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Influence of Chromium Propionate Supplementation on Feed Intake, Growth Rate, Haematological and Antioxidant Enzymes Profile in Sahiwal Calves During Summer Season

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ABSTRACT

Twelve Sahiwal calves were divided into 2 group of 6 animals each All the animals in both the groups were fed as per NRC requirements, however, the animals in control group were given no chromium while in treatment 1 group, the animals were supplemented with 0.5 ppm chromium in form of chromium propionate in order to study feed intake and blood parameters during summer season. Body weight gain, DM intake and haematological parameters were found to be similar in both the groups. The activities of superoxide dismutase, glutathione reductase and glutathione peroxidase were also similar in both the groups, however, catalase activity was lower ($P<0.05$) in treatment group compared to control.

Key words: Body weight gain, Chromium propionate supplementation, Feed intake, Sahiwal calves, Summer season

INTRODUCTION

Thermal stress is of major concern for growing animals, especially in the hot regions of the world because of the resulting poor growth performance, immuno-suppression and high mortality rate (Hansen, 2004). Chromium (Cr) is an essential trace element for man and animals (NRC, 1997) especially in stress conditions such as thermal, physical, biological stress *etc.* It improves metabolic rate by improving thyroid hormones inter-conversions, increasing DM intake and reducing blood NEFA (Hayirli *et al.,* 2001). Moreover, Cr supplementation protects against stress-induced losses of several trace elements (Schrauzer *et al.,* 1986). An additional dietary Cr supplementation during summer season is suggested to alleviate stress associated effects (Almeida *et al.*, 2001). Supplementation of Cr has been shown to improve performance of growing and lactating ruminants exposed to thermal stress (Kegley *et al.,* 1997). The excessive production of free radicals and concomitant damage at cellular and tissue levels are controlled by cellular antioxidants defense systems. Antioxidants prevent or remove oxidative damage to target molecules (Halliwell and Gutteridege, 2007). The determination of products of peroxidative damage to macromolecules and antioxidant substances like glutathione and enzymes (superoxide dismutase, glutathione per-oxidase and catalase) are useful markers for the oxidative stress and antioxidant status, respectively. The information regarding the ameliorative effect of organic Cr supplementation on performance of summer-exposed Sahiwal calves is scanty, therefore, the present study was planned to explore the effect of Cr supplementation on growth rate, feed intake, haematological and antioxidant status of Sahiwal calves during summer.

MATERIALS AND METHODS

Twelve Sahiwal female calves were selected from Livestock Research Centre, ICAR-National Dairy Research Institute, Karnal, Haryana, India and divided into two equal groups i.e., control (C) and treatment (T). The protocol was approved by the Institutional Animal Ethics Committee (IAEC) constituted as per the article no. 13 of the CPCSEA rules laid down by Govt. of India. The animals in both the groups were fed as per NRC (2001), however, group T was additionally supplemented with chromium propionate to provide Cr @ 0.5 mg/kg of DM intake.

The daily minimum and maximum temperatures, dry bulb temperature (Cdb) and wet bulb temperature (Cwb) were recorded at 7.30 a.m. and 2.30 p.m. (Zeal,

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Table 1. Ingredient composition of concentrate mixture (%) and chemical composition (% DM basis) of ration components

Ingredient	Concentrate	Wheat straw	Maize fodder
Maize	28		
Ground nut cake	10		
Soybean meal	15		
Mustard cake	13		
Deoiled rice polish	11		
Wheat bran	15		
Bajra/pear millet	5		
Common salt	1		
Mineral mixture	2		
Chemical composition			
DM	90.33	91.10	18.56
OM	94.12	91.80	92.02
CP	20.19	3.07	8.98
EE	4.20	0.76	1.45
NDF	22.91	79.19	66.50
ADF	10.78	54.16	34.13

UK). Relative humidity (RH) values were calculated using a psychometric chart (Hafez, 1968). Temperature humidity index (THI) was calculated using the formula (McDowell *et al.,* 1976) THI = 0.72 × (Cdb + Cwb) + 40.6 (Table 2).

