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EFFECT OF DIFFERENT DIETARY PROTEIN AND ENERGY LEVELS ON THE GROWTH PERFORMANCE, MEAT AND BODY FAT COMPOSITION IN BROILER CHICKS

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The aim of modern poultry enterprise is to reduce feed cost for optimal economic returns because feed constitutes approximately 70% of the total production cost. One of way to reducing the feed cost is improvement in the feed efficiency of birds. While formulating a broiler's diets, main emphasizes are placed on metabolize energy (ME) and crud protein (CP), because ME itself comprises 70% of the total cost of feed and protein have major cost components in broiler diets. Thus the present study was conducted to evaluate the performance of day old broiler chicks on various dietary proteins and energy levels for 35 days. A total of 2250, day old broiler chicks were divided into three groups having six replicates each. Three experimental diets; A, B and C formulated for starter phase contained 21.92, 21.35 and 21.35% CP and 3090, 3090 and 3034 Kcal/Kg ME, respectively. For finisher phase, A, B and C diets contained 20.79, 20.22 and 20.22% CP and 3118, 3118 and 3062 Kcal/Kg ME, respectively. With diets A, B and C overall weight gain remained 1376.29, 1364.61 and 1388.24 g/bird; feed intake was 2959.70, 2940.20 and 2991.64 g / bird and feed: gain ratio remained 2.15, 2.15 and 2.15, respectively. The results showed non-significant ($P<0.05$) effect of nutrient variability in diets on all growth parameters in birds. It was concluded that reducing CP by 0.50% in combination with 50 Kcal/kg ME gave better results in terms of cost of production and profit.

Keywords: Crude protein, metabolizable energy, feed, poultry, economics

INTRODUCTION

In poultry production, the feed accounts for 65-70% of the total cost of production (Naseem *et al*., 2006), while protein costs about 50% of the cost of production in feed (Banerjee, 1992). In Pakistan, there is deficiency of protein sources for poultry feed. The domestic production hardly meets 29% of the total demand. Remaining 71% is made available through imports (Anonymous, 2012). National Research Council (NRC, 1994) recommended 23% CP and 3200 Kcal/Kg ME in broiler starter and 20% CP with 3000 Kcal/Kg ME in broiler finisher diets.

Ojano-Dirain and Waldroup (2002) reported that increased dietary CP at high ambient temperature is not beneficial to broilers. In Pakistan, as the temperature and humidity remains high in summer, the recommended NRC standards are considered impracticable. High prices of imported protein sources and variable availability made difficult to follow NRC (1994) standards for economical poultry production. So, optimum performance in birds cannot be achieved by following the NRC (1994) standard nutrient profile under high ambient temperature and poor housing facilities prevailing in the Pakistan. Low nutrient profile, particularly CP and ME is being practiced in Pakistan poultry feed industry which has awful impact on carcass quality (Adela *et al*., 2013). So, by increasing the dietary protein content in isocaloric diets will increase protein content and decrease fat content in broiler carcass (Adela *et al*., 2013).

Present study was conducted to determine the weight gain, feed intake and feed gain ratio of chicks fed on varying dietary levels of protein and energy, to assess growth performance, meat quality, fatty acid profile, cost of production and profit. Lowering CP and ME content of broiler diets than NRC standard may reduce feed cost and allow for use of alternate feedstuffs.

MATERIALS AND METHODS

This experiment was conducted during summer August to September, 2012 where maximum ambient temperature remained 30-35°C with relative humidity 50-60%. Weather data was recorded by Agro Meteorological Department, National Agricultural Research Centre, Islamabad, Pakistan.

***Dietary treatments*:** Three experimental diets each for starter (0-4 weeks) and finisher phase (5^{th} week) were prepared. The diets A, B and C contained 21.92, 21.35 and 21.35% CP while 3090, 3090 and 3034 Kcal/kg ME, respectively, for

starter phase. For finisher phase, diets A, B and C had 20.79, 20.22 and 20.22% CP and 3118, 3118 and 3062 Kcal/kg ME, respectively. Percent composition and nutrient profile of starter and finisher diets are presented in Table 1.

