TOLERANCE TO HEAT STRESS IN TWO STRAINS OF TURKEY

BY

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B.Sc. Agric. Sci . (Poultry Production), Ain Shams University , 1980

M.Sc. Agric. Sci . (Poultry Production), Ain Shams University , 1998

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ABSTRACT

YASER KAMEL El-SAYED HASAN BADAWI , Tolerance to heat stress in two strains of turkey . Unpublished Doctor of Philosophy Dissertation , Dept. of Poultry Production, Faculty of Agriculture , Ain Shams University 2005 .

Two experiments were conducted to study the effect of heat stress on the physiological , hematological and immunological responses of two strains of turkey (Nicolas and Bronze) .

First experiment : Two strains of turkey 12 wk old were subjected to long term heat stress at 32 ^{o}C and short term heat stress at 45^{o}C. Body temperature (Tb), surface temperature (Ts) , respiration rate (RR), feed intake (FI) , heterophil to lymphocytes (H/L) ratio, hematocrit value (Ht) , plasma total protein (PTP), and plasma content of heat shock protein (Hsp)70 KDa were investigated. A total of 60 birds of each strain was divided into 3 groups, 20 birds each ; 10 of each sex. First group was exposed to acute heat stress at 45 ^{o}C for 60 min , the second group was exposed to relatively longer heat stress at 32 ^{o}C for 6 hours , and the untreated group was kept at the normal ambient temperature of about 20 ^{o}C. The relative humidities were 40 , 50 and 50 % for the first , second and control groups , respectively. Results shows that heat stress at 45 ^{o}C and at 32 ^{o}C decreased feed intake in both strains , hematocrit percentage , plasma total protein and increased body temperature , respiration rate, heterophils to lymphocytes (H/L) ratio and heat shock protein (Hsp) 70 Kda .The increase in Hsp 70 Kda was associated with the increase in the temperature of heat treatments. These results suggest that Bronze turkey could be considered as heat

tolerant strain compared with Nicolas under the present condition . Using modern biotechnological techniques such as Hsp analysis is preferable to classical methods as a tool in Marker Assisted selection (MAS) for identifying the most tolerant strain of turkey .

Second experiment : The two above mentioned strains of turkey of the first experiment (Nicolas and Bronze) were subjected to chronic heat stress at 40 ^{o}C for 4h /3days/3weeks from 5-8 weeks of age to study the physiological response which influenced by the effect of chronic heat stress . Feed consumption , water consumption , weight gain (WG) , feed conversion , body temperature (Tb) , respiration rate (RR) , H/L ratio, plasma total protein (PTP) , glucose, insulin, thyroid hormones (T_3 and T_4) and plasma electrolytes (Ca , P, Na , K , Mg , Mn and Zn) were measured. A total of 40 birds of each strain was divided into 2 groups, 20 birds each ; 10 of each sex. First group was exposed to chronic heat stress at 40 ^{o}C for 4 hours , the second group was kept at the normal ambient temperature of about 20 ^{o}C (control). The relative humidities were 65 and 40 % in control and heat stressed group , respectively. Feed consumption was not affected by heat stress . Both sexes responded differently to heat stress. Chronic heat stress at 40 ^{o}C decreased body weight gain and feed intake in both strains, plasma total protein , electrolytes , hemoglobin , T_3 and T_4 hormones , hematocrit percentage and increased insignificantly in body temperature , respiration rate , water consumption, heterophils to lymphocytes (H/L) ratio , mortality rate , glucose and insulin hormone compared with unstressed control .

The results indicated that exposure of turkey to chronic heat stress 40^{o}C result in acceptable adaptation and increase the thermotolerance leading to maintenance of productivity .

Key words: turkey , heat stress , body temperature , respiration rate , water consumption , feed intake , mortality rate , T_3 , T_4 , hemoglobin , hematocrit , heterophils to lymphocytes (H/L) ratio , glucose , plasma electrolytes , plasma total protein and heat-shock protein .

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INTRODUCTION

The physiological response of poultry to sudden high ambient temperature heat stress (HS) has been reported by several investigators including **May *et al* ., (1987) ; El-Gendy and Washburn, (1995) ; El-Nabarawy , (1997) and El-Badry (2004)** .

Since the past five decades researchers have shown that feed consumption is inversely related to high environmental temperature **(Parker *et al* .,1972 ; Mitchell *et al.*, 1992).**

Exposing birds to heat stress has been reported to reduce feed intake and increase water consumption **(Krista *et al* ., 1979 ; Van Kampen 1981)** to reduce the metabolic rate and hence body heat load which is one of the possible mechanisms of thermotolerance that is regulated to a large extent by triiodothyronine (T3) **(McNabb and King 1993).**

The most common measured variables were body temperature and respiration rate . Increased body temperature is one of the responses associated with heat stress .

Heat stress causes serious losses in poultry production by adversely affected growth rate and increasing the incidence of mortality but is greater in heavier birds than in lighter birds **(Squibb and Wogan 1960 ; Marks and Huston ,1973 ; Bohren *et al.,* 1982 ; Teeter *et al* ., 1985) .**

Considerable information exists on the relationship of growth to heat stress in birds **(Hurwitz *et al.,* 1980).**

The influence of heat stress on growth rate depends on age at the heat exposure , its duration , sex **(Van Kampen 1981 ; Mitchell , *et al.*, 1992) .**

Rectal temperature is a balance between heat production and heat loss **(Folk, 1974).**

Studies on temperature regulation in birds indicate that they had the ability to regulate their core body temperature within a constant level of 40.5^{o}C to 41^{o}C within a wide range of ambient temperature **(Hillman *et al*.,1985) .** The respiration rate is higher in birds exposed to high temperature than those raised under normal ambient temperature **(Arad *et al* .,1975; Kalamah ,2001)**.

A number of studies have suggested that thyroid activity is affected by the environmental temperature . Thyroid size and secretion rate are decreased by high temperature in chickens , but not in ducks and geese **(Huston and Carmon ,1962 ; Huston *et al* ., 1962).** Circulating concentration of T3 is reduced at high temperatures **(Yahav *et al*., 1996) .** Therefore , it may be anticipated that induction of thermotolerance will be associated with modulation of plasma T_3 concentration **(Yahav and Hurwitz ,1996).**

Changes in the blood system are part of the thermoregulatory responses acquired by birds to enable them to withstand heat stress . Stressed birds established a cascade of physiological adaptive responses include elevation of plasma glucose, and electrolytes **(Pech-Waffenschmidt *et al* ., 1995)**. Increased mineral excretion is one of the important consequence of heat distress. High temperature affect availability of minerals (**Belay *et al.,* 1992 ; Belay and Teeter 1996 ; Smith *et al*., 1995).**

Birds raised at high ambient temperature had lower hematocrit values than those raised at lower ambient temperatures **(Sturkie 1986 ; Zhou *et al* ., 1998 and El-Badry , 2004).**