Damanhour Journal of Veterinary Sciences

Journal homepage: https://djvs.journals.ekb.eg/

Effect of cold stress on growth performance, carcass traits, blood parameters and antioxidant enzymes in different broilers strains

Mahmoud M. Abo ghanema

Animal Husbandry and Wealth Development Department, Faculty of Veterinary Medicine, Damanhour University, Damanhour 22511, El-Behera, Egypt

ABSTRACT

The present study aimed to investigate the effect of cold stress on the different broiler strains performance. A total of 2000-day old chicks of five strains (Cobb 500, Ross 308, Avian 48, Arbor Acres (A.A.) and Indian River (IR) each of 400 chicks were randomly assigned into two groups one subjected to cold stress and the second was considered control group. Cold stressed groups were housed in a closed house supplied with cooling pads to provide ambient temperature at 29 ºC during 1st week, 25 ºC during 2nd week, 20 ºC during 3rd week, 16 ºC from 4th till 7th weeks of age. Results indicated that cold stress had significantly reduced final weight (2291.94 vs. 2635.36 g), total weight gain (2248.86 vs. 2592.00 g) with significant increase in feed consumption (4996.00 vs. 4694.88 g) and feed conversion ratio (2.23 vs. 1.81), while mortality rate had significantly increased in cold stressed broilers (8.88 % vs. 2.60 %). Cobb were showed lower affection by cold stress than other stains in growth performance and mortality rate, as Cobb had highest body weight in heat stressed groups (2414.21 vs. 2333.22, 2249.82, 2159.56 and 2302.90 g), similarly total weight gain, while Cobb had significantly lower feed intake and feed conversion ratio and mortality %. Carcass traits, antioxidant enzymes and blood biochemical parameters also had significantly affected by cold stress and in the same way Cobb showed significantly lower affection. In conclusion, cold stress adversely affect productivity of broilers, however Cobb 500 could be considered the most tolerant strain to cold.

Keywords: Broiler strain; Cold stress; antioxidant enzymes; growth performance

1. Introduction

Broilers usually face many stressors during rearing. Stress could be defined as a biological reaction of animals to environmental stimuli, being considered a major challenge in the poultry industry, because of its unfavorable effects on growth performance (Ali et al., 2018). Cold stress is a challenge that broilers exposed to rather during winter or transportation. The most distinct effect of cold exposure is hypothermia. This occurs when birds are not able to physiologically regulate their body temperature due to exposure to extreme conditions of cold and wetting (Hunter et al., 1999).

To avoid cold stress in broiler, they need for heating. The cost of fuel required for heating broiler to reach optimum temperature is a very important factor that affect the economic performance of broiler production and it may adversely affect the profitability of the producer (Tsiouris et al., 2015). Cold stress could be considered one of the main barriers that limiting the development of the poultry husbandry in cold areas and seasons.

Cold stress able to increase the susceptibility of birds to a number of

infectious and non-infectious agents (Huff et al., 2007). Moreover, low temperature is one of the main triggers for pulmonary hypertension

syndrome in modern fast-growing broilers (Sato et al., 2002). According to Chen et al. (2012), cold stress can affect the function of the neuroendocrine, the anti-oxidation and the immune systems. In addition, birds subjected to prolonged lower ambient temperature exhibited oedema, hyperaemia, haemorrhage and epithelial damage in the intestinal mucosa.

Cold stress also considered as one of the predisposing factors to necrotic enteritis which is described as a disease of high economic impact, which affects the health status and welfare of broilers and also poses a threat to public health (Tsiouris et al., 2015).

The increased cost required for heating in broiler farms especially during autumn and winter seasons under the local Egyptian conditions with regarding the adverse changes in climate during these seasons had increased the need for selecting strains that are suitable for rearing under lower ambient temperature to decrease the heating cost. The present study aimed to evaluate different broiler strains available in Egypt and their response for raising under low climatic temperature.

2. Material and methods

2.1. Birds, management and experimental design

All procedures were implanted according to the Local Experimental Animal Care Committee and approved by the ethics of the institutional committee of Damanhur University, Egypt. The experiment was carried out in private farm in which two thousand broiler chicks from five different strains (Cobb 500, Ross 308, Avian 48, Arbor Acres and Indian River) each of 400 birds and they divided randomly into two groups one subjected to cold stress and the second was considered as a control group. Each group subdivided into 10 separate replicates each of 20 bird. Broiler chicks were reared on wire cages each replicate in 2 pens, the pen dimensions were 1 meter length, 90 cm width and 45 cm height. All cages were equipped with feeding hoppers made of galvanized steel and automatic drinkers (nipples). Chicks that were subjected to cold stress were housed in a closed controlled house provided with cooling pads and exhaustion fans and they were brooded on 29 ºC, 25 ºC and 20 ºC during first, second and third week, respectively and 16 ºC from 4th till 7th week of age, while control groups were brooded on 33 ºC, 30 ºC and 27ºC during first, second and third week, respectively and 24 ºC from 4th till 7th week of age. The recommended vaccination program was applied for all birds. Birds were fed for the first three weeks on El Fagr starter ration (23% protein and 2900 kcal/kg) manufactured by El Fagr company for feed industry (Al Nubarya, El Bohira, Egypt). The birds were fed on EL Fagr grower ration (21% protein and 3200 kcal/kg) till the end of the experimental period.

