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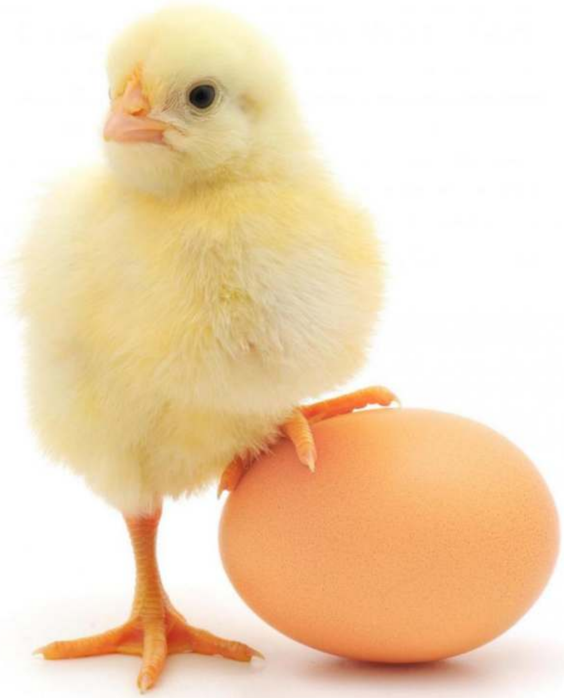

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Effect of Dietary Protein Level and Strain on Growth Performance of Heat Stressed Broiler Chicks

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Abstract: An experiment was carried out to study the effect of heat stress on growth performance of three broiler strains fed two different level of dietary protein. Three hundred and sixty, one day old unsexed broiler chicks (120 for each strain, Ross, Cobb and Hubbard strain), were randomly assigned in factorial arrangement. The total number of chicks for each strain was divided into two groups (A and B), with six replicates (10 chicks per each). Group (A) for each strain was fed on diet contained (23%) Crude Protein (CP) as starter diet for the first four weeks of age and then replaced by a diet contained (21%) CP as finisher diet. Group (B) for each strain was fed a diet contained (21%) CP as starter diet for the first four weeks and then shifted to a diet contained (19%) CP as finisher diet. The minimum and maximum range of ambient temperature during the experimental period was 34-93°C. Feed intake, body weight gain and feed conversion ratio were recorded on weekly basis throughout the entire duration of experiment, however feed intake per bird for Ross, Cobb and Hubbard strains were 3127.54, 3074.69 and 2850.17g respectively. The results revealed that birds in group (A) for each strain were significantly higher ($p<0.05$) in live body weight and growth performance than those in group (B) moreover Ross strain got the highest significant ($p<0.05$) live body weight gain in comparison with Cobb and Hubbard strains. The interaction between strain and diet was significantly ($p<0.05$) increased for live body weight.

Key words: Protein levels, heat stress, broiler chick strain, growth performance

INTRODUCTION

Poultry industry plays an important role in converting feeds into eggs and poultry meat which are excellent sources of animal protein for human. In the past, commercial broiler production in Sudan was practiced in a very limited scale by small agricultural units and private farms; however recently, there is an increasing demand for poultry products. In Sudan, feeding of poultry depends upon feeding 2 ingredients such as sorghum, wheat bran, groundnut cake, sesame cake in addition to the imported super concentrate. Generally Poultry commercial strains used in production are imported from temperate zone or produced by local hatcheries as hybrid such as Ross, Cobb and Hubbard. Successful poultry production in developing countries such as Sudan requires careful attention to climate, management, disease control, breeding and nutrition. Ambient temperature and feed ingredients are the fundamental factors limiting the development of poultry production in developing countries (Ayman, 2008). It has been shown that both protein synthesis and breakdown are affected by chronic heat stress; however protein synthesis is more affected than breakdown, Leading to reduced protein deposition. The decreased protein synthesis cannot be restored by high dietary protein level (Temin *et al*., 2000). The growth rate and meat yield of commercial fast growing broiler chickens is suppressed by high dietary protein level at high temperature (Cahaner *et al*., 1995). The high environmental temperatures had deleterious effects on growth and production performance of poultry. In broilers, it has been shown that decreased rate of growth occurs (Howlider and Rose, 1987) when environmental temperature rises. Breeding for improved adaptation to a particular stressful environment should be the strategy of choice when genotype by environment interaction significantly affects the economically important traits (Cahaner, 1990; Hartmann, 1990). The objective of the present study was to evaluate the growth performance of three different commercial broilers chicks strains reared under hot climatic conditions and fed different levels of dietary protein.

