4 *Egypt. J. Anim. Prod.,* Vol. 27, No. 1, pp. 37 - 45 (1990)

Some Physiological Responses to Heat Stress, Dehydration and Starvation in Lohman Selected Loghorn Cockerels

M.H. Khalil and N.F. Abd-El-Hakim

Anim. Prod. Dept., Fac. Agric., Al-Azhar Univ., Nasr City, Cairo, Egypt.

A TOTAL number of 24 L.S.L. Cockerels was randomly divided into 4 equal groups. The first group served as a control and received water and feed **ad lib.** The 2nd group was deprived from water and feed for 72 hours. The 3rd group was deprived of water and not of feed. The 4th group was deprived of feed and not of water. Measurements were taken under shade just before the exposure of animals to direct sunlight and 4 times after exposure.

Results indicated that hemoglobin, glutamic oxalacetic GOT and GPT glutamic pyruvic transaminase levels were increased by dehydration and heat stress while hematocrite value decreased by heat stress. Body temperature and respiration rate increased with heat stress. The highest mortality rates were recorded in the dehydrated heat stressed animals.

Such results might encourage poultrymen to recommend depriving birds of feed in tropical and subtropical areas during times of water shortage.

Key words : Cokerels, Heat stress, Dehydration, Starvation.

Water deprivation and starvation are a well known stimulus for enzymatic and biochemical changes in blood and consequently for homeostatic responses of various physiological mechanisms (Arad *et al.,* 1983 ; Khalil *et al.,* 1985 and Abd-el-Hakim *et al.,* 1986). Combined heat stress and dehydration add to the physiological constraints, as thermoregulation in birds depends to a great extent on evaporative cooling (Arad *et al.,* 1983). Previous findings revealed that heat exposed fowl could efficiently regulate acid-base status and body temperature and consequently avoid serum enzyme changes with minimal metabolic disturbances (Arad, 1983 and Arad *et al.,* 1983).

The relationship between the osmoregulatory and thermoregulatory responses in the domestic fowl was discussed by Azahan and Sykes (1980) and Arad *et al.* (1983). Both authors found that hypothalamic cooling caused a diuretic response, however hypothalamic heating did not show consistent antidiuretic response.

This study deals with enzymatic, GOT and GPT, response as well as some physiological changes in the dehydrated and/or starved heat exposed L.S.L. cockerels.

Material and Methods

The present study was carried out during summer (July and August) on 24 white L.S.L. cockerels aging 22 months at the Poultry Experimental Station of the Animal Production Department, Faculty of Agriculture, Al-Azhar University Cairo, Egypt. Birds were randomly divided into 4 experimental groups of 6 birds each. Groups were fed a ration containing 18% protein and 2800 K. Cal/ME/Kg. diet for 25 days and feed and water were offered ad lib. in order to determine feed and water consumption before the start of the experiment. After this period, the first group served as control and was offered water and feed *ad lib.* The *2nd* group was deprived of water and feed. The *3rd* group was deprived of water and not of feed. The *4th* group was deprived from feed and not from water. Birds were housed in floor pens during the pre-experimental period.

Water and/or food deprivation was continue for 72 hours starting at 00.08 h. All the animals were subjected to solar radiation, after the feeding and watering treatments for successive 8 hours.

Body weights, was recorded during the pre-experimental period, before and after exposure to solar radiation. Ambient temperature was taken using the thermohygrograph, black body temperature " solar radiation " was measured at the site of the experiment during the course of measurements (Table 1).

TABLE 1. Meteorological data at the site of the experiment during the course of measurements.

Time	Ambient Temp. °C	Solar Radiation °C
Before exposure	26.3±0.39	———
2 hrs exposure	33.8±0.90	47.5±0.58
4 hrs exposure	35.4±0.83	49.6±0.24
6 hrs exposure	35.4±0.13	48.5±0.08
8 hrs exposure	33.3±0.17	40.6±0.51

Rectal and skin temperatures were measured using a Yellow Spring Telethermometer. Respiration rate (respiration per minute) was counted by counting chest movements. Glutamic oxalacetic (GOT) and glutamic pyruvic (GPT) transaminases were determined according to Reitman and Frankel (1957). Hemoglobin concentration (Hb) was estimated in gm/100 ml. blood (Bauer, 1970-a). The packed cell volume percentage (Ht) was estimated by the microhematocrite method (Bauer, 1970-b). All the above parameters were taken under shade just before the exposure of animals to direct sunlight. This was followed by immediate exposure of the animals and measurements of these parameters were made at 2-hr intervals (at 2, 4, 6 and 8 hours of exposure ; *i.e.* at 10 *a.m.*, 12 *m.d.*, 2 *p.m.* and 4 *p.m.* respectively). Blood samples for GOT and GPT determinations were collected at 8 *a.m.* and 12 *m.d.*

Statistical analysis of the multifactor experiments having repeated measures on the same animal were carried out as performed by Winer (1971).

