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Impact of Oxidative Stress on Serum Glucose Level of Different Age Group in Poultry

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ABSTRACT: An investigation was carried out to determine the effect of oxidative stress on serum metabolite i.e. glucose level in non-descript broilers at the age of 2 weeks, 4-6 weeks and older than 8 weeks during moderate and hot humid ambience. Serum metabolite i.e. glucose level is investigated in this study. The overall mean value of serum glucose during moderate ambience was8.75± 0.07 mmol/L.

When we compare the overall mean value of serum glucose in moderate and hot humid ambience, the value of hot humid ambience was significantly (p≤0.01) higher. The age effect was highly significant (p ≤0.01) in both ambiences on glucose mean values. The pattern of changes was similar during the both ambiences.

It was concluded that hot humid ambience produced marked effect on the serum levels of metabolite i.e. glucose. It can be recommended that broilers must be supplemented with appropriate antioxidants to defend them from harsh effects of adverse ambient temperature and oxidative stress. This would not only protect the broilers from harsh effects of free radicals produced but also increase the immune response of growing broilers to defend against the infectious agents. The supplementation of antioxidants will also improve the growth of broilers which would help in improving the economic status of farmer.

Thus, it can be concluded that though there is no evident symptom of oxidative stress but diagnosis can be made with the alterations in serum glucose level. Alteration in the levels of serum glucose level clearly indicate their involvement which can further be utilized to improve the condition of broilers during extremes of temperatures.

Keywords: Glucose, oxidative stress, broiler, temperature.

INTRODUCTION

The stress caused to the body due to extreme heat adversely affects the growth and development of chickens which has a very negative impact on metabolism and immunity. During heat stress, most chickens reduce their food intake, which keeps their body temperature normal, but as a result, glucose metabolism is reduced (Syafwan *et al.*, 2011). Broiler chickens maintain normal body temperature by reducing metabolism during heat stress (Conte *et al.*, 2018). Glycolysis is reduced during heat stress in broilers resulting in increased gluconeogenesis to maintain glucose levels (Guo *et al.*, 2012). After that, glucose is produced from pyruvate and other non-carbohydrate substrate. It is very interesting think that heat stress increase gluconeogenesis process for glucose synthesis which then circulates throughout the body to maintain cellular functions. We show in this study that chronic heat stress increases gluconeogenesis.

MATERIAL AND METHODS

The experiment was conducted during extreme weather condition i.e. moderate and hot humid ambience. The broilers are divided into three categories i.e. two week, four to six weeks and older than eight weeks of age. Blood samples were collected from private slaughter house of Bikaner. Total 240 blood samples were collected in both weather conditions. In each condition 120 blood samples were taken and these are again

subdivided into three categories i.e. 40 samples in each age group. The data were calculated by ANOVA. The IBM SPSS version 20.0 software was used for ANOVA. The glucose level in serum sample was taken by this procedure:-

Estimation of serum glucose. It was calculated by Nelson-Somogyi method as described by Oser (1976).

Principle. Deproteinization of blood is done by zinc-hydroxide-barium sulfate procedure. By this procedure a filtrate is obtained which give only one reducing sugar i.e. glucose.

Reagents

(i) Barium hydroxide solution.
(ii) Zinc sulfate solution.
(iii) Alkaline copper reagent A
(iv) Arsenomolydate colour reagent
(v) Standard glucose solutions.

Procedure

(A) Deproteinization. Take 1ml blood in 50-ml flask. Add drop by drop 9.5 ml Ba $(OH)_2$ solution and 9.5 ml $ZnSO_4$ solution in this flask and rotate well. After that, shake vigorously and filter on dry filter paper. This obtained filtrate now used in glucose estimation.

(B) Determination of glucose. Take a 10 ml calibrated test tube and add 0.5 ml barium zinc filtrate in it. After that, add 1 ml alkaline cupper reagent in it and mix well. Cover the top of tube with stopper and place in boiling water bath for 20 minutes in upright position. After 20 minutes, remove tube from water bath and cool it upto normal room temperature. After cooling, add 1 ml of arseno-molybdate colour reagent and 10 ml distilled water and mix properly. Set zero optical density in spectrophotometer and take optical density of standard and unknown at 540 mμ.

