME intake were also computed, and were used to calculate protein efficiency ratio (PER) and energy efficiency ratio (EER) respectively. PER was computed as weight gain divided by total protein intake while EER was expressed as a percentage of weight gain per total ME intake.

2.7. Statistical analysis

The experiment was conducted according to completely randomized design and the general linear model procedure of SPSS 20.0 (2015) was used for statistical analysis of data. Analysis of variance (ANOVA) techniques (Steel *et al*., 1997) was performed to test the main effects of different levels of ME, CP and their interaction effects on BWG, feed intake, FCR, EER, PER and carcass characteristics. The Duncan multiple range test was used to separate treatment means that were significantly different at 5% level of significance.

Table 1. Ingredients and nutrient composition of experimental diets.

Ingredients	Diets								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Maize	53.0	50.5	48.7	51.0	50.0	51.0	55.5	55.2	53.0
Rice polish	8	9.5	9.5	19.2	18.2	15.2	13.0	11.8	11.8
Soyabean meal	17.0	18.5	22.0	20.0	21.4	22.2	20.0	20.0	22.0
Wheat bran	8.5	9.0	7.5	-	-	-	-	-	-
Fish meal	-	-	-	-	-	-	1.0	1.0	1.0
Protein concentrate	10.0	10.0	9.8	7.5	8.5	10.0	7.0	9.0	9.5
Di calcium phosphate	2.5	1.5	1.5	1.3	0.9	0.6	1.0	0.5	0.2
Vitamin mineral premix	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Salt	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Oil	-	-	-	-	-	-	1.5	1.5	1.5
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Nutrient composition									
ME (kcal/kg)	2850	2848	2851	2953	2950	2952	3069	3064	3050
CP (%)	20.0	21.07	22.08	20.04	21.04	22.02	20.09	21.07	22.05
EE (%)	5.77	6.19	5.44	8.10	8.30	8.52	8.44	8.66	8.68
CF (%)	3.66	6.27	4.32	6.41	5.11	4.66	6.21	4.85	6.12
Ca (%)	1.10	0.98	0.97	0.79	0.76	0.78	0.72	0.73	0.70
P (%)	0.69	0.54	0.54	0.53	0.47	0.42	0.35	0.37	0.34
ME: CP	142.5	135.1	129.1	147.3	140.2	134.0	152.7	145.4	138.3

Supplied the following per kilogram of feed: vitamin A, 6250IU, vitamin D3, 1250 IU, vitamin E, 10mg, vitamin K3, 1.5mg, vitamin B1, 5mg, vitaminB2, 2.5mg, vitaminB6, 0.5mg, vitamin B12, 2.5mg, niacin, 5.625mg, pantothenic acid, 0.3mg, choline chloride, 50mg, iron, 18.75mg, copper, 3mg, manganese, 37.5mg, zinc, 31.25mg, iodine, 5mg and selenium, 0.0625 mg

3. Results and Discussion

Performance characteristics of hilly chicken, fed on different level of energy and protein in the diets are presented in Table 2. Final body weight and body weight gain were not significantly affected (P>0.05) by the dietary regimes. Faruque *et al.* (2007) observed that body weight of indigenous hilly chickens at 8 weeks of age averaged 513 g. Those weights recorded were much lower than the present findings. Different ME levels had significant effect on 8 weeks cumulative feed intake and feed conversion ratio (FCR). The results indicate that (where significant difference was observed) the feed intake was higher among the chickens receiving diets with higher levels of ME (3050 kcal/kg). The chickens fed diets containing lower ME had significantly (P<0.05) better FCR when compared to those received higher dietary ME diets during the experimental period. However, no significant effect of different CP levels was observed on feed intake and feed conversion of these periods. The effects of energy levels agree with NRC (1994), in which has been stated that it is not always accurate to conclude that poultry adjust feed intake to achieve a minimum energy intake from diets containing different energy levels. The above results indicated that chicken reared on a lower level of protein and energy consumed less feed. The present result agreed well with the finding of Sheriff *et al*. (1981), who also obtained lower feed consumption in broiler fed 22% and 2670 kcal ME/kg ration containing a low level of feed intake and also agree the findings of Farrell *et al*. (1973), who concluded that the feed intake was inversely related to energy concentration in the diet. The variation in feed intake could be due to energy content that associated with increase dietary energy concentration. Quail feeding with different levels of energy and protein did not affect feed intake of offspring (Azghad *et al*., 2014). Thus, a proper calorie protein ratio is needed in the ration for optimum intake of nutrient through feed consumption. However, protein efficiency was better (P<0.05) at the lower level of dietary protein (20% CP) and energy (2850 ME Kcal/kg). At 20% of CP level, increasing dietary energy from 2850 to 3050 kcal/kg ME resulted into a 29g decreases in weight gain. Conversely, at 2850 kcal/kg ME an increase in dietary protein from 20% to 22% CP resulted into a 27 g decrease in weight gain. Maximum weight gain was achieved at an ME: CP ratio of 142.5 which corresponded with the 2850 kcal/kg ME and 20% CP diet. A range of calorie and protein ratio of 132 to 155:1 for broiler was suggested could be lowered to between 155 and 195 or 10% of the recommended levels when broilers are fed low crude protein concentrate (Aftab *et al.*, 2006). In this study, the calorie and protein values of each treatment diets, were met the recommended values (Figure 1). Nutrient digestibility values are presented in

