Vet.Med.J.,Giza. Vol.43,No.4.(1995): 461-468.

EFFECT OF LIGHT AND FOOD WITHDRAWAL ON THE BROILER RESPONSES TO HEAT STRESS AND/OR SALMONELLA TYPHIMURIUM INFECTION AT EAELY GROWING STAGE

By

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SUMMARY

Young growing 8 days old broilers were exposed to heat stress of 40°C for a period of 4 hr. each day for 4 days (10.00 a.m - 2.00 p.m). The birds were inoculated once with Salmonella typhimurium organism at 9-days old by intercrop instilation wih 0.1 ml of 10^6 colony forming unit (c.f.u.) The birds were kept under good husbandary with ample floor area (200 width x 200 length x 210 cm height / each pen) at that stage of age. Three lighting and feeding treatments were applied during hot period. The treatments were , LF (control, negative, Salmonella typhimurium), light and food throughout, NF (no food) food withdrawn 2 hours before the hot period (8.00 - 10.00 a.m) and applied immediately after it, NL (no light) extinguished throughout the hot period , LFS (food and light allowed at hot period) and Salmonella infection.

Food and light withdrawal had no significant effect on body weight gain percentages throughout the experiment. All treatments, had decreased body weight at the end of the second and the third weeks versus the control birds. Alleviating heat stress by light and food withdrawl showed a significant decrease in rate of reisolation of Salmonella typhimurium from all internal organs (bile, liver , heart blood and intestine) in some of groups.

No significant differences were noticed in weights of liver, and spleen between all treatments and the control, while it was noticed between all treatments and the control in weight of bursa of Fabricius and between LF versus NL and NF groups.

Mortality rate was the highest (24%) in Salmonella infected birds (CS) while it was the lowest (10%) in heat stressed (LFH), and in heat stressed with no food and with no light , it was (13.3%). Heat stress with Salmonella infection showed a moderate rate of (15%).

INTRODUCTION

Heat stress could be reduced in broilers in tropical regions by increasing water supply, it could be affected by available, evaporative cooling insulation, ventillation, adopting feed consumption, lighting regime and reducing bird density (Prabakaran , 1990). Furthermore addition of some chemicals as asocrbic acid and Metyrapone (Gross, 1990), potassium chloride drinking water supplementation (Deyhim and

Teeter, 1991). Carbohydrate low diet or food deprivation (Lesson, 1986 and Smith and Teeter, 1990). addition of different vitamins ADEB and electrolytes (Ferket and Qureshi, 1992) may have some effect of heat strees. Food and light withdrawal (No Light and No Food) significantly reduced the rate of increase of rectal temperature (heat stress ,manifestation) after 4 hr of heat exposure (Carmen et al., 1991).

Food deprived birds at heat stress period had lower mortality (5%) than in normally fed, this heat period (4hr, at 40°C) caused a greater loss of weight than 2 hr. heat period (Gracia et al., 1992).

The aim of this experiment was accordingly, to test the effects of temporary withdrawal of food and/ or temporary imposition of darkness on the ability of young growing broilers (8-22 days old) to tolerate acute exposure to high air temperature. In addition, the effects of these treatments on bird response to Salmonella - typhimurium infection (as expected environmental microbe) were evaluated.

MATERIAL AND METHODS

Chickens:

One hundred and eighty, one day old chicks (Lohman breed) were used throughout the experiment. They were subgrouped into 6 groups each of 30).

MANAGEMENT:

The chickens were housed into 6 pens that were fumigated before use. The pens were electrically heated and lighted . Wood shaving litter was used, food and water were supplied manually ad-libitum except at the groups treated with no food (NF) 2hr. before the heat period. Ample spaces were allowing in all groups (200 width, 200 length, and 210 height cm dimensions). The litter samples were collected from each pen before the chickens were placed to confirm absence of Salmonella. The chickens were classified and treated as follows:

Group 1: Control negative of any treatment (C-ve).

Group 2: Control positive, no heat no light and no food treatments but artifically infected with Salmonella typhimurium (CS).

Group 3: Heat stressed birds for 4 hrs. at 40°C while food and light were available during the heat period (HLF) with no Salmonella infection.

Group 3: Heat stressed birds for 4 hrs. at 40°C while food and light were available during the heat period (HLF) with no Salmonella infection.

Group 4: The birds were exposed to heat and Salmonella infection with no food 2 hrs prior to heat period (NFHS).

Group 5: The birds were exposed to heat and Salmonella infection with no light allowed during heat exposure (NLHS).

Group 6: The birds were heat stressed and Salmonella infected while food and light were available at hot period (HSFL).

HEAT STRESS:-

Heat stress was initiated by exposing 8-days old chickens in groups 3,4,5 and 6 to 40°C for 4 hours each day for 4 continuous days. This was done by

increasing the electric heaters to get the desired temperature and complete insulation of each pen at the hot period. Minimum and maximum thermometer was used for recording the temperature with readjustment if desired . Humidity was adjusted and recorded to be (65 - 75%) using hair hygrometer. Heat exposure was applied at 10.00 a.m. to 2.00 p.m. (Carmin et al., 1991 and Gracia et al., 1992).