2.2. Data collection and measurements

Birds were individually weighted at day old and separately. Final body weight was at 49 day old, total body weight gain was calculated as the difference between the 49th day body weight and one day body weight, total feed intake was calculated as the sum of feed consumed during all weeks, total feed conversion was calculated and the total water consumption was calculated at the end of the experiment. At the end of the experimental period, five representative birds from each replicate from each strain were randomly taken as sample for estimation of the carcass

Table 1: Effect of strain, cold stress and their interaction on body weight, feed intake, feed conversion ratio, total water intake and total mortality

Items.		Initial weight.	Final weight.	Body weight reduction %	Total Gain	Total Feed intake	FCR	Total water intake	Total Mortality %
Effect of Strain									
Cobb		43.00±0.38	2504.14±35.36[a]		2461.14±35.29[a]	4812.67±37.98[b]	1.96±0.04[b]	7567.82±130.39	5.13±0.77
Ross		43.27±0.37	2430.81±37.60[ab]		2387.55±37.58[ab]	4908.27±37.81[ab]	2.07±0.05[ab]	7650.74±147.49	6.87±0.46
Avian		43.00±0.48	2371.15±46.74[ab]		2328.15±46.66[ab]	4928.40±48.66[ab]	2.13±0.06[ab]	7649.91±139.31	7.87±0.49
Arbor Acres		43.20±0.39	2308.71±57.22[b]		2265.51±57.22[b]	4969.67±32.66[a]	2.22±0.07[a]	7723.10±163.55	8.27±0.36
Indian River		43.40±0.55	2417.27±44.77[ab]		2373.87±44.77[ab]	4859.13±35.12[ab]	2.06±0.05[ab]	7612.15±142.72	5.80±0.61
Effect of cold stress									
Cold stressed		43.08±0.27	2291.94±13.56[b]	13.03%	2248.86±13.57[b]	4996.00±8.23[a]	2.23±0.02[a]	7259.20±4.64[b]	8.88±0.53[a]
Control		43.36±0.22	2635.36±6.63[a]		2592.00±6.63[a]	4694.88±14.72[b]	1.81±0.01[b]	8403.84±26.35[a]	2.60±0.20[b]
Strain*cold stress interaction effect									
Cobb	Cold stress	42.90±0.50	2414.21±14.24[c]	10.05%	2371.31±14.07[c]	4912.60±4.19[d]	2.07±0.01[d]	7223.27±6.07[g]	6.40±0.88[c]
	Control	43.20±0.58	2684.00±9.27[a]		2640.80±9.04[a]	4612.80±9.50[h]	1.75±0.01[g]	8256.91±17.01[d]	2.60±0.51[d]
Ross	Cold stress	43.10±0.50	2333.22±10.24[d]	11.15%	2290.12±10.51[d]	5007.60±4.19[b]	2.19±0.01[c]	7261.02±6.07[efg]	8.80±1.16[abc]
	Control	43.60±0.51	2626.00±9.27[b]		2582.40±9.49[b]	4709.60±11.58[f]	1.82±0.01[f]	8430.18±20.73[b]	3.00±0.32[d]
Avian	Cold stress	42.80±0.68	2249.82±12.68[e]	13.93%	2207.02±12.70[e]	5052.60±4.19[a]	2.29±0.01[b]	7286.27±6.07[ef]	10.40±1.07[ab]
	Control	43.40±0.51	2613.80±11.42[b]		2570.40±11.30[b]	4680.00±40.50[g]	1.82±0.02[f]	8377.20±72.49[c]	2.80±0.49[d]
Arbor Acres	Cold stress	43.20±0.53	2159.56±14.92[f]	17.16%	2116.36±14.95[f]	5055.60±4.19[a]	2.39±0.02[a]	7290.62±6.07[e]	11.20±1.16[a]
	Control	43.20±0.58	2607.00±3.00[b]		2563.80±2.92[b]	4797.80±6.62[e]	1.87±0.00[e]	8588.06±11.85[a]	2.40±0.60[d]
Indian River	Cold stress	43.40±0.81	2302.90±17.51[d]	12.97%	2259.50±17.47[d]	4951.60±4.19[c]	2.19±0.02[c]	7234.82±6.07[fg]	7.60±1.11[bc]
	Control	43.40±0.51	2646.00±6.96[ab]		2602.60±7.00[ab]	4674.20±6.62[g]	1.80±0.01[f]	8366.82±11.85[c]	2.20±0.37[d]

