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SHORT COMMUNICATION

Supplementation of Brown Seaweed (*Turbinaria conoids*) Powder and its Effect on Blood Metabolites and Mineral Profile in Adult Goats

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ABSTRACT

Fifteen adult goats (14.59±1.41kg kg BW; 11-12 months of age) were assigned to 3 groups (CON, T_1 and T_2) using completely randomised design. Goats in CON group were fed a standard ration of concentrate mixture, straw and green with no seaweed supplement whereas, goats in T_1 and T_2 groups were given concentrate mixture having 4 and 8% of brown seaweed (*Turbinaria conoids*), respectively. The values of PCV, hemoglobin, albumin, globulin and A: G ratio were similar in all the groups, however, serum glucose and total protein levels were higher (P<0.01) in group T_2 as compared to groups T_1 and CON. Serum mineral concentation of Ca, P, Fe, and Mn did not differ among the groups whereas Cu level was found to be higher in T_1 as compared to CON and T_2 and serum Zn concentration was higher (P<0.01) in group T_1 followed by groupsT_2 and CON. Hence, incorporation of brown seaweed at 4% level in the concentrate mixture of adult goats increased the concentrations of glucose, total protein, Cu and Zn without any adverse impact on other blood metabolites.

Key words: Blood parameters, Brown seaweed, Goats, Serum minerals

Seaweeds are rich in complex carbohydrates, amino acids, vitamins like B_{12}, C, E and carotenoids (Burtin, 2003), minerals (Ito and Hori, 1989), natural bioactive compounds (Chojnacka *et al.,* 2012), growth promoters and fucoidan *etc.* (Urbano and Goni, 2002) and thus the supplementation of suitable amount of seaweeds to animal feed may promote the growth and thus improve animal health as well as quality of animal product. Brown algae (*Turbinaria conoids*) is largest seaweed and has been more exploited than other algae types for their use in animal feeding. Brown seaweed possesses large amount of iodine (I) and calcium (Ca) compared with other foods (Kaufmann *et al.,* 1998). Using seaweed as an animal feed supplement has great potential but little attention has been paid in India to exploit these as animal feed. Considering the functional properties of seaweeds, it would be most appropriate to use them as feed additive (Makkar *et al.,* 2016). Research conducted so far was mainly focused on therapeutic uses of red seaweed meals mostly in laboratory animals. Considering the functional properties of brown seaweed, it is hypothesized that supplementation of brown seaweed meal would satisfy the minerals requirement of goats without affecting vital organ functions.

The experiment was carried out at Animal Nutrition Research Shed, ICAR-Indian Veterinary Research Institute, Izatnagar. Fifteen adult goats (mean BW= 14.59±1.41 kg) were randomly divided into 3 groups with 5 goats each in completely randomized block design. The goats were randomly allocated into three dietary treatments; control (CON) and 2 treatment groups (T_1 and T_2). In the control group, goats were offered a concentrate mixture without brown seaweed, however, goats in groups T_1 and T_2 were given concentrate mixture having 4 and 8% of brown seaweed, respectively. The composition of respective concentrate mixtures has been given in Table 1. All the experimental animals were provided weighed amount of respective concentrate mixture daily (NRC, 2001). Wheat straw was offered *ad lib.* after ensuring complete consumption of the concentrate mixture. A small amount of green oats fodder (500 g) was given to all the experimental goats. All the goats were housed in

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a well ventilated shed having provision for individual feeding. The animals were provided with fresh and clean tap water free choice twice daily. Proper ethical care and management procedures were adopted throughout the study period according to the guidelines for Institutional Animal Ethics Committee for experimentation.

About 6 mL of blood samples were collected from all experimental goats early in the morning before feeding at 0, 30 and 60 d of experimental period from jugular vein. Out of 6 mL, 2 mL was added with EDTA for subsequent estimation of haematological parameters and the remaining was taken in a well cleaned sterilized centrifuge tubes to separate sera. Serum was separated and preserved at -20°C for further analysis. Haemoglobin (Hb) and packed cell volume (PCV) were estimated in whole blood immediately after blood collection by cyanomethaemoglobin method and Wintrobe's tube, respectively. All the serum biochemical parameters and concentration of Ca and P were estimated by using diagnostic kits (Cogent) manufactured by Span Diagnostics Pvt. Ltd., Surat, India. Iron, zinc, copper, manganese concentration in serum samples were estimated by Atomic Absorption Spectrophotometer (Electronics Corporation of India Ltd., Hyderabad, India, Model No. 4141). The data were analysed statistically (Snedecor and Cochran, 1994).