MATERIALS AND METHODS

Experimental birds: A total of 360 one-day-old chicks's, unsexed broiler chicks from three commercial strains (Ross, Cobb and Hubbard strain) were purchased from three different local hatcheries.

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Housing and Management: The experiment was conducted in a naturally ventilated, open-sided, deep litter poultry house, with a concrete floor, corrugated sheet roof. The house is extended east-west and constructed from 0.5 meter bricks walls, iron posts and wire netting. The house is portioned into equal size pens made of iron posts and wire netting (approximately one square meter), with enough apace allowance. The pens 3 were cleaned, washed and disinfected, thick layer of wood shaving litter material was laid on each pen with allocation of one tubular feeder trough and one round fountain drinker. Continuous Lighting was provided for 24 hours (natural light during the day 12 hours and provided artificial lighting during the night), using an incandescent bulbs (60 watt). The temperature inside the poultry house was recorded daily (three times 8:00 am, 1:00 pm and 6:00) by using digital thermometer hanging in the middle of house throughout the experimental period (8 weeks).

All Chicks from each strain (120 for each strain) were initially weighed and divided into two groups A and B with equal number of chicks (60 chicks). Each group was divided into six replicates (experimental unit) with 10 chicks per replicate. Chicks in group A were fed with starter diet containing 23% (CP) for the first four weeks and then shifted to finishing diet with 21% (CP). Group B was fed with starter diet containing 21% (CP) and then shifted to 19.5% (CP) and as finishing diet. The formulation and calculation of experimental diet is shown in Table 2. Calculation of experimental diets has been done according to NRC (1981). The metabolizable energy of local ingredients was calculated according to equation:

Me (kcal/kg) = 32.95 (% crude protein+ether extract x 2.25 x % available carbohydrates) - 29.2.
(Lodhi *et al*., 1976)

The flocks were kept and reared under same condition during the experiment. All Chicks were vaccinated against Infectious Bronchitis (IB) and Newcastle (ND).

Feed intake, body weight gain, live weight gain and feed conversion ratio: Feed intake, body weight gain and feed conversion ratio were measured on a weekly basis. The temperatures were recorded throughout the experimental period Table 1.

Statistical analysis: Data obtained were subjected to analysis of variance based on factorial arrangement by general linear model using SPSS program. Means separation was done by Duncan multiple range tests, according to (Steel and Torrie, 1980). The fowling model was used:

$$Y_{ij} = \mu + G_i + S_i + GS_{ij} + e_{ij}$$

Where:

Yij : Individual observation
µ : Overall mean
Gi : Strain effect (I = 1, 2 and 3)
Sj : Protein effect (j = 1 and 2)
Gsij : Strain by protein interaction
eij : Tthe random error associated with the experimental unit

Table 1: Environmental temperature (°C) during the experiment period

Age (days)	8:00 am	1:00 pm	6:00 pm	Min	Max
1- 7	33	38	36	33	38
8- 14	35	40	37	34	40
15- 21	34	39	36	35	39
22- 28	35	38	37	35	38
29- 35	35	41	38	35	41
36 -42	33	37	36	33	37
43- 49	34	39	38	34	39
50- 57	32	38	37	32	38

