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Effect of heat stress on serum magnesium level in non-descript broilers

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Abstract

This research conducted in non -descript broilers to explore the impact of heat stress on serum magnesium. During sampling process two hundred forty healthy broilers were examined in two ambiances which were moderate and hot humid. Total 120 non -descript broilers sampled in each ambiance. Each and every group of one hundred twenty birds was again divided into 3 subgroups according to their age namely two weeks, four to six weeks and more than eight weeks. Each subgroup contains 40 non-descript broilers. Data were analyzed through IBM SPSS software by two-way ANOVA. During moderate ambiance, overall mean value of serum magnesium was 0.85 ± 0.00 mmol L⁻¹ irrespective of age group and the scale was between 0.83-0.87 mmol L⁻¹. The overall mean value of serum magnesium during hot humid ambiance was 0.55 ± 0.01 mmol L⁻¹ irrespective of age and the scale was between 0.47-0.60 mmol L⁻¹. The overall range was 0.47-0.87 mmol L⁻¹. The results of present study in respect with serum magnesium level showed that heat stress create oxidative stress in broilers which can alter serum electrolytes level such as magnesium so the antioxidants supplementation suggested during both seasons to reduce the adverse impact of stress produced by free radicals.

Keywords: Heat stress, sampling, overall mean value, magnesium

Introduction

The incessant increase in poultry production over the last decades to meet the highly growing demand, in order to provide food security, has recently received much attention due to the negative impacts of the currently most challenging environmental stressor, the heat stress, on birds. When the poultry house ambient temperature goes above the thermo-neutral levels, heat stress is exerted which leads to the disturbance of the symmetry between heat released from the body and body temperature to safeguard homeostasis (Nardone *et al.*, 2010^[14] and Ezzat *et al.*, 2011^[7]). Heat stress leads to massive losses, especially in hot regions of planet because of its negative effect on feed consumption, growth performance, organ weight, immune suppression and mortality (Biswal *et al.*, 2022^[4]; Ding *et al.*, 2020^[5]; Habibian *et al.*, 2014^[8]; Hosseinivashan *et al.*, 2016^[9]; Zhang *et al.*, 2018^[23]).

Some earlier studies reported on heat stress in poultry using specific biochemical and electrolyte parameters, could help by practical assessment of managemental practices, nutritional status, organ function and health conditions with main focus on the changes of serum electrolyte and metabolite levels (Jeevana *et al.*, 2017^[10]; Tang *et al.*, 2017^[19]; Saracila *et al.*, 2018^[15]; Murali and Sherin, 2020^[13]; Makola *et al.*, 2021^[12]; Akinyemi and Adewole, 2022^[2]). However, no comprehensive information is currently available on the serum magnesium level affected by high environmental temperature. Thus, the aim of this research was to evaluate the impact of heat distress for various ambiances in non-descript broiler by calculating the fluctuations in the magnesium level in serum during two weeks, four to six weeks and more than eight weeks of age. The present study examined serum magnesium content in heat stressed birds.

Material and Methods

For achievement of all objectives, blood samples of 240 birds were taken from slaughter house of Bikaner. The blood sampling was done in the time of hot humid moderate ambiances. Birds were kept in natural habitat under standard circumstance. Sampling process conducted before afternoon in moderate and hot humid ambiances. The collection of blood was done in anticoagulant added clean test tube. For separation of serum, test tubes were kept in the tilting posture and blood was start to clot.

After 30 minutes blood was finally clotted and serum was isolated from clotted blood with the help of sterilized stainless-steel wire. Serum samples collected during moderate ambience were processed immediately after collection. Serum sample collected throughout hot humid ambience were stored in refrigerator at 0 °C-4 °C for small period as freezing of serum cause incomplete inactivation of few parameters.

(King, 1965) [11]. Serum magnesium level examined in fresh samples in each ambience. Blood samples of 120 birds were collected during each ambience. Birds divided in subgroups on the basis of age as two weeks, four to six weeks and more than eight weeks in both ambiances. Each subgroup contains 40 broilers as shown in this following table:

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S. No.	Subgroup	No. of birds
	Overall	240
	Moderate Ambience	120
1	2weeks of age	40
2	4-6 weeks	40
3	older than 8 weeks of age	40
	Hot humid ambience	120
1	2 weeks of age	40
2	4-6 weeks	40
3	older than 8 weeks of age	40

In every subgroup figures were analyzed for Mean ± SE and ANOVA (2×6 factorial design). Ambience and age were classified as main effects. Estimation of serum magnesium level was done by standard Titan yellow method as reported by Varley (1988) [22].

Recording of environmental temperature and calculation of THI

THI values were calculated from recorded meteorological

variables as described below by formula given by (Tao and Xin, 2003) [20]. Digital thermo hygrometer was used to record relative humidity and temperature so maximum and minimum relative humidity and temperature can be observed.

$$THI = 0.85T_{db} + 0.15T_{wb}$$

THI = Temperature humidity index in °C

T_{db}= Dry bulb temperature (°C)

T_{wb} = Wet-bulb temperature in °C

This table demonstrate environmental temperature and relative humidity during different environmental temperature periods:

S. No.	Ambience	Environmental temperatures in °C (Mean ±SEM)		Relative humidity in %	
		Highest	Lowest	7.00 am	6.00 pm
1.	Moderate	21.02±0.01	24.00±0.12	49.51±0.11	33.12±0.09
2.	Hot humid	27.43±0.20	39.02±0.29	67.31±1.12	43.41±1.29

