Effect of Summer Stress and Supplementation of Vitamin E and Selenium on Serum Lipid Profile in Hallikar Cattle

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Abstract: ***A study was carried out to assess the effect of different seasons and supplementation of vitamin E and selenium during different seasons on serum triglycerides, total cholesterol, HDL cholesterol, LDL cholesterol and VLDL cholesterol levels in Hallikar cattle belonging to different farmers of Madabal Village of Magadi Taluk, Ramanagar District, Karnataka, India. The study was carried out in two groups of animals, viz., control group that received regular diet and supplemented group that received vitamin E and selenium in addition. In the present study, the serum triglycerides levels were significantly (P<0.05) lower and total cholesterol levels were significantly (P<0.05) higher during summer compared to winter season in control group. Both triglycerides and total cholesterol levels were significantly (P<0.05) higher in supplemented group compared to control group during all the seasons. Serum HDL cholesterol levels were significantly (P<0.05) higher in supplemented group compared to control group. Serum LDL cholesterol and VLDL cholesterol levels were significantly (P<0.05) higher and lower, respectively, during summer season compared to winter season in control group. It was concluded that the summer stress significantly influence the levels of serum lipid profile and supplementation with vitamin E and selenium during summer stress is beneficial as they significantly increase the concentration of HDL cholesterol in Hallikar cattle.***

Keywords: Summer stress, Triglycerides, Total cholesterol, HDL cholesterol, LDL cholesterol

1. Introduction

Heat stress is one of the wide varieties of factors which cause oxidative stress in animals. It can be defined as the point where the animal is not able to dissipate adequate quantity of heat to maintain thermal steady state. Various climatic factors like ambient temperature, relative humidity and radiation influence the degree of heat stress (Samal, 2013).

Heat stress has become major issue in the current scenario of climate change and it is not only adversely affecting the milch animals, but also the dual purpose animals and draught cattle population. In Indian subcontinent, heat stress is the most important climatic stress that even threatens the survival of the animals (Sejian *et al*., 2013). Heat stress depresses the physiological and metabolic activities in the affected animals and heat exposure induced hyperthermia is known to disturb the lipid metabolism in heat stressed cattle (O' Kelly, 1987). The elevated body temperature and basal metabolic rate during summer enhance the generation of reactive oxygen species leading to oxidant-antioxidant imbalance and oxidative stress. Vitamin E and selenium are the two components which contribute to the antioxidant potential of the plasma and tissue. Dietary modulation with inclusion of vitamin E and selenium is used to correct the oxidant-antioxidant imbalance (Doni *et al*., 1984). Though the effect of summer stress on lipid profile in various animal species is available, owing to the lack of such scientific information in Hallikar cattle the present study was carried out to ascertain the influence of summer stress on serum lipid profiles and effectiveness of the vitamin E and selenium supplementation on reverting the summer stress induced changes in the components of lipid profile in Hallikar cattle.

2. Materials and Methods

The study was conducted at Madabal Village of Magadi Taluk, Ramanagara District, during three seasons of the year 2014, *viz*., winter months (January and February), summer months (April and May) and comfortable months (July and August).A group of twelve female Hallikar cattle (4 to 6 years) randomly selected from different farmers and grouped as control and supplemented group with six animals in each group were utilized in the present study. All the animals were maintained in semi-intensive management system with similar feeding practices in the farmer's premises. Animals of both the groups were exposed to the natural environmental stressors during three different periods of the study by allowing them for grazing for about 7 hours/day (1030 to 1730 hours). The animals of control group received only maintenance diet, whereas, supplemented group received vitamin E (D-alpha tocopherol acetate: 1000 IU/day/animal) and selenium (sodium selenite: 0.3 ppm / kg dry matter intake) in addition during the entire period of study. Blood samples were collected from each of the selected animals on the last day of every month during the respective season. Each time about 5 ml of blood was collected from each animal in clot activator coated vial and collected blood samples were kept undisturbed for 30 minutes at room temperature before it was transported to the laboratory in refrigerated temperature, within two hours after the collection. Clotted blood samples were later centrifuged at the rate of 700 x g for 15 minutes to obtain the serum. The serum samples obtained were stored at – 80 °C and later utilized for determination of serum triglycerides, total cholesterol, HDL cholesterol and LDL cholesterol levels. All serum lipid parameter were determined at 37 °C with the help of Microlab 300 semi-automated biochemical analyzer (Merck Pvt. Ltd, Mumbai). Commercially available ERBA diagnostic reagent kits (Transasia Bio-medicals Ltd., Dist. Solan, Himachala Pradesh) were utilized for determination of serum triglyceride and total cholesterol levels. Serum triglyceride levels were estimated by using reagent kits developed as per the method of Allain *et al.* (1974). Serum total cholesterol levels were analyzed using reagent kits based on the method of McGowan (1983).

