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The Effect of Feeding Different Levels of Methionine and Two Levels of Energy on Broiler Performance During Heat Stress

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Abstract: This experiment was conducted to study the effect of high environmental temperature on growth performance, mortality of broiler chicken using graded level of methionine at two different levels of energy. Two hundred and forty day old chick Ross were used. Six dietary treatment with 3050 kcal/kg and 2850 kcal/kg and three levels of methionine 0% (NRC, 1994 level), 0.2%, 0.4% above the NRC (1994) level were fed to each group with four replicate ten birds each. The body weight gain, feed consumption, feed conversion ratio, water intake and mortality were evaluated. Birds fed diet with low energy diet (2850 kcal/kg) supplemented with 0.2% methionine above the NRC level (1994) attained significantly ($p<0.05$) higher body weight gain compared to those fed high energy (3050 kcal/kg) with 0.4% methionine. No significant ($p>0.05$) effect of the two different levels of energy on body weight gain was found. In low energy diets (2850 kcal/kg) the higher levels of methionine added to the diets resulted in significantly ($p<0.05$) improved feed conversion ratio as compared to non supplemented groups. In contrast, the birds fed high energy diet had no difference in feed conversion between the different groups. The birds fed low energy diet (2850 kcal/kg) had significantly ($p<0.05$) higher feed intake than those fed high energy diet (3050 kcal/kg). No statistical significant effect of different levels of methionine on mortality. Water intake increase in birds fed diet with 2850 than those fed 3050 kca/kgME.

Key words: Heat stress, methionine, energy, performance, broiler

INTRODUCTION

Broiler production in tropical and subtropical countries faces many challenges which result in lower production performance which is relatively inferior compared with performance in temperate countries in North America and Western Europe. One of the major challenges in the tropics is the high temperature and high relative humidity. In Sudan poultry production during summer months is affected adversely in quantitative and qualitative terms. The quantitatively effects are mainly due to high mortality and qualitatively due to reduced body weight in mature broilers and egg production in broiler breeder hens. Broilers respond adversely to hot environments and the documented reactions of poultry to high ambient temperatures include reduced feed intake and rate of body weight gain while the extent of fat deposition and water consumption are increased.

Poultry react to high ambient temperatures by various physiological and behavioural mechanisms aimed at reducing the undesirable effects of high temperature on their well-being. In recent research, it was concluded that elevated temperature influenced the amino acids needs of broilers as it reduced amino acids digestibility. Consequently in order to improve live performance of broilers under heat stress we need to improve their access to limiting nutrients and decrease feed heat increment (Zarate *et al*., 2003).

Temim *et al*. (2000) concluded that an increase in dietary protein may improve growth of birds reared at high temperature. Information on the requirement for energy, protein and limiting amino acids in broilers is available from temperate countries. However, the requirements in the tropics have not been documented. The objectives of the present study were to evaluate the effects of feeding various levels of amino acids (lysine and methionine) and different levels of energy on growth performance of broilers under high environmental temperatures.

MATERIALS AND METHODS

There were six dietary treatments, two level of Metabolizable Energy (ME), high energy level (3050 kcal/kg), low energy level (2850 kcal/kg) and three levels of tested amino acid (methionine) NRC 1994 level, 0.2%, 0.4% above the NRC 1994 level.

Experimental birds: Day old unsexed Ross broilers chicks were used in these experiments.

The chicks were weighed and randomly distributed in experimental pens with approximately the same initial weight into six groups. Each group was further divided into replicate.

Management

Feeding and watering: The birds were fed on the basal diet (Diet 1) for an adaptation period of one week, then

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Table 1: Formulation of the experimental diet

	Diets					
Ingredient %	1	2	3	4	5	6
Sorghum	57.83	57.83	57.89	46.28	46.45	46.43
Ground nut meal	16.50	16.50	16.60	14.55	14.55	15.00
Sesame meal	15.50	15.50	15.50	14.80	14.80	14.95
Wheat bran	4.00	4.00	3.72	18.28	17.94	17.12
Superconcentrate*	5.00	5.00	5.00	5.00	5.00	5.00
Dicalcium phosphate	0.67	0.64	0.64	0.59	0.56	0.60
Sodium chloride	0.50	0.33	0.25	0.50	0.50	0.50
Lysine	-	-	-	-	-	-
Methionine	0.00	0.20	0.40	0.00	0.20	0.40
Total	100.00	100.00		100.00	100.00	100.00