Results

Highly significant (p≤0.01) decrease of overall mean value of magnesium in serum was observed during hot humid ambience in contrast to overall moderate mean value. Highly significant (p≤0.01) effect of variation in ambience was shown by ANOVA. Overall mean value of hot humid ambience decreased 35.29 % in contrast to overall mean value of moderate ambience. Age effects displayed highest decrease in the mean value of broilers of 2 weeks of age. ANOVA showed highly significant (p≤0.01) age effects. The mean value of magnesium level in serum of birds of 4-6 weeks of

age was higher than mean value of birds of 2 weeks and lower than mean value of birds of > 8 weeks of age. The mean value of serum magnesium in birds of age group > 8 weeks was highest and greater than other two categories. On the basis of percentage, highest decrease in the mean value of magnesium in serum of broiler was discovered at 2 weeks of age (-43.37%). Age and ambience interrelation found highly significant (p≤0.01) for serum magnesium which demonstrated the impact of ambience on all age group broilers.

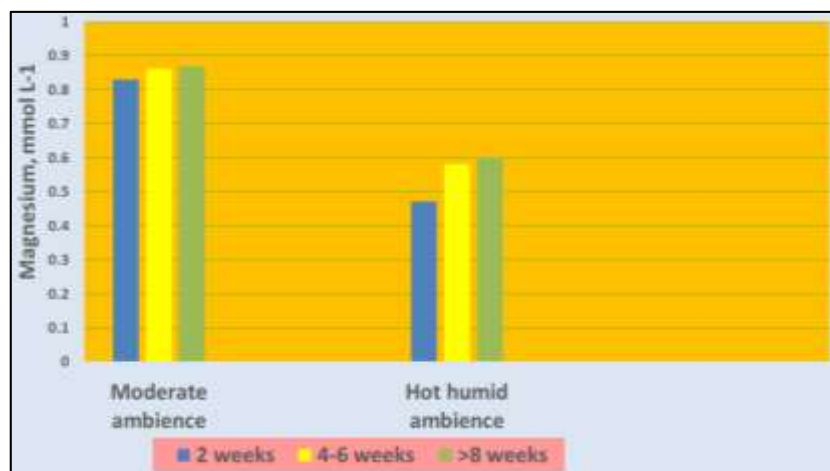


Fig 1: Mean changes in serum magnesium in non -descript broilers with effect of ambience and age

Table 1: Mean ± SEM values of serum magnesium (mmol L⁻¹) in non -descript broilers

Key effects	Subgroups	Mean ± SEM values	
		Moderate	Humid hot
1. Age	2 weeks (40)	0.83 ^{a, x} ±0.01	0.47 ^{b, x} ±0.02
	4-5 weeks (40)	0.86 ^{a, y} ±0.01	0.58 ^{b, y} ±0.01
	>8 weeks (40)	0.87 ^{a, z} ±0.00	0.60 ^{b, z} ±0.01
2. Overall mean values		0.85 ^A ±0.00	0.55 ^B ±0.01

^{A, B} marks highly significant (p≤0.01) differences between overall mean values of both ambience

^{a, b} marks highly significant differences (p≤0.01) between mean values of different age groups in a row

^{x, y, z} marks highly significant differences (p≤0.01) between mean values of different age groups in a column

Table 2: Analysis of variance of serum magnesium (mmol L⁻¹) in non -descript broilers

Source of variation	DF	MSS	p-Value
Ambience	1	5.468	0.000
Age	2	0.168	0.000
Ambience X Age	5	1.180	0.000
Error	236	0.008	

DF Marks degree of freedom MSS Marks mean sum of squares

Table 3: Percent changes in the mean value of magnesium (mmol L⁻¹) in serum of broiler of different age groups during hot humid ambience

Effects	Subsets	% Change
		Hot humid ambience
Age groups	Overall value	-35.29
	2 weeks	-43.37
	4-6 Weeks	-32.55
	>8 weeks	-31.03

Discussion

Akinyemi and Adewole (2022) [2] recorded higher plasma magnesium concentrations in heat stressed batch as in contrast to those in treatment batch. Ding *et al.* (2020) [5] suggested no significant change in serum magnesium among all experimental groups. Hoeven-Hangoor *et al.* (2013) [21] studied effect regarding magnesium source on intestinal water reabsorption. Skrivan *et al.* (2016) [18] evaluated magnesium levels and its relationship to ca: NPP in layer hens. Ajakaiye *et al.* (2010) [1] investigated plasma magnesium in hens during hot humid period. Silva *et al.* (2007) [17] recorded decreased magnesium levels at 21 and 42 days of age, whereas highest at 35 days of age. Arora (2006) [3] recorded age effects on the serum levels of magnesium in broilers. Estevez and Petracci (2019) [6] studied effect of magnesium in broiler subjected heat stress. Magnesium is a cheif dietary component and it is very essential for growth and development of body in birds because it play very important role in metabolism of cell and development of bone (Shastak and Rodehutsord, 2015) [16]. Hence it can be concluded that magnesium levels altered with increasing age and change in ambience in broilers which can be attributed to growth, hormonal influence and metabolism.

Conclusion

It can be summarized that there was a decline in serum magnesium level which evident the appearance of heat distress. The decline level assures the reduction of level of oxidative stress inhibitors in neutralizing the free radicals produced in broilers throughout hot season, Thus, we suggested that addition of oxidative stress inhibitors and magnesium in broilers ration.

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