***Birds and management*:** Two thousand two hundred and fifty (2250), day old broiler chicks (Hubbard) were procured from Islamabad Poultry Breeding Company, Rawalpindi. Chicks (average weight of 41.0g) were randomly divided into three groups. Each group was further divided into six replicates having 127 chicks each. The birds for each replicate were kept in separate pens measuring 10′x15′and reared under standard managemental conditions on deep litter upto 35 days. Birds were vaccinated against Newcastle, Infectious bronchitis, Infectious bursal and Hydro-pericardium syndrome diseases as per recommended schedule by Disease section, Poultry Research Institute, Rawalpindi. The feed was offered three times a day at equal intervals. Fresh and chlorinated water was made available round the clock. Birds were weighed at the start of experiment per replicate basis. Record of daily feed intake and weekly weight gain of each replicate was maintained and feed gain ratio was calculated. Mortality of birds was recorded as and when occurred.

***Economic analyses*:** Economic analysis of live weight gain of broiler chicks was calculated by deducting net expenditure cost of chicks from the gross income of the live weight gain (Khan *et al*., 2005).

***Chemical analyses*:** Proximate composition of feedstuffs, diets and broiler meat were determined by AOAC method (2011) while calcium and total phosphorus of diets were determined by following the methods described by AACC (1960) and Fiske and Subarrow (1925), respectively. The fatty acid profile of abdominal fat pads was determined by extracting the fat in chloroform and methanol (Bligh and Dyer, 1959). Fatty acids were converted into methyl esters and separated by gas chromatography, as described by

Table 1. Composition (%) of experimental diets with different levels of crude protein and metabolizable energy.

Ingredients	Diets A		Diet B		Diet C	
	Starter	Finisher	Starter	Finisher	Starter	Finisher
Corn	44.95	31.01	44.95	31.02	44.54	31.00
Rice	5.49	21.81	4.49	21.42	4.50	17.10
Wheat	4.99	5.00	6.29	5.00	6.00	8.00
Rice polish	5.99	5.10	6.99	7.01	7.01	7.00
Wheat bran	----	1.00	----	1.00	----	2.00
Corn glutten meal 60 %	0.50	0.60	0.50	0.60	0.00	0.10
Corn glutten meal 30 %	0.50	0.50	0.50	0.50	0.50	0.50
Rapeseed meal	3.50	2.50	3.50	2.50	3.50	2.50
Canola meal	10.99	12.00	10.99	12.01	11.01	12.00
Sunflower meal	2.60	3.00	4.00	2.00	4.00	2.90
Guar meal	2.00	3.00	0.20	2.00	1.30	2.90
Soybean meal	10.99	6.80	9.99	6.70	10.01	6.70
Fish meal 5.25 %	2.40	2.00	2.50	2.00	2.50	2.00
Molasses	2.00	2.00	2.00	2.00	2.00	2.00
Marble chips	0.80	0.70	0.80	0.70	0.80	1.00
Di-Cal. Phosphate	0.70	0.48	0.69	0.59	0.68	0.63
Bone ash	0.60	0.60	0.60	0.60	0.60	0.60
L-lysine	0.18	0.10	0.21	0.13	0.21	0.13
DI-methionine	0.11	0.08	0.11	0.09	0.11	0.10
Sodium chloride	0.11	0.10	0.11	0.10	0.11	0.10
Sodium bicarbonate	0.10	0.11	0.10	0.12	0.10	0.13
Premix	0.50	0.50	0.50	0.50	0.50	0.50
Chemical composition						
Crude protein %	21.92	20.79	21.35	20.22	21.35	20.22
ME, Kcal/Kg	3090.00	3118.00	3090.00	3118.00	3034.00	3062.00
Crude fat %	3.32	3.36	3.32	3.45	3.41	3.42
Crude fiber %	5.40	5.18	5.40	5.32	5.66	5.58
Ash %	6.90	6.57	6.90	6.62	7.59	6.84
Calcium %	0.97	0.89	0.97	0.90	1.00	0.90
Total Phosphorus %	0.70	0.70	0.70	0.69	0.70	0.70
Lysine %	1.07	0.93	1.07	0.93	1.07	0.93
Methionine %	0.45	0.42	0.45	0.42	0.45	0.42

Lopez-Bote *et al*. (1997) using 5890 Hewlett Packard Espanola S.A., Las Rozas, 20230 Madrid Spain and a glass column (Sp-2%-2300, Gp Sp-3%-2310) on 100/120 chromosorb® WAW. External standards of fatty acid methyl esters were purchased from Sigma-Aldrich Quimica, Alcobendas, 28100 Madrid Spain. Analyses were performed using a temperature program of 170 to 245°C. The injector and detector were maintained at 250°C. The carrier gas (helium) flow was 0.5 $Kg/cm^{2.}$

***Statistical analysis*:** All data were determined using the SPSS version 9.5 (SPSS, Cary, NC, USA) statistical analysis program. A P-value of was considered a significant difference among groups and the comparison of means was made using Duncan's Multiple Range Test (Steel and Torrie, 1984).

