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Short communication

EFFECT OF DIETARY ENERGY TO PROTEIN RATIO ON THE GROWTH OF MALE BROILERS KEPT UNDER OPPRESSIVELY HOT CLIMATIC CONDITIONS

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A trial involving male broiler birds in completely randomized design was conducted to determine optimal dietary energy to protein ratio (E:P) for maximum performance in severe hot climatic conditions. One hundred and fifty 8-days old Starbro® male chicks were divided into 15 experimental units/ replicates having 10 chicks/ replicate. Five experimental diets were formulated with metabolizable energy (ME) 2900, 3000, 31000, 3200 and 3300 Kcal/kg, and a constant crude protein (CP) of 21% with E:P 138, 143, 148, 152 and 157 respectively. The experimental diets were randomly allotted to replicates and fed *ad libitum* from day 8-42 and data on weekly body weight gain and feed consumption recorded. At the end of the trial, two birds from each replicate were picked up at random and slaughtered to record the carcass yield. Feed consumption of the birds was observed to be significantly (P<0.05) improved when dietary ME diluted from 3300 to 3200. Weight gain and carcass yield were not greatly affected (P>0.05) by ME dilution. The feed conversion ratio (FCR) was significantly (P<0.05) improved with ME 3300 compared with that of 2900 kcal/ kg. Increasing ME or replacing carbohydrates calories with fat/vegetable oil calories in the diet of male growing broilers was beneficial in terms of growth, FCR and dressed meat yield.
Keywords: Dietary energy to protein ratio, energy dilution, hot environment

INTRODUCTION

One of the problems challenging poultry industry in Pakistan is the extreme weather especially high temperature during summer (Ali, 2003). As ambient temperature increases, feed intake decreases (Ahmad and Sarwar, 2006) unavoidably leading to reduced growth. Reduced feed intake in response to high ambient temperature is a bird's regulatory mechanism to decrease the metabolic heat production, which ultimately helps in lowering body temperature. This condition can be alleviated by feeding high energy and nutrient dense diets having low heat increments (Dale and Fuller, 1979). Such kind of diets could be formulated by replacing calories from carbohydrates with those of fats (Reece and McNaughton, 1982) as fats have the lowest heat increment of three major classes of nutrients (Dale and Fuller, 1980) utilized by the body for energy. Besides, reducing total dietary protein level, such diet is also useful in decreasing the severity of stress if appropriate ratios of essential amino acids are maintained (Zaman *et al.*, 2008). The effect of dietary energy to protein ratios (E:P) higher than that suggested by NRC (1994) on the growth and carcass yield have rarely been investigated (Kamran *et al.*, 2008; Zaman *et al.*, 2008). The present study was planned to evaluate the effect of altering E:P on feed consumption, growth and carcass composition of the growing male broilers during severe sub-tropical summer months (mid June-July) in Faisalabad, Punjab, Pakistan.

MATERIALS AND METHODS

Two hundred, day-old, Starbro® male broiler chicks were reared in a group for one week (acclimatization period), during which they were fed commercial broiler starter mash. On day 8th, one hundred and fifty chicks closest to the average weight were chosen for the trial. These birds were divided into 15 experimental units/ replicate each having 10 chicks. Five experimental diets A, B, C, D, and E were made using the software *WinFeed 2.8* (WinFeed Ltd. U.K. 185, The Sycamore, Milton, Cambridge). These replicates were randomly allotted to experimental diets such that each diet received 3 replicates under a completely randomized design. The experimental diets viz., A, B, C, D and E had ME 2900, 3000, 31000, 3200 and 3300 kcal/kg, and a constant CP 21% resulting in dietary E:P 138, 143, 148, 152 and 157, respectively. Dietary ME of experimental diets was increased by nutrient adjustment and supplementing vegetable oil. All the diets were chemically analyzed for proximate composition following (AOAC, 2000).
The birds were kept on softwood shaving as a bedding material on a concrete floor in a separate pen measuring 3×4, thoroughly cleaned and disinfected for this purpose.

