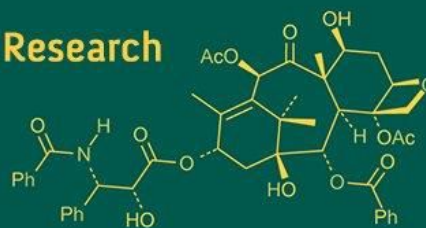


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Effect of selenium and chromium supplementation on liver profile in growing Vrindavani male calves exposed to thermal stress in Psychrometric chamber

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Abstract

Twelve healthy growing Vrindavani male cattle of uniform age and weight (1.5-2 years with 135-185 kg body weight) were selected for the study. The animals were used in switch over design. The calves were randomly divided into five groups (6 animals each) viz. Group I (control, maintained in the shed on normal feeding without any treatment), Group II heat stress (HS), Group III (HS+ Chromium (Cr) supplementation), Group IV (HS+ Selenium (Se) supplementation) and Group V (HS+ Cr+ Se supplementation) for monitoring the effect of Cr, Se, Cr+Se supplementation on various group of animal. The Dietary supplementation of Chromium was given @ 0.5mg/kg/DMI/day and Selenium @ 0.3mg/kg/DMI/day respectively. The respective groups of animals were exposed to 38 °C in Psychrometric chamber for 6 hours (9:00 AM–3:00 PM) a day. The effect of heat stress on few liver enzymes viz. Alanine aminotransferase (ALT) and Aspartate aminotransferase (AST) have been assessed. Blood serum sample was collected at weekly interval for the estimation of ALT and AST. ALT and AST level was significantly ($P < 0.05$) higher in animals exposed to thermal stress without any treatment as compared to animals treated with Cr, Se and Cr+Se together. The finding of present study indicated that the Cr, Se and Cr+Se together helps to reduce ALT and AST level to its normal value during heat stress condition. The dietary supplementation of Cr, Se and Cr+Se may be very helpful in ameliorating the effect of heat stress in growing Vrindavani cattle.

Keywords: Vrindavani, ameliorating, Aspartate aminotransferase, Alanine aminotransferase, assess

Introduction

India is the country with the largest dairy herd in the world compared to industrialized countries that produce milk (Rhoads *et al.*, 2009) [15]. Different meteorological conditions, such as high ambient temperature, air movement patterns, solar radiation intensity, wind speed fluctuations and the relative humidity of the ambient environment have a substantial influence on dairy production (Maurya *et al.*, 2018) [9]. By the 21st century's end, environmental temperatures are expected to have risen by 1.5 °C (IPCC, 2018). Rhoads *et al.* (2009) [15] reported that due to rise in environmental temperature (global warming) ranging from 0.3 to 4.8 °C, there will be direct and indirect consequences for animal production systems because of thermal stress in animals. Animals that experience heat stress activate physiological systems that can include behavioural, neuroendocrine, and endocrine responses Maurya *et al.*, (2015) [11]. Hormone and neurotransmitter release are influenced by the neuroendocrine system's activation, and these chemicals work together as response mechanisms to help organisms cope with stress (Sejian *et al.*, 2011; Maurya *et al.*, 2019) [17, 10]. Antioxidants are added in animal's diets as part of nutritional management to minimize oxidative damage during heat stress (Chauhan *et al.* 2020., Maurya *et al.*, 2024) [4, 8]. Now a days a number of feed additives, such as niacin, vitamin A, C, E, selenium (Se) and chromium (Cr) are added in animal's diet to reduce the adverse consequences of heat exposure by preventing oxidative damage in the animals experiencing heat stress (Chauhan *et al.*, 2020., Verma *et al.*, 2025) [4, 18]. Selenium (Se) is a dietary trace element which acts as an essential co-factor of glutathione peroxidase and acting as an antioxidant enzyme which is very essential for the animal's productivity. Chromium (Cr) is essential micro mineral which

is vital for the metabolism in animals (Lashkari *et al.*, 2018) [6]. Cr plays a crucial role in the cellular breakdown of fat, protein, and carbohydrates and is a very important component of the glucose metabolism and it also act as an antioxidant role (Sahin and Sahin, 2002) [16]. The dietary supplementations of Cr in heat stressed calves helps in maintaining their health and immune system up to some extent (Sahin and Sahin, 2002) [16]. In the present study dietary CR and SE are being used as an antioxidant to ameliorate the heat stress on animals.

