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بسم الله الرحمن الرحيم

BODY FLUIDS AS AFFECTED BY FAT SUPPLEMENTATIONDURING HEAT STRESS IN BROILERS

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ABSTRACT

This study was conducted to determine the effect of dietary fat supplementation in body fluids compartments, respiration rate (RR) and rectal temperature (Rt) of broilers during heat exposure. One hundred and twenty (1- day – old) unsexed Sasso chicks were divided randomly into 4 groups. The first group was fed a control diet and kept under normal ambient temperature (28^{o}c). The second group was fed the control diet and exposed to 40^{o}c for 3 hrs. at 49 days of age. The third group was fed the control diet supplemented with corn oil (6%). The fourth group was fed the control diet supplemented with (6%) corn oil and exposed to 40 ^{o}c for 3hrs. at 49 days of age. Body fluids compartments, respiration rate and rectal temperature were measured. Results indicated that rectal temperature and respiration rate increased during heat exposure in broilers fed diet with or without fat supplementation.

Fat supplementation diet decreased total body water % (TBW%) of broilers with or without heat exposure. Heat exposure (40^{o}c) decreased the percentage of plasma volume (PV%) in broilers. Fat supplementation prevent the reduction of P.V%. In occlusion, the maintenance of plasma volume % in broilers via dietary fat supplementation is an adaptive mechanism to heat stress.

Keywords: broilers, heat stress, body fluids, fat supplementation

INTRODUCTION

Mortality of broilers due to heat prostration is a problem for broiler producers when summer temperature is near 38^{o}c., especially in the humid production areas. Economic losses due to heat prostration are very drastic, especially, when broilers are about ready for marketing (Reece *et al*., 1972). May (1995) found that mortality rate of broilers exposed to 37.8 °C for 8 hrs. was higher than broilers at normal temperature (29.4°C) .

Physiological effects of hyper thermic panting have been studied. Khalifa *et al*. (1994) and Dawoud (1998) found that the evaporative cooling by panting in broilers decreased plasma volume by about 50% during heat stress.

Several authors used ascorbic acid for reducing the deleterious effects of heat stress in broilers, McKee and Harrison (1995) found that ascorbic acid was responsible for increasing resistance of female Hubbard broiler chicks to multiple concurrent stressors.

Heat stress substantially reduced growth rate of broilers. Fat supplementation to diets has been recorded to reduce this problem via reducing the heat increment of the diet (Fuller and Mora, 1973).

Part of the heat produced by metabolism is referred to the specific dynamic effect (SDE) and is attributed to various nutrients in the ration. Protein produces a high SDE, whereas carbohydrates produce low SDE, while fat has been suggested to produce the lowest SDE (Ceringlia at al., 1983).

Khalifa *et al*. (1994), Dawoud (1998) and Ahmed *et al*. (1998) reported that the increase of broilers mortality rate in summer might be due to the decrease of body fluids compartments, especially plasma volume. Dawoud (1998) and Ahmed *et al*. (1998) found that NaCl supplementation to the diet did not improve the decrease plasma volume reared in summer.

The objective of this study was to investigate the effect of dietary fat supplementation on body fluids compartments in broilers during heat stress.

MATERIALS AND METHODS

The present study was carried out to study the effect of dietary fat supplement-ation on body fluids compartments and thermal reactions of broilers during exposure to heat.

One hundred and twenty unsexed (one – day – old) Sasso chicks were used in this study. Chicks were randomly divided into 4 groups. Birds in group 1 were fed a broiler diet containing 20% crude protein and 2890 kcal/kg diet (control diet) and kept under normal ambient temperature (28 °c) up to 49 days of age. Birds, in group 2 were fed a control diet up to 49 days of age. Birds in group 3 were kept under normal ambient temperature and fed the control diet supplemented with 6% fat (as corn oil). Birds in group 4 were fed a control diet with 6% fat supplementation up to 49 days of age. Feed and water were available ad-libitum during rearing and heat stress periods. At 49 days of age birds in group 2 and group 4 were exposed to 40°C for 3hrs and twenty birds (5 from each group) were used for measurements. Rectal temperature (Rt) was measured using digital thermometer inserted for 2 cm in cloaca. Respiration rate (RR) was measured by counting body wall movements per minute. Body fluids compartments were determined.