Table 3. Dry matter, CP, fat and fiber digestibility values were not significantly (P>0.05) affected by treatment diets.

The carcass yield, breast meat, thigh meat and drumstick meat weight of the experimental birds are shown in Table 4. Varying protein levels did not affect carcass yield of the hilly chicken. This result is in agreement with Lesson *et al.* (1996a) and Smith and Pesti (1998), who found that levels of protein in diet did not affect carcass yield and protein deposition. Similarly, Renden *et al.* (1992) found no significant effect of protein levels on carcass quality of broiler chicks. Lesson and Summers (2000) also agree with this result, who found when very low protein diets are used, dietary protein levels have no effect on the quality of protein deposited in the carcass. Growing birds have a limit for maximum protein deposition. The dietary protein level required for maximum protein accretion in the muscle is reported to be higher in fast growing birds (Acar *et al.*, 1993). Fanatico *et al.* (2008) showed that slow growing birds have a less efficient pattern of growth and are therefore less heavily muscled. Hillybirds fed with lowest energy level (2850 kcal/kg ME) yielded the heaviest carcass (P<0.001), breast (p<0.01) and thigh (p<0.05) meat. These findings agreed with those of Magala *et al.* (2012) who found cockerel fed diets with the lowest energy (2800 kcal/kg ME) yielded heavier drumstick, breast and thigh than those fed 2900 and 3000 kcal/kg ME. The lighter drumstick at the higher dietary energy levels would suggest that energy intake was in excess of the birds requirements.

Table 2. Performance characteristics of hilly chicken, fed on different level of energy and protein in the diets.

Parameter	Protein (%)	Energy (Kcal)			Average (Mean±SE)	Level of significance		
		2850	2950	3050		p	ME	P*ME
Final body weight (g/bird)	20	785.3	688.5	750.9	741.4±15	NS	NS	NS
	21	736.6	725.2	741.3	734.8±15			
	22	752.9	725.2	715.7	730.6±15			
Mean ± SE		758.3±15	718.60±16.5	735.3±15				
Body weight gain (g/b)	20	752.3	661.5	723.2	713.7±15	NS	NS	NS
	21	704.7	698.4	687.2	696.5±15			
	22	725	699.2	710	703.8±15			
Mean ± SE		727±15	686.4±15	706.8±15				
Total feed intake (g/b)	20	1758.8	1818.0	1925.0	1834±11.91	NS	***	**
	21	1904.2	1904.2	1857.1	1843±11.91			
	22	1821.9	1913.2	1876.8	1870±11.91			
Mean ± SE		1783±11.91	1878.5±11.91	1886±11.91				
FCR (Feed: Gain)	20	2.33	2.76	2.59	2.56±.05	NS	**	NS
	21	2.51	2.73	2.60	2.61±.05			
	22	2.52	2.62	2.60	2.62±.05			
Mean ± SE		2.45±.05	2.74±.05	2.6±.05				
PER[1]	20	1.8	1.5	1.8	1.7±.07	*	*	NS
	21	1.7	1.5	1.5	1.6±.07			
	22	1.5	1.5	1.5	1.5±.07			
Mean ± SE		1.7±.07	1.5±.07	1.6±.07				
EER[2]	20	9.2	7.6	8.0	8.2±.17	NS	***	NS
	21	8.5	8.0	7.6	8.1±.17			
	22	8.9	8.0	7.7	8.2±.17			
Mean ± SE		8.9±.17	7.8±.17	7.8±.17				

NS=Non significant, ***(P<0.001), **(P<0.01) *(P<0.05)

[1]PER=Protein efficiency ratio calculated as weight gain per protein intake

[2]EER=Energy efficiency ratio calculated as weight gain ×100/total metabolizable energy intake

Table 3. Nutrient digestibility of hilly chicken fed nine regimes of energy and protein percentage.