Percentage Means ± standard error carry different superscripts within the same column are significantly different (P≤0.05)

Table 2: Effect of strain, cold stress and their interaction on carcass traits

Items.		Dressing %	Liver %	Abdominal fat %	Breast %	Thigh %	Left filet %
Effect of Strain							
Cobb		72.08±0.49[a]	4.26±0.08[a]	1.58±0.08[b]	27.31±0.41[a]	16.89±0.40[a]	11.30±0.33[a]
Ross		69.24±0.27[b]	3.95±0.07[b]	1.89±0.07[a]	25.49±0.38[bc]	15.68±0.31[b]	10.32±0.25[b]
Avian		69.51±0.46[b]	3.80±0.13[b]	1.57±0.08[b]	25.49±0.55[bc]	15.25±0.46[b]	10.20±0.29[bc]
Arbor Acres		69.28±0.46[b]	3.95±0.06[b]	1.56±0.06[b]	25.04±0.50[c]	16.44±0.22[ab]	9.97±0.32[c]
Indian River		69.87±0.41[b]	4.07±0.10[ab]	1.96±0.07[a]	26.72±0.54[ab]	15.51±0.27[b]	11.01±0.27[a]
Effect of cold stress							
Cold stressed		69.30±0.22[b]	3.88±0.05[b]	1.70±0.04	25.30±0.25[b]	15.75±0.18	10.21±0.15[b]
Control		71.38±0.37[a]	4.25±0.07[a]	1.72±0.07	27.43±0.34[a]	16.36±0.32	11.25±0.25[a]
Strain*cold stress interaction effect							
Cobb	Cold stress	71.29±0.57[b]	4.17±0.08[ab]	1.54±0.09[c]	26.92±0.52[ab]	16.57±0.45[ab]	10.89±0.41[bcd]
	Control	73.65±0.39[a]	4.42±0.17[a]	1.65±0.14[abc]	28.09±0.59[a]	17.55±0.77[a]	12.11±0.38[a]
Ross	Cold stress	69.18±0.38[c]	3.91±0.08[b]	1.91±0.10[ab]	25.20±0.44[cd]	15.68±0.46[bcd]	10.40±0.33[cde]
	Control	69.36±0.34[c]	4.04±0.15[b]	1.89±0.06[ab]	26.06±0.72[bc]	15.68±0.22[bcd]	10.17±0.37[cde]
Avian	Cold stress	68.54±0.26[c]	3.48±0.05[c]	1.69±0.10[ab]	24.28±0.26[d]	14.63±0.44[d]	9.76±0.24d[e]
	Control	71.44±0.73[b]	4.44±0.16[a]	1.52±0.12[bc]	27.92±0.82[ab]	16.48±0.86[abc]	11.09±0.56[abc]
Arbor Acres	Cold stress	68.32±0.29[c]	3.85±0.05[b]	1.48±0.07[c]	24.08±0.37[d]	16.08±0.10[abcd]	9.39±0.14[e]
	Control	71.20±0.64[b]	4.16±0.11[ab]	1.60±0.14[bc]	26.95±0.77[ab]	17.14±0.51[ab]	11.12±0.69[abc]
Indian River	Cold stress	69.18±0.32[c]	4.01±0.13[b]	1.96±0.07[a]	26.01±0.63[bc]	15.79±0.24[bcd]	10.63±0.28[bcd]
	Control	71.25±0.78[b]	4.19±0.14[ab]	1.96±0.19[a]	28.13±0.72[a]	14.96±0.63[cd]	11.76±0.43[ab]

Means ± standard error carry different superscripts within the same column are significantly different (P≤0.01).

Table 3: Effect of strain, cold stress and their interaction on hematological and blood biochemical parametres