Serum HDL cholesterol levels were determined by HDL direct kit manufactured by Spinreact, S. A. and marketed by Euro Diagnostic Systems Pvt. Ltd., Chennai. Low density lipoprotein cholesterol (LDL-C) in serum was calculated as the difference between total cholesterol and the sum of VLDL-C and HDL-C as suggested by Kanchana and Jeyanthi (2010).

Very low density lipoprotein cholesterol (VLDL-C) levels in serum was calculated by employing the Friedwald formula (Satyanarayana and Chakrapani, 2006).

3. Statistical Analysis

Data obtained in the present study were analyzed using computerized statistical software programme, Graph Pad Prism version 5.01 (2007) by applying two-way ANOVA with Bonferroni post mean comparison test. The significance of analysis was determined at probability levels of 95 per cent ($P<0.05$).

4. Results and Discussion

The serum triglycerides (mg/dL) level was significantly ($P<0.05$) lower in control group during summer compared to winter season (Table 1). This reduction in serum triglycerides could be attributed to the increased hormone sensitive TG-lipase as a result of enhanced secretion of the cortisol during summer stress in control group. Omran *et al.* (2011) and Pandey *et al.* (2012) also reported significant decrease in triglycerides levels during heat stress in Egyptian buffalo calves and Marwari goats, respectively. Further, the serum triglyceride levels were significantly higher ($P<0.05$) in supplemented group compared to control group during all the seasons. This could be due to reduced lipolysis affected by lowered cortisol levels owing to reduced oxidative stress in antioxidants supplemented group.

Serum total cholesterol was significantly higher ($P<0.05$) during summer compared to winter season in both control and supplemented groups (Table 1). The higher levels of circulating cholesterol during summer season might support the enhanced cortisol synthesis that occurs during summer stress as the cholesterol acts as a precursor for the synthesis of steroid hormones in the body. The finding of the present study was in agreement with the reports of Sinha *et al.* (1981) in Jersey and Red Dane cattle, Kumar *et al.* (2012) in Beetal goats, Sejian *et al.* (2013) in Malpura ewes and Das *et al.* (2013) in buffaloes. This increase in circulating cholesterol could also support hepatic gluconeogenesis during adaptive mechanisms (Sejian *et al.*, 2013). However, Rasooli *et al.* (2004), Gudev *et al.* (2007a), Cincovic *et al.* (2011) and Pandey *et al.* (2012) reported significant decline in the cholesterol during the summer season in Holstein heifers, Bulgarian buffaloes, Egyptian buffalo calves and Marwari goats, respectively. Lowered cholesterol level during the heat stress was attributed to lowered thyroid activity (Pandey *et al.*, 2012), decreased feed intake during hot summer and consequent reduction in intake of dietary cholesterol (Gudev *et al.*, 2007a).