Materials and Methods

The present experiment was carried out at the Nuclear Research Laboratory and the Physiology and Climatology Division at the Indian Council of Agricultural Research-Indian Veterinary Research Institute, Izatnagar (UP). The proposed experiment was conducted in a psychrometric chamber by the Physiology and Climatology Division of the Indian Veterinary Research Institute, Izatnagar Bareilly (UP). The animals were used in switch over design. The calves were randomly divided into five groups (6 animals each) viz. Group I (control, maintained in the shed on normal feeding without any treatment), Group II heat stress (HS), Group III (HS+ Chromium (Cr) supplementation), Group IV (HS+ Selenium (Se) supplementation) and Group V (HS+ Cr+ Se supplementation) for monitoring the effect of Astaxanthin supplementation on various group of animal. The Dietary supplementation of Chromium was given @ 0.5mg/kg/DMI/day and Selenium @ 0.3mg/kg/DMI/day respectively. The respective groups of animals were exposed to 38°C in Psychrometric chamber for 6 hours (9:00 AM–3:00 PM) a day. The duration of all experimental groups of animal was 28 days for each group. Blood samples were collected from animal on weekly basis. Blood samples were collected on 1st, 7th, 14th (Acclimatization period under shed) and 1st, 7th, 14th, 21st, 28th day of exposure at respective schedule of experiment. Further, blood sample were also collected from all the animals at day 35th day of experiment (recovery period). The serum sample from blood samples were separated for the estimation of ALT and AST.

ALT (Alanine Amino Transferase): Serum ALT activity was measured using a commercially available ALT test kit (Coral Clinical System).

AST (Aspartate Amino Transferase): Serum AST activity

was measured using a commercially available AST test kit (Coral Clinical System).

Statistical analysis: The data collected throughout the experimental period was analyzed by using two way ANOVA.

Results and Discussion

The analysed results of ALT and AST have been shown in the Table no.1 and Table no.2 and Figure no.1 and Figure no.2 respectively.

Alanine aminotransferase (ALT)

The Mean $\pm$ SE value of control and treatment (HS, HS+Cr, HS+Se, and HS+Cr+Se) group have been presented in the Table 1 and Figure 1. Prior to exposure, there was no significant difference in the ALT levels between the control (Shed), HS, HS+Cr, HS+Se, and HS+Cr+Se, respectively. The ALT levels was Significantly higher ($p < 0.05$) in the animals exposed to psychrometric chamber without any treatment at day 7th, 14th, 21th and 28th days of study as compared to animal maintain in the shed without any treatment as well as HS+Cr, HS+Se, and HS+Cr+Se group of animals. The dietary supplementation of HS+Cr, HS+Se, and HS+Cr+Se had a significantly ($p < 0.05$) lower values of ALT at day 7th, 14th, 21th and 28th days of experiment. However the level of ALT was lowest in HS+Cr+Se group of animals as compared to all other group of animals. In accordance to our finding Yadav *et al.*, (2012) [19] reported an increase in serum ALT activity in cattle exposed in the climate chamber. The serum ALT activity rises (Nazifi *et al.*, 2003) [12] as environmental temperature rises. The heat stress induced oxidative damage of the liver lead to an increased activity of ALT concentration in the heat stress exposed group of animals. (Li *et al.*, 2015). The supplementation of Sodium Selenite in male cattle reduced ALT concentration in the blood serum as reported by Aderao *et al.* (2020) [2] which also support our findings. The Paul *et al.* (2015) [13] reported that the Cr and Se supplementation decrease the level of AST and ALT in heat exposed cows which is also coincide with our finding. From all the previous finding it may be concluded that the supplementation of Cr, Se and Cr+Se together reduces the ALT concentration in heat induced growing Vrindavani cross bred male calves as compared to calves exposed under psychrometric chamber without any treatment.