Table 2: Calculated composition

	Diets					
Item	1	2	3	4	5	6
ME	3050.85	3050.58	3050.08	2850.73	2850.14	2850.00
Crude protein	23.90	23.96	23.69	23.69	23.65	23.78
Calcium	1.05	1.09	1.07	1.07	1.06	1.07
Phosphorus	0.46	0.45	0.45	0.45	0.45	0.46
Lysine	1.10	1.10	1.13	1.13	1.12	1.13
Methionine	0.50	0.70	0.90	0.50	0.70	0.90
Meth + Cystine	0.82	0.82	0.91	0.91	0.92	0.913

Table 3: Proximate analysis of the experimental diet

	Diets					
Item %	1	2	3	4	5	6
Dry matter	95.00	69.70	95.40	95.91	94.60	94.50
Crude protein	24.97	25.01	24.90	24.36	25.02	25.50
Ether extract	4.03	4.00	4.50	4.30	4.80	4.12
Crude fiber	5.10	5.98	5.70	7.20	6.81	7.00
Ash	7.68	7.00	6.99	7.99	7.80	6.89
NFE	53.22	54.71	53.31	52.06	50.17	50.99
ME kcal/kg	3.6823	3.6935	3.809	3.726	3.8434	3.673

they were given the experimental diets described in Table 1 and Table 2. Feed and water were provided *ad libitum*. Continuous light was provided during the study period.

Experimental house: The experiment was conducted in an open sided deep litter poultry house. The house was constructed of iron post pillars, zinc sheet roofing, concrete floor and wire netting sides. The experimental pens were (1 x 1 m^2 area). Dry wood shaving was used as litter material. The temperature inside the poultry house was recorded which range from 32-42°C.

Performance measurement: Broiler chicks were weight at the start of the experiment and then at the end of each week for six week. Body weight gain and feed intake and feed conversion ratio (feed/gain) were estimated weekly throughout experimental period. Mortality was recorded when it occurred.

Water consumption: Daily water consumption was measured using measuring cylinder to measure the remaining water in the drinker and then calculate the consumption after adjusting the total capacity of the drinker by subtracting the vapour amount. The vapour amount was measured by putting a drinker in the center of the house.

RESULTS

Data on Table 4 show the overall performance of broiler chicks reared during heat stress at high environmental temperature and fed different levels of methionine and two energy levels.

Broilers fed diet with low energy diet (2850 kcal/kg) supplemented with 0.2% methionine above the NRC level (1994) attained higher body weight gain compared to those fed high energy (3050 kcal/kg) with 0.4% methionine above the NRC (1994) recommended level. Although, the former attained the highest weight gain but it was not different from all the dietary treatments except the mentioned above.

In low energy diets the benefit of increasing methionine level from NRC recommendation (1994) to 0.2% was 9.23% increase in weight gain as compared to 0.4%

Table 4: Overall performance of broiler chicks under high temperature fed different level of methionine and energy

Individual treatment							
Diets	Added methionine %	Live weight g\bird	Weight gain g\bird	Feed intake g\bird	FCR g:g	Water intake ml\bird	Mortality %
High energy	None	1484.20[ab]	1445.20[ab]	2930.50[c]	2.03[b]	6695.20[b]	60.00[a]
3050 kcal\kg	0.2	1539.35[ab]	1500.35[ab]	2980.20[c]	1.99[a]	6860.80[b]	40.00[ab]
	0.4	1434.24[b]	1395.24[b]	2900.10[c]	2.08[b]	6811.20[b]	40.00[ab]
Low energy	None	1453.00[ab]	1415.30[ab]	3260.30[a]	2.30[a]	7434.10[a]	20.00[b]
2850 kcal\kg	0.2	1588.20[a]	1550.20[a]	3130.20[a]	2.02[b]	7442.23[a]	20.00[b]
	0.4	1468.12[ab]	1430.12[ab]	2960.32[b]	2.07[b]	7480.50[a]	20.00[b]
	±SE	41.97	60.04	6.26	0.07	13.35	5.25
Individual factor							
	High energy (3050 kcal\kg)	1485.36[a]	1446.86[a]	2936.70[b]	2.03[b]	6789.07[b]	46.67[a]
	Low energy (2850 kcal\kg)	1503.71[a]	1465.21[a]	3116.94[a]	2.13[a]	7452.28[a]	20.00[b]
	±SE	24.27	34.66	3.61	0.04	5.45	11.05
	None	1468.50[ab]	1430.25[ab]	3095.40[a]	2.16[a]	7064.65[a]	40.00[a]
	0.2	1563.78[a]	1525.28[a]	3055.20[a]	2.00[b]	7151.52[a]	30.00[a]
	0.4	1451.18[ab]	1412.68[b]	2930.21[b]	2.07[b]	7145.85[a]	30.00[a]
	±SE	29.67	42.45	4.43	0.05	6.67	9.52