Serum HDL cholesterol levels did not vary significantly ($P<0.05$) among the season in control group. In supplemented group, HDL cholesterol level was significantly higher ($P<0.05$) during summer compared to winter season (Table 2) which could be attributed to higher total cholesterol during summer season as the HDL cholesterol is involved in reverse transportation of cholesterol for its degradation and elimination from the body. HDL cholesterol levels were significantly higher ($P<0.05$) in supplemented group compared to control group during all the seasons. HDL-cholesterol being good cholesterol, its significant increase in supplemented group compared to control group indicated the beneficial effect of antioxidant supplementation. High density cholesterol functions as LDL antioxidant (Tomas *et al.*, 2004) and the higher HDL cholesterol in supplemented group could be attributed to correspondingly higher levels of LDL cholesterol. Findings of the present study were in agreement with Das *et al.* (2013) who also reported significantly higher plasma HDL-cholesterol levels in buffaloes supplemented with niacin, yeast and mustard oil and they attributed the same to the combined effects of supplementation and managemental factors.

The plasma cholesterol is associated with the different lipoprotein fractions such as LDL, VLDL and HDL cholesterol (Satyanarayana and Chakrapani, 2006) and significantly higher ($P<0.05$) levels of LDL cholesterol recorded during summer compared to winter season in control group (Table 2) could be due to correspondingly higher levels of circulating total cholesterol. As the transportation of vitamin E demands higher levels of lipoproteins (VLDL and LDL) in the body (Satyanarayana and Chakrapani, 2006), significantly higher LDL cholesterol in supplemented group compared to control group could be due to higher levels of vitamin E in that group.

VLDL cholesterol being involved in transportation of triacylglycerol from liver to the adipose tissue (Satyanarayana and Chakrapani, 2006), significant ($P<0.05$) reduction in VLDL cholesterol levels observed during summer in control group could be attributed to the corresponding lower levels of triglycerides in that group. The significant ($P<0.05$) increase in serum VLDL cholesterol in the supplemented group compared to control group could be attributed to higher levels of triglycerides in that group. It was concluded that the supplementation of vitamin E and selenium during summer stress is beneficial as they significantly increased the levels of HDL cholesterol that serve as antioxidant to LDL cholesterol in Hallikar cattle.

Table 1: Mean ± SE values of serum triglyceride (mg/dL) and total cholesterol (mg/dL) levels during different seasons in Hallikar cattle (n = 6).

Seasons	Triglycerides		Total cholesterol	
	Control Group	Supplemented Group	Control Group	Supplemented Group
Winter	27.59 ± 1.09^{bA}	35.93 ± 1.15^{aB}	117.92 ± 4.07^{aA}	162.33 ± 5.15^{aB}
Summer	22.41 ± 1.65^{aA}	32.35 ± 1.22^{aB}	168.25 ± 5.63^{bA}	200.17 ± 4.50^{bB}
Rainy	25.44 ± 0.81^{abA}	33.68 ± 1.11^{aB}	173.00 ± 5.60^{bA}	222.58 ± 6.18^{cB}

The values with different superscripts within a column (a, b and c) and within a row (A and B) differ significantly (P<0.05).

Table 2: Mean ± SE values of serum HDL cholesterol (mg/dL), LDL cholesterol (mg/dL) and VLDL cholesterol (mg/dL) levels during different seasons in Hallikar cattle (n = 6).

Seasons	*HDL cholesterol*		*LDL cholesterol*		*VLDL cholesterol*	
	Control Group	*Supplemented Group*	*Control Group*	*Supplemented Group*	*Control Group*	*Supplemented Group*
Winter	8.01 ± 0.51^{aA}	11.38 ± 0.28^{aB}	104.39 ± 4.40^{aA}	142.42 ± 4.54^{aB}	5.52 ± 0.22^{bA}	7.19 ± 0.23^{aB}
Summer	7.16 ± 0.23^{aA}	14.70 ± 1.07^{bcB}	161.69 ± 5.43^{bA}	165.16 ± 5.05^{bA}	4.48 ± 0.33^{aA}	7.14 ± 0.33^{aB}
Rainy	8.19 ± 0.23^{aA}	12.88 ± 0.36^{acB}	159.72 ± 5.40^{bA}	192.47 ± 2.66^{cB}	5.09 ± 0.61^{abA}	6.74 ± 0.22^{aB}

The values with different superscripts within a column (a, b and c) and within a row (A and B) differ significantly (P<0.05).

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