Total body water (TBW) was measured using antipyrine method as described by Weiss (1958). Extracellular fluid (ECF) was estimated by potassium thiocyanate method as described by Hix *et al*. (1959). Plasma volume (Pv) was determined by Evan's blue method as described by Kennedy and Mellikan (1938). Intracellular fluid (ICF) was calculated by subtracting ECF from TBW, and interstitial fluid (ISF) was calculated by subtracting Pv. from ECF.

Least square means was used to calculate the mean of studied traits using SAS (1988). Differences among means were compared using Duncan's test (1955).

RESULTS AND DISCUSSION

1- Rectal Temperature (RT)

Exposure to heat significantly increased rectal temperature in group 2 and group 4 (Table1). Similar results were found by Kamar and Khalifa (1977), Borady *et al.* (1979), Sinarat and Balanare (1985) and Deyhin and Teeter (1991) who found that body temperature was increased as ambient temperature increased. Dietary fat supplementation slightly decreased RT when comparing birds of group 1 and 3 (Table1).

Table 1: Effect of dietary fat supplementation on respiration rate (RR) and rectal temperature (Rt) of broilers during exposure to heat.

Group	RR	Rt.
Group 1	$53.20^{B} \pm 1.356$	$42.96^{B} \pm 0.356$
Group 2	$103.20^{A} \pm 6.591$	$44.68^{A} \pm 0.548$
Group 3	$53.60^{B} \pm 3.31$	$42.20^{B} \pm 0.148$
Group 4	$104.40^{A} \pm 6.794$	$44.14^{A} \pm 0.068$

$^{A, B}$ Means in the same column having different superscripts are significantly different (P < 0.05).

Group 1: control group.

Group 2: control group and heat exposure (40 °c 3hrs at 49d age).

Group 3: control group with fat supplementation (6%)

Group 4: control group with fat supplementation (6%) and heat exposure (40°c for 3hrs.) at 49 days of age.

2- Respiration rate (RR)

Exposure to heat significantly increased respiration rate in both groups (2 and 4). Similar trends were found by Weiss and Barbely (1957) and Kamar and Khalifa (1977) who found that respiration rate was slightly lower at warm weather (21°C) than at hot weather (31°C). Respiration rate greatly increased at air temperatures higher than 30°C to aid in heat loss by evaporating cooling.

3- Total Body Solids (TBS%):

Exposure to heat showed no effect on TBS%. Total Body Solids were significantly increased (Table 2) in groups 3 and 4 which fed diets supplemented with fat. This increase may be due to the increase in abdominal fat.

4-1- Total Body Water (TBW%):

Exposure to heat showed no effect no TBW%. However, fat supplementation in both groups 3 and 4 significantly decreased TBW% (Table 2). This decrease may be due to the increase in abdominal fat.

Table 2: Effect of dietary fat supplementation on body fluids compartments of broilers during heat exposure

Group	Body	TBS	TBW	ECF %	ICF %

	weight (gm)	%	%	ISF %	PV %	Total	%
Group 1	1234 $^{A}\pm$ 115.52	33.34 $^{B}\pm$ 0.763	66.66 $^{A}\pm$ 0.763	29.67$^{A}\pm$ 0.667	7.56 $^{A}\pm$ 0.584	37.23 $^{A}\pm$ 0.375	29.43 $^{B}\pm$ 1.096
Group 2	1208 $^{A}\pm$ 129.28	33.71 $^{B}\pm$ 0.787	66.29 $^{A}\pm$ 0.779	26.58$^{A}\pm$ 1.024	5.89 $^{B}\pm$ 0.448	32.47 $^{A}\pm$ 1.175	33.82 $^{A}\pm$ 1.513
Group 3	1460 $^{A}\pm$ 124.89	41.65 $^{A}\pm$ 0.443	58.34 $^{B}\pm$ 0.443	26.55$^{A}\pm$ 1.367	7.39 $^{A}\pm$ 0.510	33.94 $^{B}\pm$ 0.984	24.40 $^{A}\pm$ 1.318
Group 4	1146 $^{A}\pm$ 59.96	41.01 $^{A}\pm$ 0.876	58.39 $^{B}\pm$ 0.876	20.52$^{B}\pm$ 0.818	6.57 $^{A}\pm$ 0.568	27.09 $^{C}\pm$ 0.358	31.30 $^{A}\pm$ 1.215

$^{A, B, C}$ Means the in same column having different superscripts are significantly different ($P < 0.05$).