Calculation

mg glucose per 100 ml blood
= Density of unknown/Density of standard)×(mg glucose in standard)×(100/0.025)
Conversion factor of mg/dl to mmol/l for glucose i.e.mg/dl of glucose x0.0555 =mmol/l

RESULTS AND DISCUSSION

The Mean ± SEM, analysis of variance, Percent changes in the mean value of serum glucose in the broilers of various age groups are presented in Table 1-3 respectively. Earlier researchers reported serum glucose values in broilers which were in accordance to the present study (Rako *et al*., 1964; O'Donnell *et al.*, 1978; Li, 2017).

Effect of hot humid ambience on serum glucose. The increase in overall mean value of serum glucose during hot humid ambience was $9.76^{B} \pm 0.05$ mmol L^{-1} which show highly significant ($p \leq 0.01$) effect of ambience on serum glucose levels. Overall mean value of hot humid ambience 11.54 % increase as compared to overall mean value of moderate ambience.

Li (2017) discussed blood glucose level in birds. Navidshad *et al*. (2010) investigated serum glucose concentrations under low moderate and high temperatures. Habibian *et al*. (2014) reported increased serum glucose concentration in the heat stressed conditions. Zhu *et al*. (2015) found higher serum glucose levels in hens. Gumus and Imik (2016) detected lower glucose levels in broilers exposed to heat stress. Attia and Hassan (2017) found significant increase plasma glucose of heat stressed broilers. Oke *et al.* (2020) detected higher blood glucose levels in broilers under hot humid tropical environment. Ghasemi and Nari (2020) reported higher glucose concentration in heat stressed broilers. Gopi *et al*. (2020) detected greater glucose concentration in broilers under hot humid conditions.

Effect of age on serum glucose

The mean value of serum glucose in two weeks old broilers during moderate and hot humid ambience was $8.42^{a, x} \pm 0.10$ mmol L^{-1} and $9.45^{b, x} \pm 0.09$ mmol L^{-1} respectively which show highly significant ($p \leq 0.01$) effect of age on serum glucose level. The same pattern was also found in other age group.

Gharieb and Moursi (2014) also detected levels of glucose in broiler chicks. Akbarian *et al.* (2015) studied serum glucose levels in broilers at 38 days of age. No significant difference observed in serum glucose levels at 36 and 52 weeks old by Tang *et al*. (2017). Bueno *et al.* (2017) recorded blood glucose levels in broilers chicken of 21-42 days of age. Habibian *et al*. (2014) also recorded age related changes in serum glucose concentrations.

Table 1: Mean ± SEM values of serum glucose (mmol L^{-1}) in broilers.

Key effects	Subgroups	Mean ± SEM values	
		Moderate	Humid hot
1. Age	two weeks(40)	$8.42^{a, x} \pm 0.10$	$9.45^{b, x} \pm 0.09$
	Four to Six weeks(40)	$8.73^{a, y} \pm 0.08$	$9.76^{b, y} \pm 0.07$
	older than eight weeks(40)	$9.09^{a, z} \pm 0.06$	$10.07^{b, z} \pm 0.07$
2. Overall mean values		$8.75^{A} \pm 0.07$	$9.76^{B} \pm 0.05$

$^{A, B}$ marks highly significant ($p \leq 0.01$) differences between overall mean values of both ambience
^{a,b}marks highly significant differences ($p \leq 0.01$) between mean values of different age groups in a row
$^{x, y, z}$ marks highly significant differences ($p \leq 0.01$) between mean values of different age groups in a column

Table 2: Significance value for serum glucose (mmol L^{-1}) in broilers.

Source of variation	p-Value
Ambience	0.000
Age	0.000
Interaction between ambience and age	0.000

Table 3: Percent changes in the mean value of glucose (mmol L^{-1}) in serum of broiler of different age groups during hot humid ambience.

Effects Ambiences	Subsets	% increase during hot humid ambience
Age groups	Overall value	11.54
	Older than eight weeks	10.78
	Four to six weeks	11.79
	two weeks	12.23

CONCLUSIONS

The levels of glucose increased with increase in age according to this investigation which may be due to mobilization of nutrient with increasing age and hormonal imbalance in birds.

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