Table 2: Ingredients and calculated composition of the basal diets

Ingredient composition	Diet (1) Starter (%)	Diet (1) Finisher (%)	Diet (2) Starter (%)	Diet (2) Finisher (%)
Sorghum	61	61.5	61.5	68.5
Groundnut cake	15.8	12	12	7.3
Sesame cake	13	11.3	11.3	9
Wheat bran	4	9	9	9
Super concentrate	5	5	5	5
Limestone	0.9	0.9	0.9	0.9
Nacl	0.25	0.25	0.25	0.25
Lysine	0.04	0.04	0.04	0.04
Methionine	0.01	0.01	0.01	0.01
Total	100	100	100	100
Ingredient calculation crud protein	23.03	21.58	21.58	19.5
Metabolizable energy	3071	3031	3031	3079
(kcal/kg) Calcium	1.229	1.18	1.18	1.108
Phosphorus	0.328	0.329	0.329	0.321
Lysine	1.116	1.084	1.084	1.019
Methionine	0.49	0.465	0.465	0.426
Fibber	4.731	4.884	4.884	4.413

*Calculation based on analytical data of Sudanese feed obtained by Control Animal Nutrition Research Laboratory, Kuku (Bulletin III)

RESULTS AND DISCUSSION

Feed intake: The results showed the means values of feed intake in first week for Ross, Cobb and Hubbard strains are (98, 53, 86, 61, 81, 62) respectively. There is significant differences ($p<0.05$) between Ross and Cobb, Ross and Hubbard but there was no significant difference between Cobb and Hubbard. The feed intake in week 3, 6 and 7 show the same picture as described for week one. In week two there was significant difference between Ross and Cobb but there were no significant differences between Ross and Hubbard, Cobb and Hubbard. In week 5, 8 there was significant difference between Ross and Hubbard, Cobb and Hubbard (generally Hubbard strain has the lowest feed consumption) are shown in Table 3. These results might be attributed to genetic variation among different strains in their ability to withstand high ambient temperature and negative effect of high ambient temperature. These results was in full agreements with studies reported by El-Gendy *et al.* (1992); Yaron *et al.* (2004).

Body weight gain: The results of body weight gain are given in Table 3. It was clear that the weekly body weight gain is affected by genetic variation among different strains. Ross strain in the 1st, 5th, 7th and 8th week was got the highest body weight gain than Cobb and Hubbard. The difference in the body weight gain between these three strains is highly affected by different protein levels. The body weight gain reflected significant difference ($p<0.05$) between strains. This result might be due to the fact that, Ross strain was more adapted for hot environmental conditions.

Feed conversion ratio (FCR): The results of weekly feed conversion ratio were significantly different ($p<0.05$) between the three strains as appeared in Table 3. FCR from week two to week eight showed significant difference between Ross and Cobb but there was no significant difference between Ross and Hubbard, Hubbard and Cobb. On the other hand, Ross strain had higher feed conversion ratio than Cobb and Hubbard strains. This might be due to the impact of ambient temperature and it was in agreement with results obtained by Van Kampen (1981).

Effect of dietary protein level on feed intake: The effects of dietary protein level on weekly feed intake of the strains are presented in Table 4. The results demonstrated that there was significant differences ($p<0.05$) between strains at difference protein level but there was no significant difference within strain. Ross strain were consumed greater feed than Cobb and Hubbard at all level of protein but Hubbard strain was consumed smaller feed than the other two strains during the entire duration of the experiment. Feed intake was increased with increasing level of protein these findings are in consistence with that obtained by Blair *et al.* (1999); Sabino (2001). Birds were consumed more diet contain high crude protein than diet contain low crude protein these results were in consistence with that recorded by Pond *et al.* (1995); Ahmed *et al.* (1985).