Table 1: Mean $\pm$ SEM of ALT (IU/L) of different groups over the study period in growing Vrindavani cattle

ALT IU/L					
Days	Control	HS	HS+CR	HS+SE	HS+CR+SE
0	21.14 $\pm$ 1.931 ^{aB}	29.77 $\pm$ 1.497 ^{cA}	25.32 $\pm$ 1.014 ^{bAB}	27.41 $\pm$ 1.240 ^{abA}	23.13 $\pm$ 2.196 ^{aB}
7	22.16 $\pm$ 0.333 ^{aC}	41.73 $\pm$ 2.048 ^{bA}	30.71 $\pm$ 1.368 ^{aB}	31.36 $\pm$ 1.689 ^{aB}	26.31 $\pm$ 2.97 ^{aBC}
14	20.62 $\pm$ 0.313 ^{aC}	50.28 $\pm$ 1.358 ^{aA}	32.16 $\pm$ 2.191 ^{aB}	30.91 $\pm$ 2.696 ^{aB}	25.24 $\pm$ 2.989 ^{aBC}
21	23.62 $\pm$ 0.705 ^{aB}	43.13 $\pm$ 2.490 ^{abA}	27.12 $\pm$ 2.321 ^{abB}	26.12 $\pm$ 2.391 ^{abB}	21.24 $\pm$ 1.989 ^{aB}
28	21.92 $\pm$ 0.720 ^{aC}	40.47 $\pm$ 1.008 ^{bA}	28.31 $\pm$ 2.793 ^{abB}	28.91 $\pm$ 3.312 ^{abB}	20.36 $\pm$ 2.78 ^{aC}
35	20.56 $\pm$ 2.489 ^{aAB}	25.23 $\pm$ 1.312 ^{cA}	22.91 $\pm$ 2.789 ^{bAB}	19.58 $\pm$ 1.312 ^{bB}	24.51 $\pm$ 2.981 ^{aAB}

^{ABC} values with different superscripts represents significant difference ($p < 0.05$) between the groups

^{ab} values with different superscripts represents significant difference ($p < 0.05$) within the group

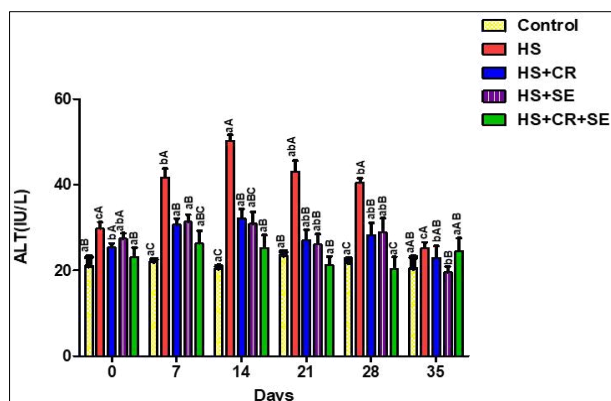


Fig 1: ALT (IU/L) of different groups over the study period. All values are shown as Mean± SEM.

Aspartate aminotransferase (AST)

The Mean ±SE value of control and treatment (HS, HS+Cr, HS+Se, and HS+Cr+Se) group have been depicted in the Table 2 and Figure 2. During treatment day 7th, 14th, 21th and 28th days, the AST levels was Significantly higher

Table 2: Mean±SEM of AST (IU/L) of different groups over the study period in growing Vrindavani cattle

AST IU/L					
Days	Control	HS	HS +CR	HS +SE	HS+ CR+SE
0	98.61±3.833 ^{abA}	105.67±5.393 ^{ba}	92.31±5.931 ^{ba}	96.23±3.68 ^{aA}	101.5±6.392 ^{aA}
7	108.32±5.698 ^{abB}	145.21±4.929 ^{aA}	99.39±7.318 ^{abB}	106.31±7.369 ^{ab}	98.61±7.368 ^{ab}
14	104.98±2.432 ^{abB}	165.31±6.678 ^{aA}	106.39±6.631 ^{abB}	102.31±6.123 ^{ab}	99.36±6.397 ^{ab}
21	99.39±5.367 ^{abB}	160.41±5.981 ^{aA}	109.12±4.383 ^{abB}	108.41±5.987 ^{ab}	96.23±6.789 ^{ab}
28	96.52±3.622 ^{abB}	152.32±8.396 ^{aA}	111.21±7.321 ^{ab}	106.5±5.981 ^{ab}	94.31±7.124 ^{ab}
35	93.21±6.378 ^{abA}	101.31±2.987 ^{ba}	104.81±7.368 ^{abA}	103.9±6.381 ^{aA}	101.61±5.392 ^{aA}

ab.values with different superscripts represents significant difference (<0.05) between the groups