Items.		Hemoglobin	PCV%	Glucose	Total protein	Total Lipids
Effect of Strain						
Cobb		10.01±0.13	37.40±0.78	239.27±3.49[a]	4.26±0.14	475.90±8.93
Ross		9.77±0.11	38.53±0.82	235.68±5.12[a]	4.14±0.14	455.58±7.71
Avian		10.00±0.10	37.80±0.78	219.92±7.25[b]	4.15±0.09	472.96±4.62
Arbor Acres		9.81±0.14	37.07±0.74	204.86±9.35[c]	4.05±0.10	460.22±21.51
Indian River		9.78±0.15	38.00±0.79	225.69±7.27[b]	4.17±0.15	445.82±14.34
Effect of cold stress						
Cold stressed		9.77±0.07[b]	37.70±0.44	213.07±3.79[b]	4.00±0.07[b]	449.20±7.61[b]
Control		10.09±0.07[a]	37.88±0.56	249.11±2.20[a]	4.46±0.04[a]	487.88±5.26[a]
Strain*cold stress interaction effect						
Cobb	Cold stress	9.91±0.17	37.20±0.99	233.80±3.99[abc]	4.09±0.19[abcd]	464.99±6.64[ab]
	Control	10.20±0.17	37.80±1.39	250.20±3.41[a]	4.62±0.07[a]	497.71±21.45[a]
Ross	Cold stress	9.67±0.14	38.70±0.94	226.13±5.31[bcd]	3.96±0.18[cd]	442.86±8.77[ab]
	Control	9.97±0.17	38.20±1.71	254.80±3.32[a]	4.50±0.09[abc]	481.02±5.99[a]

Avian	Cold stress	9.96±0.13	37.70±1.09	207.28±8.15[d]	4.06±0.12[bcd]	469.30±6.48[ab]
	Control	10.08±0.19	38.00±1.00	245.20±3.61[ab]	4.33±0.05[abcd]	480.28±3.94[a]
Arbor Acres	Cold stress	9.60±0.15	36.90±0.82	184.51±7.11[e]	3.92±0.12[d]	449.07±31.45[ab]
	Control	10.22±0.22	37.40±1.63	245.55±8.37[ab]	4.31±0.11[abcd]	482.51±14.96[a]
Indian River	Cold stress	9.69±0.20	38.00±1.12	213.63±8.34[cd]	3.99±0.19[bcd]	419.78±15.84[b]
	Control	9.96±0.08	38.00±0.95	249.80±4.88[a]	4.54±0.07[ab]	497.89±3.68[a]

Means ± standard error carry different superscripts within the same column are significantly different (P ≤0.01)

Table 4: Effect of strain, cold stress and their interaction on antioxidant enzymes

Items.		GPx	MDA	SOD
Effect of Strain				
Cobb		22.47±0.96	2.19±0.12	66.53±3.68
Ross		24.27±1.21	2.48±0.16	68.07±3.92
Avian		24.47±1.47	2.56±0.15	69.67±4.30
Arbor Acres		24.87±1.39	2.61±0.18	70.80±4.57
Indian River		25.47±1.38	2.41±0.14	69.47±4.14
Effect of cold stress				
Cold stressed		27.54±0.29[a]	2.80±0.04[a]	79.70±0.48[a]
Control		17.84±0.30[b]	1.74±0.07[b]	47.32±0.36[b]
Strain*cold stress interaction effect				
Cobb	Cold stress	24.90±0.35[b]	2.47±0.07[b]	76.20±0.57[c]
	Control	17.60±0.51[c]	1.64±0.02[c]	47.20±0.66[d]
Ross	Cold stress	27.40±0.27[a]	2.84±0.07[a]	78.40±0.40[bc]
	Control	18.00±0.45[c]	1.76±0.19[c]	47.40±0.51[d]
Avian	Cold stress	28.20±0.61[a]	2.96±0.03[a]	80.90±0.96[ab]
	Control	17.00±0.32[c]	1.78±0.11[c]	47.20±0.66[d]
Arbor Acres	Cold stress	28.30±0.60[a]	3.03±0.05[a]	82.70±1.23[a]
	Control	18.00±1.00[c]	1.76±0.22[c]	47.00±0.71[d]
Indian River	Cold stress	28.90±0.59[a]	2.73±0.06[ab]	80.30±0.70[ab]
	Control	18.60±0.93[c]	1.78±0.23[c]	47.80±1.46[d]

Means ± standard error carry different superscripts within the same column are significantly different (P≤0.01).

traits. Prior to slaughtering the birds were deprived of feed for 12 hours then weighed. After slaughtering, birds were scalded, wet-plucked and eviscerated. Then technological division of the carcass was performed and calculated according to (Wang, 2000) Thus; the carcass was separated to the following cuts; Breast (including the sternum and breast muscles), Thigh (weighing two thighs and taking average), Left filet (the de-skinned left breast muscle on the left side of sternum). Liver was separately weighed to determine the dressed weight and the dressed percentage. The blood, viscera, lungs, limbs, head and neck were termed as the offal's and they were discarded. The abdominal fats in pelvic and abdominal cavity were collected completely from carcass and weighted. Dressing percentage: After weighing warm carcass, dressing percentage was calculated according to (Price, 1967) as follows:

$$\text{Dressing percentage} = \frac{\text{Hot carcass weight}}{\text{Fasted live body weight}} \times 100$$

Breast, thigh, left filet, liver and abdominal fat were expressed as percentage of the carcass weight.