The data on haematological and biochemical have been presented in Table 2. The values of PCV (%), Hb (gdL^{-1}), albumin (gdL^{-1}), globulin (gdL^{-1}) and A: G ratio were similar in 3 groups and within the normal range reported for the species (Kaneko *et al.,* 1997). El-Banna *et al.* (2005) also reported similar results when rabbits fed with green seaweed (*Ulva lactuca*) and did not show any negative effects on haematological parameters. However, Nogueira *et al.* (2017) reported that feeding of brown algae (*Padina sanctae-crucis*) to mice at 2000 ppm raised blood metabolites significantly. The present results indicated that the dietary addition of brown seaweed to adult goats increased ($P<0.01$) blood glucose levels (mg dL^{-1}) in group T_2 followed by T_1 and CON groups although values remained within normal ranges (Braun *et al.,* 2007). Similarly, higher blood glucose levels have been reported when brown seaweed was added to the diets of goats (Kannan *et al.,* 2007) or lambs (Archer *et al.,* 2007). Total protein (g dL^{-1}) level was also higher ($P<0.01$) in group T_2 as compared to groups T_1 and CON. On the other hand, EL-Banna *et al.* (2005) and Okab *et al.* (2003) found comparable levels of glucose and protein among the groups when rabbits were fed with green seaweed (*Ulva lactuca*).

The concentrations of serum Ca, P, Fe and Mn were found to be similar in all the groups (Table 2). Venkateswaran, (2018) also observed comparable levels of serum Ca, P, Fe and Mn when Ca enriched brown seaweed was supplemented to crossbreed calves. Similarly, Singh *et al.* (2017) found no significant difference in serum Fe and Mn levels when lactating cows were supplemented with brown seaweed

Table 1. Ingredient composition (%) of concentrate mixtures

Ingredient	Group		
	CON	T_1	T_2
Maize	40	40	40
Wheat bran	40	40	40
Soyabean meal	17	17	17
Mineral mixture	2	2	2
Brown seaweed	0	4	8
Common salt	1	1	1
DCP (%)	13.85	13.72	13.75

CON: Conc. mix. without seaweed; T_1: Conc. mix. with 4% seaweed; T_2: Conc. mix. with 8% seaweed

Table 2. Effect of brown seaweed supplementation on blood metabolites and serum minerals in adult goats

Attribute	Treatment		
	CON	T_1	T_2
Blood metabolites			
PCV (%)	34.90	35.32	35.22
Hb (gdL^{-1})	9.32	9.25	9.25
Serum glucose** (mg dL^{-1})	62.91[a]	69.20[b]	73.41[c]
Total protein** (g dL^{-1})	6.56[a]	6.59[a]	6.92[b]
Albumin (g dL^{-1})	3.62	3.63	3.67
Globulin (g dL^{-1})	2.87	2.95	3.29
Albumin: globulin ratio	1.27	1.27	1.15
Serum mineral concentration			
Ca (mg/100 mL)	9.41	10.16	10.34
P (mg/100 mL)	3.96	3.95	4.57
Cu** (µg/100 mL)	69.04[b]	83.80[c]	63.27[a]
Fe (µg/100 mL)	347.67	348.97	343.00
Zn** (µg/100 mL)	172[a]	227.38[c]	185.33[b]
Mn (µg/100 mL)	94.78	98.15	91.74

[a,b,c]Means with different superscripts within a row differ significantly (P<0.01)

(*Sargassum wightii*) at 20% level in concentrate mixture. However, Chicco *et al.* (1973) reported that plasma Ca was greater (P<0.05) with increased dietary Ca from 0.19 to 0.43% in sheep. Regarding the serum P level, the result are in agreement with the findings of earlier workers (Alfaro *et al.,* 1988). Alfaro *et al.* (1988) reported that dietary Ca levels varying from 0.17 to 2.35% had no effect on serum inorganic P concentrations in dairy calves.

Serum Cu concentration was higher (P<0.01) in group T_1 followed by groups CON and T_2. However, Stevens *et al.* (1970) observed that neither the ratio of Ca: P (1.5:1.0 to 3.0:1.0) nor the level of P (0.32 to 0.48%) appeared to affect the blood serum concentration of Cu. Serum Zn level was higher (P<0.01) in group T_1 followed by groups T_2 and CON. Zn concentration in plasma increased in animals fed mineral mixture in diet and the results of the present study were in agreement with the findings of earlier workers (Lall and Prasad, 1990; Ashutosh and Singh, 2007). This phenomenon might be due to high bioavailability of seaweed minerals (Chojnacka, 2008).

Therefore, incorporation of brown seaweed at 4 and 8% levels in concentrate mixture did not affect blood biochemical parameters except that the concentration of serum glucose and protein was higher in group T_2. Supplementation of brown seaweed (4% in concentrate mixture) enhanced serum Cu and Zn levels.

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