RESULTS

***Growth performance*:** Data on body weight gain, feed intake and feed gain ratio of birds with diets A, B and C are presented in Table 2. The data revealed non-significant (P>0.05) difference in weight gain, feed intake and feed gain ratio in birds fed diets A, B and C during starter and finisher phases.

***Meat composition*:** The effect of diets A, B and C varying in CP and ME on meat composition summarized in Table 3. The data showed that experimental diets did not change (P>0.05) the broiler meat composition.

Table 2. Growth performance of broiler chicks fed on experimental diets with different levels of crude protein and metabolizable energy.

Parameters	Diets*			Pooled SEM
	A	B	C	
Starter phase (0-4 week)				
Av. Initial body weight, g/bird	41.40	41.51	41.10	0.11 NS
Av. Total body weight, g/bird	1032.96	1018.27	1026.66	3.67 NS
Av. Total feed intake, g/bird	1990.08	1990.54	1982.91	2.14 NS
Feed gain ratio	1.93	1.95	1.93	6.01 NS
Finisher phase (5th week)				
Av. Total body weight gain, g/bird	343.33	346.34	361.58	4.89 NS
Av. Total feed intake, g/bird	969.62	949.66	1008.73	15.02 NS
Feed gain ratio	2.82	2.74	2.79	0.02 NS
Overall (0-5 week)				
Av. Total body weight gain, g/bird	1376.29	1364.61	1388.24	5.91 NS
Av. Total feed intake, g/bird	2959.70	2940.20	2991.64	12.99 NS
Feed gain ratio	2.15	2.15	2.15	0.00 NS

Table 3. Meat and fatty acid composition (%) of broilers fed on experimental diets with different levels of crude protein and metabolizable energy.

Particulars	Diets*			Pooled SEM
	A	B	C	
Moisture	41.40	40.98	41.45	0.13 NS
Crude Protein	85.54	84.98	84.57	0.05NS
Ash	4.67	4.67	4.50	0.08 NS
Crude fat	5.00	5.16	5.33	0.12 NS
	------ Fatty acids composition ------			
Myristic acid (C14:0)	0.77	0.75	0.79	0.01 NS
Palmitic acid (C16: 0)	29.76	29.27	25.38	1.38 NS
Stearic acid (C18: 0)	4.55	4.84	5.25	0.20 NS
Total saturated fatty acid	35.09	34.84	31.42	1.18 NS
Oleic acid (C18: 2)	47.88	48.33	45.65	0.82 NS
Total Monounsaturated fatty acid	47.88	48.33	45.65	0.82 NS
Linoleic acid (C18: 2)	16.44	16.08	18.65	0.80 NS
Linolenic acid (C18: 3)	0.82	0.70	0.86	0.04 NS
Total polyunsaturated fatty acid	17.26	16.78	19.51	0.84 NS
Unsaturated/ Saturated ratio	1.86	1.87	2.07	

Figures within the rows without any superscript do not differ significantly (P < 0.05).

*A: Starter: CP=21.92%; ME= 3090Kcal/kg, Finisher: CP= 20.79%; ME=3118Kcal/kg.

B: Starter: CP=21.35%; ME= 3090Kcal/kg, Finisher: CP= 20.22%; ME= 3118Kcal/kg.

C: Starter: CP=21.35%; ME= 3034Kcal/kg, Finisher: CP= 20.22%; ME= 3062Kcal/kg.

***Fatty acid profile of abdominal fat*:** The effect of diets A, B and C varying in CP and ME on fatty acid composition of abdominal fat summarized in Table 4. The experimental diets have non-significant (P>0.05) effect on fatty acids profile of abdominal fat.

***Economic analysis*:** The economics of groups of birds fed diet with low protein and energy were more encouraging as it generated more profit than other groups. The results revealed that per bird total return on sale was US$ 1.56, 1.56 and 1.63 against the total expenditure of US$ 2.75, 2.73 and 2.78 per bird for groups A, B and C, respectively (Table 4). The net income per bird was US$ 1.56, 1.56 and 1.63 for groups A, and C, respectively.

Table 4. Economic analyses of broilers fed on experimental diets with different levels of crude protein and metabolizable energy.