At slaughtering, blood samples were collected from 5 birds randomly selected from each replicate, two samples from each bird, one sample collected on separate labeled centrifuge tubes with sodium citrate solution 3.2% for hemoglobin and PCV percentage and the second sample tubes were left in a slope position till serum samples were separated through centrifugation at 3000 rpm for 15 minutes. The sera were collected and preserved in a deep freezer at (-20ºC) until the time of analysis.

Blood hemoglobin (HB gm %) was assessed by cyanomtahemoglobin method (Drabkin and Austin, 1935). Packed cell volume was carried out by using microhaematocrite capillary tubes centrifuged at 12000 rpm for 5 minutes. The reading were made with the aid of a microhaematocrite reader and expressed as the volume of erythrocytes per 100 cm^3 (Blaxhall and Daisley, 1973). Blood glucose was determined by the glucose oxidase method (Sigma Chemical Co). Serum total protein was determined by kit of Bio-diagnostic (Gornal et al., 1949). Serum Total lipids: It was determined by Total lipids kit of Bio-diagnostic (Zollner and Kirsch, 1962). Glutathione peroxidase activity GPx measured using the (Paglia and Valentine 1967) spectrophotometry method based on the Northwest Life Science Specialties (NWLSS™) Glutathione peroxidase assay kits protocol NWK-GPX01. Malondialdehyde (MDA) concentration was measured by the method of (Jo and Ahn, 1998). Super Oxide Dismutase (SOD) activity was assessed using the NWLSS™ Superoxide dismutase activity assay, which provided a simple, rate method for determining SOD activity. This method is based on monitoring the auto-oxidation rate of haematoxylin as originally described by (Martin et al., 1987).

2.3. Statistical Analysis

The current data were normally distributed and were subjected to statistical analysis using Proc GLM by SAS program (SAS Institute, SAS® 2009) with the following model:

$X_{ijkl} = \mu + A_i + B_j + (AB)_{ij} + e_{ijkl}$

Where:

X_{ijkl} = an observational data.

μ = Overall mean.

A_i = Effect of ith strain of broilers i=1, 2, 3, 4 and 5 (1= Cobb 500, 2= Ross 308, 3= Avian 48, 4= A.A and 5= IR).

B_j = Effect of jth cold stress j=1 and 2 (1= Cold stressed and 2=Control).

$(AB)_{ij}$ = Effect due to interaction between strain and cold stress.

e_{ijkl} = random error.

3. Results

3.1. Growth performance, water consumption and mortality percentage

Results of initial body weight, final body weight, body weight gain, feed intake, and feed conversion ratio (FCR) and mortality percentage are presented in table 1. Strain variation was clear in final body weight, in particular Cobb 500 had significantly (P≤0.05) higher weight than other breeds followed by Ross 308 and IR and they were significantly higher than Avian 48 which was significantly higher than A. Acres (2504.14, 2430.81, 2430.81, 2371.15 and 2308.71 g, respectively). Similarly, total body weight gain was significantly higher (P≤0.05) in Cobb 500 than other breeds followed by Ross 308 and IR and they were significantly higher than Avian 48 which was significantly higher than A. Acres (2461.14, 2387.55, 2373.87, 2373.87 and 2265.51 g, respectively). Feed intake results revealed that Avian 48 and A. Acres had consumed significantly higher (P≤0.05) feed than Ross 308, which in turn consumed significantly more feed than IR and it consumed significantly higher than Cobb 500 (4969.67, 4928.40, 4908.27, 4859.13 and 4812.67 g, respectively). FCR results showed that A. Acres had significantly higher (P≤0.05) FCR than Avian 48 which was significantly higher than Ross 308 and IR, which in turn were significantly higher than Cobb 500 (2.22, 2.13, 2.07, 2.06 and 1.96 respectively). Total water consumption and mortality % revealed no significant difference between broiler strains.

Regarding the effect of cold stress, data presented in table1 showed that, cold stress had significantly reduced final body weight (2291.94 vs. 2635.36 g), total weight gain (2248.86 vs. 2592.00 g) with significant increase in feed consumption (4996.00 vs. 4694.88 g) and feed conversion ratio (2.23 vs. 1.81), while mortality rate had significantly increased in cold stressed broilers (8.88 % vs. 2.60 %).