The experimental diets were fed *ad libitum* from day 8-42. Fresh drinking water was available to chicks all the time. The data on weekly body weight and feed consumption were recorded to calculate growth rate and FCR. Mortality, corrected for feed intake, was checked daily. At the end of experiment, two birds from each replicate were picked up at random and slaughtered to record the dressed meat yield.
Cyclic day and night temperature during the experimental period (mid June to the end of July) was followed except during brooding. Chicks were vaccinated according to local prescribed schedule.
The data collected on feed consumption, weight gain, FCR and dressing percentage were subjected to statistical analyses for interpretation of results using analysis of variance technique and treatment means were compared by Tukey's significance test (Minitab, 2000).

RESULTS AND DISCUSSION

The ingredient and chemical composition (calculated) of the experimental diets is given in Table 1 & 2. The proximate composition of the experimental diets was in close agreement with the calculated values. A dietary CP level of 21% was maintained; whereas, dietary ME was increased by the addition of oil resulting in E:P 138, 143, 148, 152 and 157 in diets A, B, C, D and E, respectively. The remaining nutrients were kept almost constant.

The productive capacity of modern broiler chicks is partly regulated by the E:P. The results of the present trial reflect that the birds fed on diets with ME 3000, 3100 and 3300 kcal/kg gained comparatively more weight than control (CP 21; ME 2900). Increase in dietary ME beyond 3000 kcal/kg or E:P expansion did not affect the growth of birds. Dietary energy dilution from 3200 to 3100, and 3000 or 2900 kcal/kg numerically improved feed consumption (Table 3) but the difference ($P>0.05$) was non-significant. However, the feed consumption was significantly improved ($P<0.05$) when dietary ME diluted from 3300 to 3200 kcal/ kg (Table 3). These finding indicate that chicks are adapted to dietary energy dilution. They will simply eat less at high dietary ME level maintaining overall ME intake. In the present trial, almost similar ME intake was maintained by the birds (Table 3) substantiating the general observation that feed consumption is regulated by caloric density (Leeson *et al.*, 1996). Effect of energy dilution on feed consumption is, however, disrupted with elevated ambient temperature. As the trial was undertaken from mid June to end of July, when the environmental temperature was oppressively higher and birds were under chronic heat stress, the overall feed consumption remained lower. A decreased feed consumption in response to higher environmental temperature is a part of bird's physiological adaptation to heat stress (Deaton *et al.*, 1978).
Results of the present trial indicate that the FCR was

Table 1. Ingredient composition of experimental diets differing in energy to protein ratio

Ingredients %	EXPERIMENTAL DIETS				
	A	B	C	D	E
Corn	35.78	37.40	33.69	31.09	29.38
Wheat	10.00	8.00	8.00	8.00	8.00
Rice tips	6.08	8.28	9.85	10.68	12.06
Rice polishings	8.00	8.00	8.00	8.00	8.00
Soybean meal	16.87	10.53	11.75	10.81	7.00
Canola meal	4.00	4.00	4.00	4.00	3.00
Cotton seed meal	6.00	6.00	5.00	5.00	6.13
Corn gluten meal 60%	3.00	5.00	5.00	6.00	8.00
Fish meal	2.00	5.00	5.00	5.00	6.00
Vegetable oil	1.35	1.80	3.74	5.42	6.59
DCP[1]	1.54	1.30	1.33	1.34	1.26
Molasses	3.00	3.00	3.00	3.00	3.00
Premix[2]	0.50	0.50	0.50	0.50	0.50
L-Lysine	0.11	0.13	0.11	0.13	0.18
DL-Methionine	0.13	0.09	0.09	0.09	0.07
L-Threonine	0.04	0.04	0.04	0.04	0.04
Limestone	1.60	0.93	0.90	0.20	0.79
Total	100.00	100.00	100.00	100.00	100.00

[1]di-Calcium phosphate (Gelatin Pak.)