AB.values with different superscripts represents significant difference (<0.05) with in the treatment

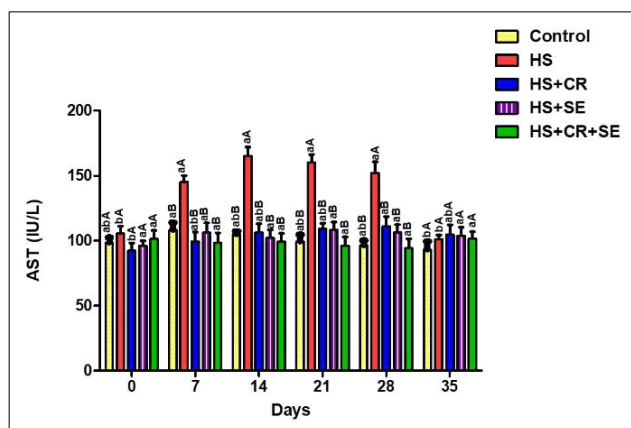


Fig 2: AST (IU/L) of different groups over the study period. All values are shown as Mean± SEM.

Conclusion

The animals exposed to HS showed highest level of ALT and AST. Our research finding indicates that there is significant difference between ALT and AST values when the animals were supplemented with Cr, Se and Cr+Se separately. There was no significant ($P>0.05$) difference between ALT and AST values when animals were maintained in the shed without any treatment and as well values obtained during recovery period. On the 7th, 14th, 21st and 28th day of the research period, highest value of AST and ALT value was found out in heat exposed group of animals as compared to HS+Cr, HS+Se, and HS+Cr+Se respectively. The finding of our study showed a protective

($p<0.05$) in the animals exposed to psychrometric chamber without any treatment as compared to animal maintain in the shed without any treatment. The supplementation of HS+Cr, HS+Se, and HS+Cr+Se had a significantly ($p<0.05$) lower values of ALT at day 7th, 14th, 21th and 28th days of experiment. However the level of AST was lowest in HS+Cr+Se treated group of animals as compared to all HS+Cr, HS+Se group of animals.

Chandra Bhan *et al.*, reported an increase in AST levels in the summer exposed animals as compared to the spring season in cattle. In support of our study Abdelatif *et al.* (1995) [1] obtained as higher AST and ALT values in animals maintained in extremely hot conditions compared to animals reared in the cold climatic conditions. The finding of Paul *et al.* (2015) [13], also supports our study finding that the feeding of Cr and Se decreases the level of AST in the cow exposed to thermal stress. The research finding of Sultana *et al.*, (2022) similar to our finding as she reported a significant decrease ($p<0.05$) in level of AST, when the heat exposed calf were treated with Se and Cr as compared heat exposed calves without any treatment.

effect of Cr, Se and Cr+Se on liver metabolic activity which very conducive for the animals which are facing the hazardous environmental fluctuations.

References

1. Abdelatif AM, Modawi SM. Effect of hyperthermia on blood constituents in the domestic rabbit (*Lepus cuniculus*). Journal of Thermal Biology. 1994;19(6):357-363.
2. Aderao GN. Effect of dietary selenium supplementation on serum glutathione concentration in goat. Nigerian Journal of Animal Science. 2020;22(1):105-111.
3. Chandrabhan D, Singh R, Dahiya S, Sharma NK. Hemato-biochemical studies in heat stressed Sahiwal cattle. Veterinary World. 2012;5(8):485-489.
4. Chauhan SS, Dunshea FR, Plozza TE, Hopkins DL, Ponnampalam EN. The impact of antioxidant supplementation and heat stress on carcass characteristics, muscle nutritional profile and functionality of lamb meat. Animals. 2020;10(8):1286.
5. Intergovernmental Panel on Climate Change. Global warming of 1.5 °C. An IPCC special report on the impacts of global warming of 1.5 °C above pre-industrial levels and related global greenhouse gas emission pathways. Masson-Delmotte V, Zhai P, Pörtner HO, Roberts D, Skea J, Shukla PR, *et al.*, editors. Geneva: IPCC; 2018. <https://doi.org/10.1017/9781009157940>
6. Lashkari S, Habibian M, Jensen SK. A review on the role of chromium supplementation in ruminant