FOOD DEPRIVATION (Withdrawal):

Food was withdrawn 2 hr prior to heat period (8.00-10.00 a,m) and applied immediately after it. This was done only in group 4.

LIGHT WITHDRAWAL (darkness):

The light was turned off and complete block of any light source during the heat period and then supplied immediately after that (Carmen et al., 1992). This treatment was applied in group 5.

FOOD AND LIGHT:

They were applied all the time in group 1,2,3 and 6.

SALMONELLA-TYPHIMURIUM INFECTION:-

No Salmonella was isolated from litter before the chicks were placed. The chicks were placed and fed a starter ration proved to be free from Salmonellae after repeated culture. Tetrathionate brilliant green (TBG) broth was used for about 30 hrs at 48°C before plating on briliant green (BGF) agar paltes and incubated at 37°C for 18 to 24 hrs. Colonies from suspected plates were transferred to triple sugar iron agar slants and subsequently serotyped before being reported positive Mallinson and Snoeyenbos, 1989). Salmonella typhimurium organism was obtained from the Department of Microbiology, Faculty of Veterinary Medicine, Cairo University.

The chicks were exposed to this infection by crop instillation of 0.1 ml of 10^6 c.f.u. from a 24 hr selenite F-broth culture. The infection was done for 2,3,4 and 5 groups at the 9th day old, 24hr-post-first heat exposure.

Reisolation of inoculated Salmonella typhimurium was carried out at 22-days of age. , from internal organs including bile, liver, heart blood , spleen and intestine on T.B.G. broth & B.G. agar plates with T.S.I. slant agar to study the distribution of this organism inside the bird under these treatments (heat stress, food and light withdrawal).

BODY WEIGHTS AND FOOD INTAKE:-

At 7,14,19 and 22-days old mortality number and rate were recorded throughout the experiment especially post-Salmonella infection.

SACRIFICATION:-

This was done for the remainder alive chicks in all groups, at 22 days old. Internal organs, including liver, bursa of Fabricius and spleen were weighed as indirect bird-stress responses measure.

RESULTS AND DISCUSSION

Reducing heat stress effects on young birds (8-22) days) by food and light withdrawal either before or during heat period were studied, and also, the ability of bird to withstand this heat stress when got infected with Salmonella typhimurium. The results were presented in tables 1 to 4.

Results in Table (1-A) indicated no significant differences between all mentioned treatments and the negative control one on body weight gain %, this might be due to birds at that young age can

tolerate acute heat stress for their normal physiological needs than older ones. Despite there were difference in final body weight gains at the second and the third weeks between all treatments and the control (decreased). Salmonella infected birds (CS) had decreased final body weight more than heat stressed ones., either with presence of food and light or with their withdrawal. However, morbidity from Salmonella typhimurium is often much higher than mortality (Snoeyenbos and Williams, 1991).

In addition , the effects of these treatments on food conversion (table 1-B) showed no significant differences between all treatments and the control, and within all the groups each other. The birds apparently utilize food more efficiently following the period of food restriction because their overall food intake and food conversion ratio (FCR). food-gain ratio are slower than that of non-treated birds (Susbilla et al. , 1994).

Number and percentages of birds proved to be positive to Salmonella infection were recorded from remainder birds at 22-days old after their sacrification (Table 2). There was a slight difference in percentage of positive isolates from bile between (CS) and (FLHS), while there were significant differences (decrease) in this percentage in groups (NFHS)) and (NLHS). The same observation was found with liver and heart blood in the same groups, while slight decrease was in the intestine percentage versus the (CS) group. A great decrease was noticed between both groups (NL and NF) and FL group in percentage of reisolation from all sites . Food and light withdrawal minimized the effect of heat stress on the bird and decreased the distribution of Salmonella typhimurium (percentage of reisolation from all internal organs mentioned). Lots of works confirmed the positive effect of food deprivation at or during heat stress and/or changing light regims on physiological bird response (Prabakaran, 1990; Carmen et al., 1991 and Gracia et al., 1992).

Effect of the designed treatments on internal organs weight are shown in table (3), where there was no significant difference in liver and spleen weights between the control (C-ve) and all treatments, while there was a significant difference in bursa of Fabricius weight between (FLH, NFHS & NLHS) and the control (C-ve) ($P<0.05$). A little difference was between (HFL) and (CS) in bursa weight. A more difference was noticed in bursa weight when birds were deprive of food and light at heat period (NF and NL) to the control one (C -ve) . However, food deprivation caused a significant loss in body weight and a profound loss in liver, bursa of Fabricius, spleen and thymus weights (Nathan et al., 1977 and Gross, 1988) and the differences in liver , heart and kidney weights follwoing restricted feeding may contribute to the ability of chickens to recover (Katanber et al., 1988).

Mortality (Table 4) due to Salmonella infection (CS) was highest (24%) while heat stress with food and light allowed was lowest (10%), but iin FLHS was (15%) higher than those deprived of food and light at heat period (NFHS, NLHS) (13.3%). heat stress (4hr. exposure to 40°C) minimized the mortality from salmonella infection, especially when young growing heat stressed birds were deprived of food and light before or during heat period.