The body weight and feed intake were recorded fortnightly. The samples of feed ingredients were analyzed for proximate principles (AOAC, 2005) and fibre fractions (Van Soest *et al.,* 1991). Peripheral blood samples were collected at 7.00 a.m. in heparinized vacutainer tubes (Becton Drive, Franklin Lakes, NJ, USA) by jugular vein puncture on days 0, 15, 30, 45 and 60. After collection, small amount of blood sample (1 ml) was used for analysis of haematological parameters and rest amount of blood sample (9 ml) was further centrifuged at 1200 g at 4°C for 20 min to separate the plasma for the analysis of antioxidant enzymes like catalase, superoxide dismutase (SOD), glutathione peroxidase and glutathione reductase (Wheeler *et al.*, 1990). Catalase activity was determined in plasma by using Catalase Assay kit (Cayman Chemical Company, USA; Catalog No.707002) according to manufacturer's protocol (Johansson and Borg, 1988). Superoxide dismutase activity was determined in plasma using Superoxide Dismutase Assay kit (Cayman Chemical Company, USA; Catalog No.706002) according to manufacturer's protocol (Marklund, 1980). Glutathione peroxidase activity was analysed using Glutathione

Table 2. Environmental variables recorded during experiment

Month	Dry bulb temperature (°C)		Wet bulb temperature (°C)		T_{max}	T_{min}	Relative humidity		THI
	I	II	I	II			I	II	
Apr.	21.1	35	17.3	20.6	35.2	17.2	68	23	81.0
May	27.1	39.8	20.9	23.3	40.5	22.2	54	22	88.8

Peroxidase Assay kit (Cayman Chemical Company, USA; Catalog No.703102) according to manufacturer's protocol (Ursine *et al.,* 1985). Glutathione reductase was determined in plasma by using Glutathione Reductase Assay kit (Cayman Chemical Company, USA; Catalog No.703202) according to manufacturer's protocol (Inoue *et al.*, 1987). Data were analyzed by analysis of variance using SAS software, version (9.1) of the SAS system for Window.

RESULTS AND DISCUSSION

The chemical composition of feed ingredients has been given in Table 1. Statistical analyses revealed no significant effects of dietary Cr supplementation on average daily gain (ADG) and body weight over a period of 60 days (Table 3). The ADG of control and treatment group was 290 g and 300 g, respectively. The results of ADG are in agreement with the findings of Swanson *et al.* (2000) and Kumar *et al.* (2015b), who also did not find any appreciable body weight gain in Cr supplemented group compared to control group. However, Barajas *et al.* (2005) noticed that chromium methionine supplementation tended (P = 0.06) to increase 2.5% of calves weight (251.38 *vs.* 257.75 kg). DMI was also similar in both groups. This finding is also similar to that of Kumar *et al.* (2015a) who also reported no change in DMI in growing buffalo calves supplemented with Cr.

The levels of plasma SOD, GPx and glutathione reductase activity were found to be similar in both the groups (Table 3). Kumar *et al.* (2015a) observed no change in GPx and glutathione reductase activity in Cr supplemented group. Zhang *et al.* (2014) also reported no change in total antioxidant capacity in Cr supplemented group. However, catalase activity was higher (P<0.05) in control group as compared to treatment group (Table 3).

There was no significant effect on haematological parameters except haematocrit (Hct) level which was higher (P<0.05) in treatment group (Table 4). Lower level of haematocrit may be due to higher environmental temperature in summer season which causes significant depression in haematocrit value and

Table 3. Effect of Cr supplementation on body weight, DM intake and enzyme activity in Sahiwal calves