- nutrition: effects on productive performance, blood metabolites, antioxidant status and immunocompetence. *Biological Trace Element Research*. 2018;186:305-321.
7. Liu F, Cottrell JJ, Wijesiriwardana U, Kelly FW, Chauhan SS, Pustovit RV, *et al.* Effects of chromium supplementation on physiology, feed intake and insulin-related metabolism in growing pigs subjected to heat stress. *Translational Animal Science*. 2015;1(1):116-125.
 8. Maurya VP, Kant L, Majumder S, Verma P, Das P, Pandey A, *et al.* Effect of transition stress in cattle and its ameliorative strategies. *Journal of Experimental Zoology India*. 2024;27(2):1-8.
 9. Maurya VP, Sejian V, Kumar D, Naqvi SMK. Biological ability of Malpura rams to counter heat stress challenges and its consequences on production performance in a semi-arid tropical environment. *Biological Rhythm Research*. 2018;49(3):479-493.
 10. Maurya VP, Sejian V, Kumar D, Naqvi SMK. Impact of heat stress, nutritional stress and their combinations on the adaptive capability of Malpura sheep under hot semi-arid tropical environment. *Journal of Animal Behaviour and Biometeorology*. 2019;7(1):31-38.
 11. Maurya VP, Sejian V, Gupta M, Dangi SS, Kushwaha A, Singh G, *et al.* Adaptive mechanisms of livestock to changing climate. In: Sejian V, Gaughan J, Baumgard L, Prasad C, editors. *Climate change impact on livestock: adaptation and mitigation*. New Delhi: Springer; 2015. p.123-138.
 12. Nazifi S, Saeb M, Rowghani E, Kaveh K. The influences of thermal stress on serum biochemical parameters of Iranian fat-tailed sheep and their correlation with triiodothyronine (T₃), thyroxine (T₄) and cortisol concentration. *Comparative Clinical Pathology*. 2003;12(3):135-138.
 13. Paul A, Dangi SS, Gupta M, Singh J, Thakur N, Naskar S, *et al.* Expression of TLR genes in Black Bengal goat (*Capra hircus*) during different seasons. *Small Ruminant Research*. 2015;124:17-23.
 14. Raghunandan T, Sultana JR, Chandra AS, Prakash MG, Venkateswarlu M, Ramana DBV. Effect of dietary chromium, vitamin E and selenium supplementation on biochemical and physiological parameters of Holstein Friesian cows under heat stress. *Indian Journal of Animal Sciences*. 2022;92(7):858-864.
 15. Rhoads ML, Rhoads RP, VanBaale MJ, Collier RJ, Sanders SR, Weber WJ, *et al.* Effects of heat stress and plane of nutrition on lactating Holstein cows: I. Production, metabolism and aspects of circulating somatotropin. *Journal of Dairy Science*. 2009;92(5):1986-1997.
 16. Sahin K, Sahin N. Effects of chromium picolinate and ascorbic acid dietary supplementation on nitrogen and mineral excretion of laying hens reared in a low ambient temperature (7 °C). *Acta Veterinaria Brno*. 2002;71(2):183-189.
 17. Sejian V, Maurya VP, Naqvi SMK. Effect of walking stress on growth, physiological adaptability and endocrine responses in Malpura ewes in a semi-arid tropical environment. *International Journal of Biometeorology*. 2011;56:243-252.
 18. Verma P, Majumder S, Kant L, Nunisa S, Samad H, Chouhan V, *et al.* Effect of dietary chromium and selenium supplementation on physio-biochemical parameters, antioxidant activity and immune function of Vrindavani cattle exposed to thermal stress. *International Journal*. 2025;9(1):489-493.
 19. Yadav B, Singh G, Wankar A, Dutta N, Chaturvedi VB, Verma MR. Effect of simulated heat stress on digestibility, methane emission and metabolic adaptability in crossbred cattle. *Asian-Australasian Journal of Animal Sciences*. 2012;29(11):1585-1592.