Conclusively, heat stressed birds with normal feed and light regime or deprived of both, did not affect significantly body weight gain percentage and food conversion at that young age (8-22 days) but may be later in lifer. Absence of food and light at heat stress period decreased the rates of percentage of reisolation of Salmonella from internal organs (increased clearance or disappearance of organisms from the bird's body). in addition, these treatments decreased organs weight (liver, spleen and bursa). It decreased the

Table (1): Effect of heat stress, food and light withdrawal and Salmonella typhimurium infection on bird response

Groups Age/wks	Item measured	C -ve	C S	HLF	NFHS	NLHS	FLHS
1	Body weight (gm.)	70.0	68.5	70.0	68.7	65.0	68.3
	Body weight (%)	0.62 ± 0.11	0.59 ± 0.11	0.62 ± 0.11	0.60 ± 0.11	0.55 ± 0.109	0.59 ± 0.11
2	Body weight (gm.)	170.0	135.0	135.0	125.0	130.0	138.0
	Body weight (%)	0.83 ± 0.15	0.65 ± 0.13	0.63 ± 0.12	0.58 ± 0.11	0.67 ± 0.13	0.68 ± 0.13
3	Body weight (gm.)	240.0	165.0	175.0	171.0	173.0	178.0
	Body weight (%)	0.34 ± 0.1	0.20 ± 0.09	0.26 ± 0.1	0.31 ± 0.10	0.28 ± 0.10	0.25 ± 0.10
B- Food conversion							
1		2.5 ± 0.5	2.5 ± 0.5	2.6 ± 0.5	2.5 ± 0.5	2.5 ± 0.5	2.9 ± 0.5
2		1.2 ± 0.22	1.1 ± 0.22	1.5 ± 0.24	1.34 ± 0.25	1.1 ± 0.26	1.4 ± 0.29
3		1.02 ± 0.19	1.06 ± 0.19	1.06 ± 0.20	0.94 ± 0.18	0.97 ± 0.19	1.18 ± 0.23

C -ve : control negative of any treatments .
CS : control positive, Salmonella infected with no heat no light and food treatments .
HLF: heat stress with light and food allowed with no Salmonella .
NFHS: heat stress with Salmonella and no food .
NLHS: heat stress with Salmonella and no light .
FLHS: heat stress with Salmonella, food and light available .

Table (2):Number and percentages of isolated Salm. typhimurium from internal organs of sacrificed infected birds

Organs	Bile		Liver		Spleen		Heart blood		Intestine	
Groups	No.	%	No.	%	No.	%	No.	%	No.	%
(2) CS	8	33	9	38	6	25	6	25	9	38
(4) NFHS	5	18	6	21	5	18	4	14	7	25
(5) NLHS	6	21	6	21	6	21	2	7	6	21
(6) FLHS	8	29	10	37	6	22	3	11	9.	33

Table (3): Effect of heat stress , food and light withdrawal at heat time, with S. infection on internal organs weight (g).

Organs / Group	Liver	Bursa of Fabricius	Spleen
(1) C -ve	5.71 ± 1.04	0.80 ± 0,15	0.38 ± 0.15
(2) CS	5.05 ± 1.03	0.52 ± 0.11	0.32 ± 0.11
(3) HFL	5.98 ± 0.11	0.48 ± 0.09	0.32 ± 0.07
(4) NFHS	4.71 ± 0.99	0.34 ± 0.06	0.33 ± 0.06
(5) NLHS	4.65 ± 0.99	0.34 ± 0.06	0.33 ± 0.06
(6) FLHS	5.29 ± 1.02	0.47 ± 0.09	0.32 ± 0.06

C -ve : control negative of any treatments .
CS : control positive, Salmonella infected with no heat no light and food treatments .
HLF: heat stress with light and food allowed with no Salmonella .
NFHS: heat stress with Salmonella and no food .
NLHS: heat stress with Salmonella and no light .
FLHS: heat stress with Salmonella, food and light available .

Table (4): Effect of heat stress, food and light withdrawal and Salmonella infection on mortality

Rates / Group	# of dead bird	Rate %
C -ve	--	--
CS	8/30	24 %
FLH	3/30	10 %
NFHS	4/30	13.3 %
NLHS	4/30	13.3 %
FLHS	5/30	15 %

 # = number of dead birds at the end of experiment.

C -ve : Control negative of any treatment.

CS : Control positive, Salmonella infected with no heat no light and food treatments.

HLF : Heat stress with light and food allowed with no Salmonella.

NFHS: Heat stress with salmonella and no food.

NLHS: Heat stress with salmonella and no light

FLHS: Heat stress with salmonella, food and light available.

mortality from 24% of Salmonella infection to 13.3% in those heat stressed with no food and light at heat period at that young age.

This experiment will be containued on advanced ages (28-42days old), because this is the critical overgrowth period (more heat increament imposed) and be sensitive to acute heat stress under Egyptian hot weather than what applied in this experiment (young age).

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