Parameters	Protein levels	Energy (Kcal/kg)			Average	Level of significance		
		2850	2950	3050	(Mean±SE)	CP	ME	CP*ME
Dry matter	20	81	80	79	80±0.4	NS	NS	NS
	21	79	78	81	79.3±0.4			
	22	80	77	72	79±0.4			
Mean±SE	Average	79.3±0.4	78.3±0.4	80±0.4				
Crude protein	20	76.2	73.4	75.3	75.3±0.2	NS	NS	NS
	21	74.2	77.2	76.4	76.0±0.2			
	22	80	75.4	78	77.8±0.2			
Mean±SE	Average	76.5±0.2	75.3±0.2	77.2±0.2				
Fat	20	80	86	88	86.3±0.2	NS	NS	NS
	21	79	81	85	85.3±0.2			
	22	87	83	88	86.3±0.2			
Mean±SE	Average	85.3±0.2	84±0.2	89±0.2				
Fiber	20	40	42	38	39.8±0.8	NS	NS	NS
	21	38	35	36	37.6±0.8			
	22	37	40	34	37.3±0.8			
Mean±SE	Average	38.3±0.8	39±0.8	36±0.8				

Table 4. Effect of diet on carcass characteristics of hilly chicken.

Parameter	Protein (%)	Energy (Kcal)			Average	Level of significance		
		2850	2950	3050	(Mean±SE)	p	ME	P*ME
Carcass yield (g)	20	486.83	434.8	441.6	464.73±7.6	NS	***	NS
	21	473.3	453	414	469.36±7.6			
	22	474.5	433	434.4	450.09±7.6			
Mean ± SE		478±7.6	440±7.6	430±7.6				
Breast meat weight (g)	20	107.8	102.63	102.51	104.31±2.1	NS	**	NS
	21	105.23	106.36	97.3	102.96±2.1			
	22	112.48	106.7	97.1	105.42±2.1			
Mean ± SE		108.5±2.1	105.2±2.1	98.96±2.1				
Drumstick weight (g)	20	73.33	67.40	72.30	71.01±1.8	NS	NS	NS
	21	75.28	72.06	67.88	71.74±1.8			
	22	76.03	70.18	69.63	71.95±1.8			
Mean ± SE		74.88±33	69.88±1.8	69.93±1.8				
Thigh weight (g)	20	75.33	69.28	71.58	72.06±1.7	NS	*	NS
	21	74.67	71.45	66.36	70.86±1.7			
	22	74.03	65.88	66.18	68.70±1.7			
Mean ± SE		74.71±1.7	68.87±1.7	68.04±1.7				

NS= Non significant, ***(P<0.001), **(P<0.01) , *(P<0.05)

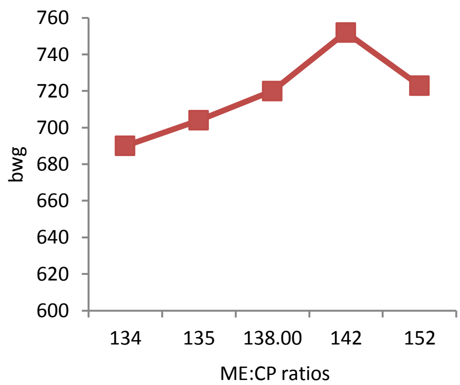

Figure 1. Response of starter chicken to various ME to CP ratios.

4. Conclusions

Feed intake and FCR performance of chicks were found to be variable between treatments diets with varying energy levels. The different energy and crude protein level had no significant effect on final body weight and body weight gain of hilly chicken. It can be thus recommended that lower energy and lower protein combination diet could be feed to improve the performance hilly chicken. Further investigation is recommended to assess the effect of further on lower level of energy and protein on growth performance of hilly chicken at early stage.

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Conflict of interest

None to declare.

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