The interaction between broiler strain and cold stress (Table 1) revealed that cold stress had significantly (P≤0.05) reduced final weight in all strains, however Cobb 500 showed lower affection by cold stress (2414.21 vs. 2684.00 g) with only 10.05% reduction in final body weight, followed by Ross 308 (2684.00 vs. 2626.00 g) with 11.15% reduction in final body weight, IR (2302.90 vs. 2646.00 g) with 12.97% reduction in final body weight, Avian 48 (2249.82 vs. 2613.80 g) with 13.93% reduction in final body weight and finally A. Acres showed the highest affection by cold stress (2159.56 vs. 2607.00 g) with 17.16% reduction in final body weight. Similar findings were observed in total weight gain. Total feed intake in all strains had significantly increased by cold stress and similarly feed conversion ratio. Total water consumption were significantly reduced by cold stress in all strains. Mortality % showed significant increase in cold stressed groups in all strains, however Cobb 500 showed less significant increase in mortality % (6.40 vs. 6.40 %), followed by IR (7.60 vs. 2.20 %), Ross 308 (8.80 vs. 3.00 %), Avian 48 (10.40 vs. 2.80 %) and Arbor Acres showed highest mortality % in cold stressed group (11.20 vs. 2.40 %).

3.2. Carcass traits

Findings of carcass traits in table 2 showed significant differences (P<0.01) in all of carcass traits studied except thigh due to strain variation. Cobb 500 had significantly higher dressing % than Ross 308, Avian 48, Arbor Acres and IR (72.08 vs. 69.24, 69.51, 69.28 and 69.87 % respectively). Liver % was significantly higher in Cobb 500 than Ross 308, Avian 48 and A.A (4.26 vs. 3.95, 3.80 and 3.95 % respectively) however IR liver % was not significantly different with all strains. IR and Ross 308 had significantly higher abdominal fat % than Cobb 500, Avian 48 and A.A. (1.96 and 1.89 vs. 1.58, 1.57 and 1.56 5 respectively). Breast % was significantly higher in Cobb 500 and IR than Ross 308 and Avian 48 and A.A. (27.31 and 26.72 vs. 25.49 and 25.49 and 25.04 % respectively.). Thigh % was significantly higher in Cobb 500 than other strains. Left filet % was significantly higher in Cobb 500 and IR than Ross 308, Avian and A.A (11.30 and 11.01 vs. 10.32, 10.20 and 9.97 % respectively).

Cold stress had significantly reduced dressing % (69.30 vs. 71.38 %), liver % (3.88 vs. 4.25 %), breast % (25.30 vs. 27.43 %) and left filet % (10.21 vs.11.25 %), while abdominal fat and thigh % were reduced by cold stress but with no significant difference. Regarding the effect of interaction between strain and cold stress (Table 2) the obtained results revealed significant reduction in all carcass traits between cold stressed group and control group in each strain, however A.A. strain showed highest level of affection by cold stress

3.3. Hematological and blood biochemical parameters

Hematological and blood biochemical results showed in table 3 revealed no significant differences in hemoglobin, PCV %, serum total protein and serum total lipids. Glucose was significantly higher (P≤0.01) in Cobb 500 and Ross 308 than IR and Avian 48 and they were significantly higher than A. Acres (239.27 and 235.68 vs. 225.69 and 219.92 vs. 2014.86 mg/dl, respectively).

Cold stress had significantly (P≤0.05) reduced blood hemoglobin (9.77 vs. 10.09 %), glucose level (213.07 vs. 249.11 mg/dl), total protein (4.46 vs. 4.00 mg/dl) and total lipids (449.20 vs. 487.88 mg/dl). The interaction between strain and cold stress revealed similar results as cold stressed groups showed significant reduction in serum glucose, total protein and total lipids in all strains.

3.4. Antioxidant enzymes

Data presented in table 4 showed no significant difference in antioxidant enzymes GPx, MDA and SOD between the studied strains.

Cold stress had significantly increased (P≤0.01) GPx (27.54 vs. 17.84 U/gHb), MDA (2.80 vs. 1.74 nmoles/ml) and SOD (79.70 vs. 47.32 U/gHb). Similar findings were reported in data of interaction between strain effect and cold stress effect as cold stressed groups showed significant increase in all antioxidant enzymes than control groups in all strains, however Cobb 500 showed significantly lower GPx, MDA and SOD in cold stressed group than other cold stressed groups of other strains.

4. Discussion

The adverse climatic condition will result in physiological stress which has profound economic influence on the productive efficiency including health and disease resistant capacity (Phuong et al., 2016). Exposure of poultry birds to extreme temperature stressor modulates the immune responsiveness and haemato-biochemical parameters of birds (Hangalapura et al., 2004). The current study aimed to assess response of different broiler strains to cold stress and its effect on productive performance, carcass traits, hematological and blood biochemical parameter and antioxidant enzymes,

in particular Cobb 500, Ross 308, Avian 48, A. Acres and IR. The obtained results revealed that Cobb 500 strain had the best ability compared to the other strains used in that study to tolerate cold stress as it produced significantly higher body weight and weight gain with lower feed consumption, water consumption and FCR and mortality rate. Also Cobb 500 had suitable carcass traits under cold stress. Glucose level as an energy parameter had significant improvement in Cobb 500 than other breeds.