Means with different superscript in the same column differ significantly (p<0.05)

level. While the latter weight gain increased about 1.18% but it was not statistically different from the NRC recommended level. However, in high energy diets the benefit of increasing methionine level from NRC recommendation (1994) to 0.2% was 3.56% but no statistical (p>0.05) difference was found. Lower weight gain was attained by the group fed 0.4% above NRC recommendation (1994) it was decreased about 3.58% from the group fed NRC level. No significant (p>0.05) difference between two levels of energy on body weight gain was found.

In low energy diets (2850 kcal/kg) the higher levels of methionine added to the diets resulted in improved feed conversion ratio as compared to non supplemented groups. However, in the birds fed high energy diet there was no difference in feed conversion between the groups fed NRC recommendation (1994) level and those fed the supplemented levels (0.2, 0.4% methionine).

The feed conversion ratio in the birds fed low energy diet (2850 kcal\kg) was high compared to those fed high energy diet (3050 kcal\kg).

The birds fed low energy diet (2850 kcal/kg) had high feed intake compared to those fed high energy diet (3050 kcal/kg).

In low energy levels (2850 kcal/kg) no difference was found in feed intake between NRC recommended level and 0.2% level of methionine, however, a decrease in feed intake at 0.4% methionine was observed.

Mortality was lower in birds fed low energy diet as compared to those fed high energy diet. There was no statistical significant effect of different levels of methionine on mortality.

The water consumption of broilers fed low energy diet was increased compared with those fed high energy diet. No effect of different levels of methionine on water consumption was detected.

DISCUSSION

Methionine is generally considered to be the first limiting amino acid in poultry diets and its supplementation to the diet will improve amino acid protein synthesis (Temim *et al.*, 2000) and reduce amino acid digestibility (Zuprizal *et al.*, 1993).

A numerical increase in weight gain in birds fed 0.2% methionine above the NRC level. There was no significant impact on feed intake or feed conversion ratio. These results agree with those of Whitaker *et al.* (2002) cited by Riberio *et al.* (2005) who found that addition of methionine at about 100-140% of the NRC (1994) requirement did not improve broiler chicks performance at high temperature. Riberio *et al.* (2005) used methionine from different sources at different levels for feeding broiler chicks at high temperature and observed a numerical improvement in weight gain, FCR and body weight independent of source of methionine. The same author found no change in feed intake due to the methionine supplementation. Riberio *et al.* (2001) found no statistical difference in the performance due to methionine source or level heat stressed broiler chicks.

The feed intake of broiler chicks fed diet with 2850 kcal/kg (ME) was higher than those fed diets with 3050 kcal/kg (ME). This might be due to higher feed intake in weight birds consume more feed, nutrient than energy. It was indicated that broiler chicks have an innate ability to regulate feed consumption when feeding diet with variable energy concentrations so as to maintain a relatively constant energy (Leeson and Summers, 2000). Baghel and Pradhan (1989) found that at high temperature the birds fed a low energy diet with high protein attained higher weight gains and they attributed this to the large amounts of feed ingested.

This also agrees well with the findings of Scott and Balnave (1988, 1989) and Balnave and Abdoellah (1990) who observed that feeding a low energy diet to laying bens allowed increased consumption of nutrients other than energy. This is important because it increased protein intake without any increase in energy requirement.

It is generally assumed that decreased feed intake in heat stressed broiler chicks is related to the heat accumulated in the body during heat stress. If the high energy diet supplemented with r methionine resulted in greater heat load for thermally stressed birds the birds should have responded with lowered feed intake. But this did not occur and feed consumption was not significantly affected. There is on storage pool in the bird's body for amino acids and they used as a source of energy.

Feed conversion ratio was not altered by methionine supplementation. This result is in disagreement with Ojano-Dirain and Waldroup (2002) who found an improvement in feed utilization when methionine was added to the diet. This disparity might be due to the difference in the levels of methionine used and the environmental temperatures prevailing during the two experiments.

Mortality rate was not affected by amino acid levels, However, the groups fed diets with 2850 kcal/kg (ME) had a low mortality rate compared to those fed diets with 3050 kcal/kg (ME). It is noteworthy that high water consumption was observed in birds fed the low energy diet (2850 kcal/kg ME) and this may have contributed to their greater survival ability under heat stress.

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