Results and Discussion

Blood and Plasma Components

Table (2) reveals that before exposure to solar radiation, Hb and PCV% behaved similarly, thus the highest values of both were obtained in the dehydrated group which was followed by the starved and dehydrated group, the normal group and the starved group. The higher values of Hb and Ht may be due to the reduction in plasma volume obtained by dehydration. Awad-Allah (1988) found an increase in PCV% in the dehydrated group and in a group which drank 1% NaCl in water. He suggested that this increase was mainly due to a reduction in plasma volume as indicated by lower extracellular fluids.

TABLE 2. Effect of exposure to solar radiation, starvation and dehydration on packed cell volume (Ht), hemoglobin concentration (Hb), glutamic oxalacetic (GOT) and glutamic pyruvic (GPT) transaminases.

Hours of exposure	Normal group	Dehydrated		Starved group
		Starved dehydrated group	Fed dehydrated group	
Before exposure				
Ht %	28±0.0	28.7±2.7	34.8±1.7	24.5±1.2
Hb %	7.1±0.4	7.9±0.7	10.1±0.7	6.8±0.8
GOT % mU/ml	41.6±12.6	96.8±16.1	117.7±12.5	83.3±13.9
GPT % mU/ml	22.4±3.9	28.4±1.0	30.7±0.8	24.3±2.1
After 4 hrs				
Ht %	24.2±0.7	24.5±1.2	28.0±0.9	26.0±0.9
Hb %	9.5±0.3	9.7±0.8	10.2±0.8	9.6±0.4
GOT % mU/ml	99.6±26.4	128.0±20.2	163.6±15.9	98.8±11.8
GPT % mU/ml	30.6±1.2	31.0±0.6	33.5±1.1	31.0±0.9

After 4 hr of exposure to solar radiation PCV % decreased while Hb concentration increased (Table 2). Literature pertaining to the effect of exposure on Hb and Ht% in poultry is scanty. Khalil *et al.* (1985) found that high ambient temperature with water deprivation increased Hb concentration in chicks. Moreover, Khalil *et al.* (1985) and Awad-Allah (1988) suggested that the reduction in Ht% under heat stress may be due to the increase in blood cells at a very rapid rate to compensate for the damaged erythrocytes by releasing cells into the general circulation before they were fully matured. Also they added that haemodilution may cause the reduction of Ht% under these conditions.

Glutamic Oxalacetic (GOT) and Glutamic Pyruvic (GPT) Transaminases

Table (2) reveals that GOT and GPT showed almost the same trend not only before exposure but also after exposure to solar radiation. They were the highest in the dehydrated group followed by the starved and dehydrated group, the starved group and the normal group. The rise in GOT and GPT in the dehydrated groups before and after exposure to solar radiation might indicate that hyperthermia and dehydration affect adversely the metabolic cycles (Arad *et al.*, 1983) which may help the animal to reduce its heat production and in turn to conserve water. In general the rise in GOT levels indicate an increased cardiac activity and output. The increase in this enzyme level in the present study may indicate that heart rates of dehydrated and dehydrated heat exposed cockerels were greatly affected. Similar results were obtained by (Arad, 1983 and Arad *et al.,* 1983).

Mortality Rate

Exposure to solar radiation had a pronounced effect on mortality rate in the dehydrated birds (Table 3). This was evident by the highly significant values observed between periods of exposure in both water deprived groups. The death of birds occurred only in the dehydrated group and dehydrated and starved group. Mortalities started in both groups after 4 hr of exposure to solar radiation (Table 3).

It is interesting to note that the steepest decline in the number of birds alive was recorded for the dehydrated group as the birds suffered the highest mortality rate (all birds died after 6 hr of exposure to solar radiation-Table 3). However, in the dehydrated and starved group (when birds were deprived not only of water but also of feed) the drastic effect was progressively alleviated but still was significantly higher (mortality rates were 33% and 50% after 6 and 8 hr of exposure respectively than both the control and starved groups (all birds tolerated heat and still alive-Table 3).

The remarkable thermoregulation (*i.e.* heat tolerance) observed in the drinking water groups (normal and starved groups), could be attributed to the fact that these birds possess some adaptive mechanism by increasing heat loss through respiratory evaporation (Khalil *et al.*, 1985 ; Abd-el-Hakim *et al.*, 1986) to counter act such stress.

Such results might encourage poultrymen to recommend depriving birds of feed in tropical and subtropical areas in times of water shortage.

TABLE 3: Means ± tandard errors of rectal temperature (Tre), respiration rate (RR) and number of birds alive (n) during the course of measurements of exposure to solar radiation.