Group 1: control group.

Group 2: control group and heat exposure (40 ^{o}c 3hrs at 49d age).

Group 3: control group with fat supplementation (6%)

Group 4: control group with fat supplementation (6%) and heat exposure (40^{o} c for 3hrs.) at 49 days of age.

4-2- Intra cellular fluids (ICF%):

Intra cellular fluids in group 2 which exposed to high temperature were significantly higher than that in group 1. Similar results were found by Khalil *et al.* (1991) who found that ICF% in hens was significantly higher in summer than in winter. A higher and significant increase occurred when birds fed diets supplemented with 6% fat and exposed to heat stress in group 4.

4-3- Extra cellular fluids (ECF%):

The increase in evaporative cooling during heat stress in group 2 caused a significant reduction in ECF% (Table 2) Khalil *et al.* (1991) found that ECF% in hens was significantly lower in summer than in winter. They suggested that this reduction was due to a higher water loss through panting in summer. Feeding birds in group 4 a diet supplemented with 6% fat and exposing them to heat stress showed significantly more decrease in ECF%.

4-4- Interstitial fluid (ISF%):

The effect of heat exposure with or witthout a diet supplemented with 6% fat (Table 2) showed similar trend on ISF% as in ECF% in group 4 and group 2, respectively.

4-5- Plasma volume (PV%):

Exposure to heat significantly decreased plasma volume % in group 2 (Table 2). Khalifa *et al*. (1994) and Dawoud (1998) found that the evaporative cooling by panting in broilers decreased plasma volume by about 50% during heat stress. On the other hand, addition of 6% fat in group 4 prevent the

reduction in PV%. Since, heat produced by fat metabolism has the lowest SDE (Ceringlia *et al.*, 1983).

It could be concluded from the results of the present study that, the maintenance of PV% via fat supplementation is an adaptive mechanism to heat stress.

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تأثير إضافة الدهن إلى دجاج التسمين على سوائل الجسم أثناء الإجهاد الحرارى

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أجريت هذه الدراسة لتحديد تأثير إضافة الدهن إلى علائق دجاج التسمين أثناء الإجهاد الحرارى على سوائل الجسم ومعدل التنفس ودرجة حرارة الجسم.

استخدم فى هذا البحث ١٢٠ كتكوت ساسو عمر يوم. تم تقسيم الكتاكيت إلى أربعة مجاميع ، المجموعة الأولى كنترول كانت التغذية فيها بدون إضافة دهن وكانت تحت درجة الحرارة العادية ٣٠°م ، المجموعة الثانية تغذت على نفس عليقة المجموعة الأولى (كنترول) ولكن تم تعريض الكتاكيت فيها على عمر ٤٩ يوم لدرجة حرارة ٤٠ °م لمدة ٣ ساعات والمجموعة الثالثة تغذت على عليقة مضاف لها ٦% زيت ذرة أما المجموعة الرابعة فتغذت على عليقة مثل المجموعة الثالثة ثم تعريض الكتاكيت على عمر ٤٩ يوم لدرجة حرارة ٤٠°م لمدة ٣ ساعات.

تم تقدير سوائل الجسم ومعدل التنفس ودرجة حرارة الجسم. أوضحت النتائج أن معدل التنفس ودرجة الحرارة ارتفعت أثناء التعريض للإجهاد الحرارى فى حالة التغذية على علائق مضاف إليها أو غير مضاف إليها دهن (زيت ذرة).

التغذية على الدهن أدت نقص الماء الكلى بالجسم عند التعريض للإجهاد الحرارى أو عدم التعريض. كما أن التعريض للإجهاد الحرارى (٤٠°م لمدة ٣ ساعات) أدى إلى نقص نسبة البلازما بينما إضافة الدهن حسّنت من هذا النقص.

مما تقدم يمكن القول أن إضافة الدهن لعلائق دجاج التسمين تؤدى إلى الحفاظ على نسبة بلازما الدم وخاصة أثناء الإجهاد الحرارى.