Similarly, antioxidant enzymes were the lowest level in Cobb 500 strain. IR and Ross 308 strains showed moderate ability to tolerate cold stress which was significantly better than Avian 48 and A. Acres as they showed low ability to tolerate cold stress. These findings may be attributed to the high production ability and fast feathering characteristics of Cobb 500 followed by IR and Ross 308 and the slow feathering ability of Avian 48 and A. Acres. Also, obtained results revealed increase in feed total feed consumption in groups subjected to cold stress when compared to birds reared under normal temperatures and that may be attributed to that chickens are homoeothermic animals and they able to live freely and comfortable under certain and narrow range of ambient temperature and because chickens eat for calories so, they are forced to elevate their feed consumption level to compensate their needs of energy.In accordance, the results obtained by Qureshi et al. (2018) observed similar findings as they studied the effect of cold stress on performance of broiler chicken and they reported significant increase in feed intake in broilers reared under cold temperature and they stated that broilers consume higher feed under cold stress to compensate their energy needs. Also, Aksit et al. (2008) reported similar results and their findings supported that broilers reared under cooler temperature showed increased feed intake as in order to balance their body temperatures, broilers are obligated to increase feed consumption under cold temperatures. Blahova et al. (2007) reported similar results as they reported significant elevation in feed consumption as a result of rearing under cooler temperature.The results obtained were in agreement with those reported by Strawford et al. (2011) as they reported significant decline in final body weight in birds reared under cold stress and those birds showed changes in their normal behavior in attempts to reduce their body heat loss by getting away from the stream of cold air. Xie et al. (2017) stated that breed variation to cold stress was clear as Bashang Long-tail chicken has a favorable cold tolerance ability than Rod Island Red RIR chickens and crossing the two breeds had improved that ability in cross bred than RIR. Similarly, Tirawattanawanich et al (2011) had reported the breed variation in response to different stressors due to environmental conditions and they studied 3 different lines of cross bred native chickens and commercial strains. They also reported the strain variation in immunity and blood parameters and the ability of cross bred strains for tolerance of environmental stress than commercial strains. The obtained results by Nyuiadzi D. et al (2017) which carried their study to evaluate the effect of cold stress on caged Ross 308 broilers during 1st 3 weeks of age and they stated the adverse effect of cold stress compared to control (thermo neutral zone) but they also reported sex difference in response to cold stress and the ability of Ross 308 broilers to tolerate it with some affection on productivity. Similarly, Olanrewaju et al. (2010) whose studied effect of Ambient Temperature and Light Intensity on Growth Performance and Carcass Characteristics of Heavy Broiler Chickens at 56 Days of Age and reported that exposure of broiler chickens to low ambient temperature may considered as stress but birds will be able to tolerate rather than heat stress and exposure to high ambient temperature may be of non-tolerable adverse effects. In similar study Justin C. et al. (2005) had studied production performance and temperature-humidity index of Cobb 500 broilers reared in open-sided naturally ventilated houses and reported the adverse effect of temperature fluctuation of growth but reported also the ability of Cobb 500 to live and produce under wide environmental conditions.

Conclusion

In conclusion, based on the present findings, it is recommended to raise Cobb 500 broiler strain during periods of low climatic temperature because its ability to tolerate low ambient temperature for prolonged periods. Also, Indian River and Ross 308 may be of good producing ability during the same conditions.

References

Akşit, M., Altan, O., Karul, A.S. 2008. Effects of cold temperature and vitamin E supplementation on oxidative stress, Troponin-T level and other ascites-related traits in broilers. Europ. Poult. Sci. 72(5), 221-230.

Ali, O., Ali, M., Tayebeh, S., Mohsen, A., Felip, M. P. 2018. Comparison of growth performance and immune responses of broiler chicks reared under heat stress, cold stress and thermoneutral conditions. Span. J. Agricul. Res. 16 (2), e0505- 7pages.

Blahova, J., Dobsikova, R., Strakova, E. 2007. Effect of Low Environmental Temperature on Performance and Blood System in Broiler Chickens (Gallus domesticus). Acta Vet. Brno 76, 17–23.

Blaxhall, P. C., Daisley, K. W. 1973. Routine haematological methods for use with fish blood. J. Fish Biol., 5, 771-781.

Chen, X., Jiang, R., Geng, Z. 2012. Cold stress in broiler: global gene expression analyses suggest a major role of CYP genes in cold responses. Mol. Bio. Rep. 39, 425–429.

Drabkin, D. L., Austin, J. H. 1935. Spectrophotometric studies: V. A. technique for the analysis undiluted blood and concentrated hemoglobin solutions. J. Bio. Chem. 112, 105-115.