Hours of exposure		Normal group	Dehydrated		Starved group
			Starved dehydrated group	Fed dehydrated group	
00	Tre	41.5±0.45	41.1±0.41	41.0±0.47	41.8±0.16
	RR	56.3±1.56	37.8±3.41	28.7±2.06	45.3±4.81
	n	6	6	6	6
2	Tre	42.7±0.40	43.5±0.16	43.1±0.23	42.8±0.20
	RR	80.3±4.57	75.2±9.33	61.7±10.2	62.2±8.14
	n	6	6	6	6
4	Tre	41.7±0.41	42.9±0.91	43.9±0.10	42.7±0.49
	RR	101.6±8.16	70.5±12.3	120.0±0.00	67.6±15.4
	n	6	5	2	6
6	Tre	40.0±2.50	42.7±0.87	———	42.4±0.07
	RR	90.4±12.7	74.7±7.06	———	64.0±10.1
	n	6	4	0	6
8	Tre	40.7±0.43	39.5±2.50	———	41.7±0.46
	RR	46.4±5.74	36.0±8.00	———	40.0±2.19
	n	6	3	0	6

Body Temperature (Tre) *and Respiration Rate (RR)*

Exposure to solar radiation had a highly significant effect on Tre and RR. This was evident in all groups studied. As shown in Table (3) Tre and RR were influenced greatly by black body temperature (solar radiation) in addition to ambient temperature. Thus, Tre and RR in all groups studied were much higher during exposure than under shade. These results agree with those obtained by Arad (1983) ; Arad *et al.,* (1983) ; Sykes and Fataftah (1986).

The percentage changes in Tre and RR between the highest values during exposure and values before exposure (under shade) were greater in the dehydrated group (7.2% and 76.2%) followed by the starved and dehydrated group (5.7% and 49.7%), the normal group (2.9% and 44.6%) the least were that of the starved group (2.3% and 32.9%) for The and RR respectively. These results indicated that the starved group was more capable to tolerate heat followed by the normal group, the starved and dehydrated group and the dehydrated group. This trend may be explained by the fact that Tre is a balance between heat production and heat dissipation (Khalil *et al.,* 1985 ; Abd-el-Hakim *et al.,* 1986 ; Awad-Allah, 1988) and that the starved birds had lower oxygen consumption (*i.e.* heat production) than that of the normal (Abd-el-Hakim *et al.,* 1984 ; 1986 ; Khalil *et al.,* 1985). Thus, the starved group could tolerate heat to a large extent more than all other groups, it is therefore, worthy to recommend poultrymen depriving birds of feed when they were exposed to heat stress.

Before exposure to solar radiation, RR was higher in the normal followed by the starved group, the starved and dehydrated group and dehydrated group (Table 3). Such results indicated that dehydration and/or starvation caused a reduction in respiration rate which may be explained by the fact that when panting animals deprived of water, they reduced their RR in order to reduce respiratory evaporation to preserve water as much as possible as an adaptive mechanism against water deprivation (Amer *et al.,* 1984 ; Khalil *et al.,* 1985 ; Abd-el-Hakim *et al.,* 1986 and Awad-Allah, 1986). Moreover, Khalil *et al.* (1985) ; Abd-el-Hakim *et al.* (1986) indicated that starvation caused a reduction in RR because of the reduction in metabolic rate due to the reduction in oxygen consumption and accordingly reduction in the movement of respiratory muscle.

Body Weight

Dehydration and/or starvation for 72 hours appeared to have a non-significant effect on body weight. However, percentages of body weight losses after treatments relative to initial body weight revealed that the decrease in this parameters was more drastic in the group deprived from both feed and water (11.2% loss , as compared with group deprived of feed (6.7%) and the dehydrated group (5.6%).

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اثر العطش والجوع مع التعرض لحرارة الاشعاع الشمسى على بعض صفات التاقلم الفسيولوجية فى ديوك ل . س . ل .

مدحت حسين خليل محمد و نبيل فهمى عبد الحكيم

جامعة الازهر ــ كلية الزراعة ــ قسم الانتاج الحيوانى ــ مدينة نصر القاهرة ــ مصر

استخدم فى هذه الدراسة عدد ٢٤ ديك من النوع ل . س . ل . حيث قسمت الديوك الى اربعة مجاميع متساوية . استخدمت المجموعة الاولى كمجموعة مقارنة حيث اعطيت كمية مفتوحة من الماء والغذاء ، اما المجموعة الثانية فقد منع عنها الغذاء والماء لمدة ٧٢ ساعة. اما المجموعة الثالثة فقد منع عنها الغذاء فقط لنفس المدة . اما المجموعة الرابعة فقد منع عنها الماء فقط لنفس المدة . اخذت القياسات تحت الظل وبعدهــا مباشرة تم تعريض الحيوانات لحرارة الاشعاع الشمسى (فى الصيف) حيث تم أخذ قياس كل ســـاعتين لمدة ٨ ســـاعات وظهرت النتائج الاتى : ارتفاع مستوى كلا من الهيموجلوبين وانزيمات الجلوتامك اوكسال اسيتك والجلوتامك بيروفك ترانس امينيز بالتعطيش والتعريض لحرارة الاشعاع الشمسى ، اما قيمة الهيماتوكريت فقد انخفضت بالتعريض للحرارة . ارتفع معدل التنفس ودرجة حرارة المجمع بالتعريض للحرارة . حققت المجموعة المعطشة اعلا نسبة تفوق مــع التعريض لحرارة الاشـــــماع الشمسى .

يستخلص من هــذه النتــائج توجيه النصـــح لمربى الدجاج بمنع الغــذاء عن الطائر فى حالة عدم توافر المياه كما يفضل منع الغذاء عــن الطــائر فى حالة ارتفاع درجة الحرارة نهارا وتقديمه للطائر ليلا .