Effect of dietary protein level on body weight gain: Effect of dietary protein level on body weight gain is given in Table 4. It is clear that weekly body weight gain is affected by different levels of protein. Body weight gain

Table 3: mean of weekly feed intake, body weight gain and feed conversion ratio

	Weekly feed intake (g/bird)							
Strain	1	2	3	4	5	6	7	8
Ross	98.53^{a}	159.93^{a}	267.57^{a}	385.36	482.50^{b}	567.96^{a}	566.53^{a}	599.16^{b}
Cobb	86.61^{b}	183.45^{b}	325.37^{b}	387.36	493.01^{b}	506.46^{b}	487.20^{b}	605.23^{b}
Hubbard	81.62^{b}	176.67^{ab}	300.92^{b}	387.36	439.58^{a}	484.09^{b}	479.58^{b}	500.35^{a}
SEM	±2.40	±5.98	±9.27	±9.98	±12.72	±11.27	±16.99	±23.41
	Weekly body weight gain (g/bird)							
	1	2	3	4	5	6	7	8
Ross	62.60^{b}	69.59^{a}	138.90^{a}	190.71	237.63^{b}	215.24	172.97^{b}	136.04^{b}
Cobb	57.79^{ab}	105.33^{b}	184.85^{b}	185.21	216.55^{ab}	186.24	123.30^{a}	90.56^{b}
Hubbard	55.92^{a}	96.07^{b}	165.80^{b}	194.20	190.72^{a}	190.92	120.70^{a}	37.25^{a}
SEM	±2.13	±4.73	±7.34	±8.01	±13.46	±11.74	±12.74	±15.99
	Weekly feed conversion ratio (g/bird)							
	1	2	3	4	5	6	7	8
Ross	0.91	1.37^{b}	1.51^{b}	1.54^{b}	1.53^{b}	1.57^{b}	1.60^{b}	1.68^{b}
Cobb	0.86	1.17^{a}	1.22^{a}	1.16^{a}	1.09^{a}	0.99^{a}	0.90^{a}	0.92^{a}
Hubbard	0.86	1.30^{ab}	1.45^{ab}	1.46^{ab}	1.48^{a}	1.505^{a}	1.59^{a}	1.74^{a}
SEM	±0.02	±0.06	±0.09	±0.10	±0.12	±0.12	±0.14	±0.14

1: Values are means of 12 replicates of 10 birds.

2: SEM: Standard error of means.

3: $^{a-b}$Values within the columns with different superscript differ significantly ($p<0.05$).

Table 4: Means interaction between strains and protein levels on weekly feed intake, body weight gain and feed conversion ratio