Fort-night	BW (kg)		ADG (g/d)		DM intake (kg/100 kg BW)		Catalase activity (nmol/min/ml)		SOD activity (U/ml)		Glutathione peroxidase (nmol/min/ml)		Glutathione reductase (nmol/min/ml)	
	C	T	C	T	C	T	C	T	C	T	C	T	C	T
0	116.58 ±6.28	121.17 ±10.22	-	-	2.86± 0.07	2.99± 0.16	12.08 ±2.04	8.42 ±1.60	26.55 0.22	26.19 0.17	2.20 0.54	0.216 0.216	45.29 1.73	44.65 ±2.87
1	121.72 ±6.36	125.84 ±9.59	343 ±49.33	311 ±69.92	3.00 ±0.10	3.06 ±0.20	10.28 ±0.66	9.10 ±0.66	26.60 ±0.43	26.47 ±0.17	2.85 ±0.80	2.07 ±0.24	49.58 ±1.70	48.82 ±2.48
2	125.85 ±6.98	129.12 ±9.40	275 ±53.51	219 ±36.32	2.94 ±0.11	3.05 ±0.21	20.15 ±2.26	15.69 ±1.52	26.22 ±0.22	25.99 ±0.36	2.96 0.27	2.36 0.32	49.37 2.21	44.99 ±2.55
3	130.77 ±7.82	134.23 ±9.27	328 ±43.50	341 ±72.21	2.93 ±0.15	3.01 ±0.28	25.20 ±3.78	21.21 ±4.19	26.46 ±0.11	26.35 ±0.17	2.82 ±0.29	2.52 ±0.15	49.83 ±4.42	46.57 ±3.75
4	133.98 ±8.41	139.14 ±8.77	214 ±20.32	327 ±53.94	2.87 ±0.15	2.95 ±0.16	28.27 ±4.45	22.88 ±0.61	26.73 ±0.10	26.72 ±0.24	2.74 ±0.18	2.55 ±0.18	52.21 ±6.42	50.81 ±5.54
Overall mean	**125.78 ±3.19**	**129.90 ±4.10**	**290 ±5.88**	**300 ±28.18**	**2.92 ±0.06**	**3.01 ±0.09**	**19.21[a] ±1.80**	**15.46[b] ±0.42**	**26.51 ±0.11**	**26.34 ±0.11**	**2.71 ±0.20**	**2.34 ±0.10**	**49.25 ±1.62**	**47.17 ±1.57**

[a,b] Means having different superscripts in a row differ significantly (P<0.05)

Table 4. Effect of Cr supplementation on haematological parameters in Sahiwal calves

Fort-night	RBC count (m/mm³)		WBC count (x10³/µl)		Hb (g/dl)		Hct (%)		MCV l (fl)		MCH (pg)	
	C	T	C	T	C	T	C	T	C	T	C	T
0	8.86	9.02	15.67	13.97	9.00	9.88	30.93	34.15	34.98	37.38	10.10	10.71
0	±0.23	±0.30	±1.25	±0.88	±0.33	±0.20	±1.14	±0.53	±1.07	±1.49	±0.26	±0.29
1	8.98	9.02	15.35	13.15	8.57	9.02	30.00	32.27	33.48	35.97	9.48	9.98
1	±0.17	±0.30	±1.32	±0.50	±0.23	±0.22	±0.88	±0.66	±0.94	±1.44	±0.24	±0.32
2	8.98	9.05	13.64	12.60	7.80	7.73	±0.26	±0.68	±0.98	±1.33	±0.27	±0.27
2	±0.17	±0.38	±0.79	±0.64	±0.22	±0.13	±0.26	±0.68	±0.98	±1.33	±0.27	±0.27
3	8.06	7.95	14.22	14.97	9.07	8.17	32.46	30.05	35.38	33.05	9.80	9.38
	±0.26	±0.22	±0.67	±1.06	±0.26	±0.13	±0.95	±1.56	±1.47	±0.89	±0.25	±0.15
4	9.24	8.85	15.75	15.17	8.63	9.02	30.27	31.92	34.20	35.58	9.68	9.96
	±0.30	±0.35	±1.37	±0.57	±0.39	±0.21	±1.54	±1.14	±1.21	±1.42	±0.27	±0.25
Overall	**8.89**	**9.22**	**14.92**	**13.97**	**8.61**	**8.76**	**30.12^{a}**	**31.15^{b}**	**34.33**	**35.31**	**9.72**	**9.95**
mean	**±0.44**	**±0.40**	**±0.49**	**±.39**	**±0.15**	**±0.16**	**±0.54**	**±0.59**	**±0.48**	**±0.61**	**±0.11**	**±0.14**

^{a,b} Means having different superscripts in a row differ significantly (P<0.05)

this might be due to hemodilution effect where more water is transported into circulatory system for evaporative cooling. Other possible reason could be that higher environmental temperature increases oxygen consumption of animals by increasing respiration rate. The higher oxygen intake increases the partial pressure of oxygen in blood, decreases erythropoiesis which in turn reduces the number of circulating erythrocytes and thus PCV and Hb values (Kumar *et al*., 2011).

CONCLUSION

It was concluded that the supplementation of dietary chromium at 0.5 ppm level did not affect body weight gain, dry matter intake and haematological parameters, however, catalase activity was lower in supplemented group during summer season.

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