[2]Each kg of premix contained: Vit. A (IU) 7500000, Vit. D_3 (IU) 1500000, Vit. B_1 (mg) 1000, Vit. B_2 (mg) 5000, Vit. B_6 (mg) 1500, Vit. B_{12} (mg) 20000, Vit. E (mg) 15000, Vit. K_3 (mg) 2000, Folic acid (mg) 500, Pantothenic acid (mg) 8000, Niacin (mg) 15000, Choline chloride (mg) 150000, Manganese (mg) 15000, Zinc (mg) 45000, Copper (mg) 25000, Potassium (mg) 2000, Iodine (mg) 2000, Iron (mg) 45000

Table 2. Nutrient composition of experimental diets with varying metabolizable energy but a constant dietary crude protein

Nutrients	EXPERIMENTAL DIETS				
	A	B	C	D	E
Crude Protein (%)	21.00	21.00	21.00	21.00	21.00
ME (Kcal/kg)	2900.00	3000.00	3100.00	3200.00	3300.00
ME:CP	138:1	143:1	148:1	152:1	157:1
Crude Fibre (%)	4.00	4.00	4.00	4.00	4.00
Ether Extract (%)	4.5	5.07	6.83	8.40	9.61
Calcium (%)	1.08	1.00	1.00	1.00	1.00
Phosphorus (%)	0.45	0.45	0.45	0.45	0.45
Lysine (%)	1.10	1.10	1.10	1.10	1.10
Methionine (%)	0.50	0.50	0.50	0.50	0.50
Arginine (%)	1.36	1.29	1.29	1.27	1.25
Histidine (%)	0.53	0.51	0.51	0.51	0.50
Phenylalanine (%)	0.99	0.99	0.99	0.99	1.00
Threonine (%)	0.80	0.80	0.80	0.80	0.80
Leucine (%)	1.80	1.90	1.90	1.95	2.04
Isoleucine (%)	0.81	0.80	0.80	0.80	0.80
Valine (%)	0.98	0.99	0.99	0.99	0.99
Tryptophan (%)	0.24	0.22	0.22	0.22	0.20

Table 3. Feed consumption, ME intake, weight gain, FCR and dressing percentage of birds in response to changes in dietary ME: P from day 8-42.

Treatment	ME (kcal/kg)	E : P	Feed Consumption (g)	ME Intake/chick (Mcal)	Weight Gain (g)	FCR	Dressing Percentage
A	2900	138	4016^{a}	11.64^{a}	1767^{a}	2.27^{a}	62.1^{a}
B	3000	143	3978^{a}	11.93^{a}	1843^{a}	2.15^{b}	63.1^{a}
C	3100	148	3872^{ab}	12.00^{ab}	1841^{a}	2.10^{bc}	64.7^{a}
D	3200	152	3899^{a}	12.47^{a}	1839^{a}	2.12^{b}	65.3^{a}
E	3300	157	3639^{b}	12.00^{b}	1820^{a}	2.00^{c}	66.4^{a}
SEM	-	-	75.9		22.7	0.03	0.99

Note: Means with same superscript have non-significant difference

significantly improved (P<0.05) in birds fed on diets with ME 3300 kcal/ kg and depressed on diet with ME 2900 kcal/kg. However, diets with ME 3000, 3100 and 3200 kcal/kg displayed no significant advantage on FCR. The results of the present study were in agreement with Soliman *et al.* (1999) who reported that broilers fed high energy diets across all temperatures significantly (P<0.05) improved FCR. It seems that a wider E:P (158) is more beneficial in heat-stressed condition. Onwudike (1983) demonstrated that a significant interaction between protein and energy in diet exists with respect to average daily gain and feed efficiency. Higher dietary CP is detrimental for broilers raised under high ambient temperature (Ojano-Dirain and Waldroup, 2002) which increased the severity of stress resulting from heat production from excess protein metabolism in the body (Kamran *et al*., 2004). Numerical decrease in the carcass yield was observed in response to dietary ME dilution, however, the difference was non-significant which demonstrates that a single energy to protein ratio may not optimize all production parameters in birds (Mbajiorgu, 2011).

Increasing dietary ME content (in the form of added oil) or replacing carbohydrate calories with fat calories in the diet of male broiler birds looks to be compelling as it maintained body weight and improved FCR during high ambient temperature. More work is required to be done on dietary energy dilution in broilers encompassing larger number of birds kept in open-shed houses during hot climatic conditions.

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