	Weekly feed intake (g/bird)							
Strain*protein	1	2	3	4	5	6	7	8
Ross*protein 1	97.89^{a}	155.43^{a}	262.07^{a}	391.13	464.88^{b}	579.86^{d}	623.34^{c}	626.86^{b}
Ross*protein 2	99.17^{a}	164.43^{ab}	273.06^{ab}	379.60	500.12^{b}	556.07^{cd}	509.72^{ab}	571.46^{ab}
Cobb*protein 1	86.50^{b}	177.56^{ab}	337.23^{c}	398.49	484.22^{b}	472.91^{ab}	441.53^{a}	520.09^{b}
Cobb*protein 2	86.73^{b}	189.34^{b}	337.23^{c}	398.49	484.22^{b}	472.91^{ab}	441.53^{a}	520.09^{b}
Hubbard*protein 1	84.82^{b}	187.12^{b}	313.53^{c}	368.90	475.03^{b}	512.01^{c}	505.64^{ab}	506.71^{a}
Hubbard*protein 2	78.42^{b}	166.22^{ab}	288.31^{ab}	363.10	404.13^{a}	456.17^{a}	453.53^{a}	493.99^{a}
SEM	±3.40	±8.46	±13.12	±14.12	±17.99	±15.94	±24.02	±33.12
	Weekly body weight gain (g/bird)							
	1	2	3	4	5	6	7	8
Ross*protein 1	60.12^{ab}	67.90^{a}	132.45^{a}	206.63	241.89	229.20^{b}	217.00^{b}	154.36^{b}
Ross*protein 2	65.08^{b}	103.48^{b}	180.93^{c}	185.07	232.87	212.12^{ab}	147.83^{a}	91.38a^{b}
Cobb*protein 1	59.07^{ab}	103.48^{b}	180.93^{c}	185.07	232.87	212.12^{ab}	147.83^{a}	91.38a^{b}
Cobb*protein 2	56.52^{ab}	107.18^{b}	188.77^{c}	185.35	200.23	160.36^{a}	98.77^{a}	89.73^{ab}
Hubbard*protein 1	57.77^{ab}	100.35^{b}	167.10b^{c}	189.02	222.78	196.10^{ab}	124.34^{a}	41.88^{a}
Hubbard*protein 2	54.07^{a}	91.79^{b}	164.50^{bc}	199.38	205.67	185.73^{ab}	117.06^{a}	32.63^{a}
SEM	±6.69	±6.69	±10.38	±11.32	±19.03	±16.61	±18.02	±22.62
	Weekly Feed conversion ratio (g/bird)							
	1	2	3	4	5	6	7	8
Ross*protein 1	0.92	1.39	1.52	1.59	1.60^{b}	1.64^{b}	1.66^{b}	1.75^{b}
Ross*protein 2	0.90	1.36	1.49	1.59	1.60^{b}	1.64^{b}	1.66^{b}	1.75^{b}
Cobb*protein 1	0.87	1.20	1.25	1.30	1.13^{ab}	1.00^{a}	0.89^{a}	0.94^{a}
Cobb*protein 2	0.86	1.14	1.19	1.25	1.06^{a}	0.98^{a}	0.91^{a}	0.90^{a}
Hubbard*protein 1	0.88	1.33	1.49	1.50	1.50^{ab}	1.51^{ab}	1.61^{b}	1.75^{b}
Hubbard*protein 2	0.85	1.28	1.43	1.44	1.48^{ab}	1.50^{ab}	1.56^{b}	1.74^{b}
SEM	±0.03	±0.07	±0.13	±0.15	±0.16	±0.17	±0.19	±0.20

1: Values are means of 12 replicates of 10 birds.

2: SEM: Standard error of means.

3: $^{a-b}$Values within the columns with different superscript differ significantly ($p<0.05$).

for first five weeks was increased with increasing protein level. Increasing protein levels at high ambient temperature during growing period improved weight gain. There is significant difference ($p<0.05$) among different strains. This result was in full agreement with that reported by Salmon *et al.* (1983); Temim *et al.* (1999). In the last three weeks body weight gain was dropped, especially in Hubbard strain. The decreased in body weight gain is not only an indicator for lower feed intake but also highlighted the direct effect of environmental temperature on broilers physiological and metabolic functions (Daniel *et al.*, 2007).

Effect of dietary protein level on Feed Conversion Ratio (FCR): Effect of dietary protein levels on feed conversion ratio has been shown in Table 4. Concerning the interaction between strains and protein level on FCR were found to be significantly different ($p>0.05$). In the first four weeks there was no significant difference. There as significant difference among the different strain in the last four weeks. Birds fed diet contained 23% crude protein showed higher feed conversion ratio than these fed diet contained 21%crude protein. Feed conversion ratio was increased with increased levels of protein. This result was in 6 agreement with the study conducted by Alleman and Leclerq (1997) Furlan *et al.* (2004); Gonzalez-Esquerra and Leeson (2005). In last four weeks Hubbard strain showed dropped feed conversion ratio. This might be due to the poor tolerance of this strain to high ambient temperature.

Conclusion: Feeding broiler chicks with high dietary protein level (23.03%), versus low protein level (21.58%) at high ambient temperature improved the growth performance by Feed intake and feed conversion ratio were increased with increasing protein levels.

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