Parameters	Diets*		
	A	B	C
Chick cost (US$)**	0.13	0.13	0.13
Feed intake (g/bird)	1990.08	1990.54	1982.91
Cost of feed consumed (US$/bird)***	0.82	0.80	0.78
Other cost (US$)	0.24	0.24	0.24
Per bird total cost(US$)	1.19	1.17	1.15
Av. Live weight after 35 days (g)	1376.29	1364.61	1388.24
Return on sale at US$ 2.00 per kg	2.75	2.73	2.78
Per bird net profit (US$)	1.56	1.56	1.63

*A: Starter: CP=21.92%; ME= 3090Kcal/kg, Finisher: CP= 20.79%; ME=3118Kcal/kg; B: Starter: CP=21.35%; ME= 3090Kcal/kg, Finisher: CP= 20.22%; ME= 3118Kcal/kg; C: Starter: CP=21.35%; ME= 3034Kcal/kg, Finisher: CP= 20.22%; ME= 3062Kcal/kg; **1US$ = 105.94 Pakistani rupees; ***Feed price: Broiler starter= US$ 20.25/50kg; Broiler Finisher=US$ 20.20/50kg.

DISCUSSION

The results of growth performance in the current study are in accordance with Oyedeji *et al*. (2005), who reported non-significant (P>0.05) effect of reducing CP in diets on live weight gain. During hot and humid season higher dietary levels of protein create discomfort for birds and birds suffer heat stress but low protein diets (20-21%) do not create such suffering and birds feel easy (Siddiqur-Rehman *et al*., 2002). Mbajiorgu *et al*. (2011) reported that CP had non-significant (P>0.05) effect on feed intake when diets were with minimum energy difference or iso-energic. The influence of energy to protein ratio on feed consumption or their interaction on feed intake was reported to be non-significant (P>0.05) (Summers *et al*., 1992). Moosavi *et al*. (2012) reported that birds consumed relatively more feed during finisher phase to maintain the CP and ME requirements. Kamran *et al*. (2008) found that iso-caloric diets with low protein will show the better efficiency of protein utilization because equal gain is achieved from a better intake. Summer *et al*. (1992) reported non-significant (P>0.05) effect of CP to ME interaction on feed: gain ratio. The present findings showed better feed: gain ratio because of the controlled protein and energy levels of the diets as reported by Adela *et al*. (2013). The control over energy intake is important not only because it affects feed: gain ratio but also it has negative effect on carcass characteristics.

Leeson *et al*. (1996) and Moosavi *et al*. (2012) found no difference in body composition of broilers when grown up to 2.1 Kg as in the present study. With controlled and lower energy diets, the feed intake is reported to be elevated and a concomitant increase in CP in carcass confirmed that broiler's high intake was well correlated to maintain CP and ME intake (Kamran *et al*., 2008). Carcass composition remained similar because the body weight throughout the experiment remained similar with diets A, B and C.

Anonymous (1988) reported 31, 45 and 23% saturated, mono-unsaturated and poly-unsaturated fatty acids, respectively in broiler's abdominal fat. The findings of the current study are in accordance with the National Livestock and Meat Board, Chicago. IL (Anonymous, 1988). Kamran *et al*. (2008) did not find any effect of dietary fat intake when the energy to protein ratio was constant. It is evident from results that oleic acid (C18:1) was the predominant fatty acid palmitic (C 16:0) and linoleic acid (C18:3) were also in higher amounts. These results are in accordance with the findings of Baio and Lara (2005), who reported that oleic acid as the major fatty acid in abdominal fat because of soybean and sunflower meal in diets. Crespo and Esteve-Garica (2001) also found that monounsaturated fatty acids (C18:1) were higher in abdominal fat pad whereas polyunsaturated fatty acids (C18:3) were higher in muscle fat. In the monogastric digestive system of the chicken, lipids are absorbed and deposited mainly in the form in which they are consumed (Ferrini *et al*., 2008). High level of oleic acid and polyunsaturated fatty acids (C 18:3) was beneficial for human health (Anonymous, 1988). The economic analyses of the present study are similar to findings of Siddiqur-Rehman *et al.* (2002), who reported that with 21% CP and 3100 Kcal/Kg ME during starter period gave the least cost per kg body weight of broiler.

In conclusion, reducing CP by 0.50% alone or in combination with 50 Kcal/Kg ME did not depress growth performance in birds and reducing CP by 0.50% in combination with 50 Kcal /Kg ME gave better results in terms of cost of production and profit. It may be suggested that feed millers can be formulated least cost rations that broiler starter ration may contain 21.35% CP with 3034 Kcal/Kg ME and broiler finisher ration may contain 20.22% CP with 3062 Kcal/Kg ME under Pakistan climate.

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