Gornall, A. G.; Bardawell, C. J., David, M. M. 1949. Determination of serum proteins by means of the biuret reaction. J. Biol. Chem., 177(2), 751-766.

Hangalapura, B. N., Nieuwland, M. G., DeVries, R., Kemp, B. 2004. Durations of cold stress modulates overall immunity of chicken lines divergently selected for antibody responses. Poult. Sci. 83(5), 765-75.

Huff, G., Huff, W., Rath, N., SolisdelosSantos, F., Farnell, B., Donoghue, A. 2007. Influence of hen age on the response of turkey poults to cold stress, Escherichia coli challenge, and treatment with a yeast extract antibiotic alternative. Poult. Sci. 86, 636–64.

Jo, C., Ahn, D. U. 1998. Fluorometric analysis of 2-thiobarbituric acid reactive substances in turkey. Poult. Sci. 77, 475–480.

Justin C., Rejoice T., Chimbombi E., 2005. Production performance and temperature-humidity index of Cobb 500 broilers reared in open-sided naturally ventilated houses in Botswana. Livestock Environment VII - Proceedings of the Seventh International Symposium. DOI: 10.13031/2013.18408.

Martin, J. P., Dailey, M., Sugarman, E. 1987. Negative and positive assays of superoxide dismutase based on haematoxylin auto-oxidation. Arch. Biochem. Biophys. 255, 329–336.

Nyuiadzi D., Travel A., Berri C., Guilloteau L. A., Wang Y., Tona J. K., Collin, A. 2017. Effect of low incubation temperature and low ambient temperature until 21 days of age on performance and body temperature in fast-growing chickens. Poult. Sci. 96(12), 4261–4269.

Paglia, D. E., Valentine, W. N. 1967. Studies on the quantitative and qualitative characterization of erythrocyte glutathione peroxidase. J. Lab. Clin. Med. 70, 158–169.

Phuong, H., Nguyen, M. S., Greene, E., Donoghue, A., Huff, G., Clark, D., Dridi, S. 2016. A New Insight into Cold Stress in Poultry Production. Adv. Food Technol. . Nutr. Sci. 2(1),1-2. DOI: http://dx.doi.org/10.17140/AFTNSOJ-2-124.

Price, M. A. 1967. Dressing percentages (%): what does it mean? Agri. Canada. Ottawa Condex publications. 420-450.

Quresh, S., Hilal, M.K., Masood, S.M., Tariq, A.R., Azmat, A.K., Haider, A., Sheikh, A. 2018. Effect of cold stress and various suitable remedies on performance of broiler chicken. J. World Poult. Res. 8(3), 66-73.

SAS 2009. Statistical Analysis System. User's Guide Statistics. SAS Institute Cary, North Carolina.

Sato, T., Tezuka, K., Shibuya, H., Watanabe, T., Kamata, H., Shirai, W. 2002. Cold-induced ascites in broiler chickens and its improvement by temperature controlled rearing. Avian Dis. 46, 989–996.

Strawford, M.L., Watts, J.M., Crowe, T.G., Classen, H.L., Shand, P.J. 2011. The effect of simulated cold weather transport on core body temperature and behavior of broilers. Poult. Sci. 90(11), 2415–2424.

Taha, A. E., EL-Edel, M. A., EL-Lakany, H. F., Shewita, R. S. 2012. Growth performance and immune response against Newcastle and Avian Influenza vaccines in Egyptian chicken stains. J. Global Vet. 9(4), 434-440.

Tirawattanawanich, C., Chantakru, S., Nimitsantiwong, W., Tongyai, S. 2011. The effects of tropical environmental conditions on the stress and immune responses of commercial broilers, Thai indigenous chickens, and crossbred chickens. J. Appl. Poult. Res. 20(4), 409–420.

Tsiouris, V., Georgopoulou, I., Batzios, C., Pappaioannou, N., Ducatelle, R., Fortomaris, P. 2015. The effect of cold stress on the pathogenesis of necrotic enteritis in broiler chicks. Avian Pathol. 44, 6430-6435, DOI: 10.1080/03079457.2015.1083094.

Wang, Y. 2000. Effect of betaine on growth performance and carcass traits of meat ducks. J. Agri. Life Sci., 26, 347-352.

Xie, S., Yang, X., Gao, Y., Jiao, W., Li, X., Ning, Z. 2017. Performance differences of Rhode Island Red, Bashang Long-tail Chicken, and their reciprocal crossbreds under natural cold stress. Asian-Australs J. Anim. Sci. 30(10), 1507–1514.

Zollner, N., Kirsch, K. 1962. A colorimetric method for the determination of serum total lipids. Z. Ges. Exp. Med. 135, 545-561.