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Avinesh Sharma
M.V.Sc. Animal Nutrition Division, ICAR-National Dairy Research Institute, Karnal, Haryana, India

Chander Datt
Principal Scientist, Animal Nutrition Division, ICAR-National Dairy Research Institute, Karnal, Haryana, India

Corresponding Author:
Avinesh Sharma
M.V.Sc. Animal Nutrition Division, ICAR-National Dairy Research Institute, Karnal, Haryana, India

Supplementation effect of red seaweed powder on dry matter intake, body weight and feed conversion efficiency in crossbred cows

Avinesh Sharma and Chander Datt

Abstract
This study was conducted to examine the effects of supplementation of red seaweed (*Kappaphycus alvarezii)* product in the diet of ruminants on dry matter intake, body weight and feed conversion efficiency in lactating crossbred cows. For conducting this study, 18 lactating crossbred (Karan fries) cows were selected from a herd and divided into 3 treatment groups of 6 animals each based on milk yield, body weight, parity and days in milk. The cows in treatment group T_1 were fed rations as per their nutrient requirements. The cows in treatment groups T_2 and T_3 were fed the similar rations as fed to control treatment group (T_1), however, their rations were supplemented with red seaweed (*K. alverazii)* based powder (*K. alvarezii* powder: *Gracilaria salicornia powder*: *K. alvarezii* sap powder in 1: 1: 1 ratio) @ 1.5 and 3% of ration (on dry matter basis), respectively. The study lasted for 150 days. The values for dry matter intake, body weight and feed conversion efficiency were not influenced by red seaweed-based feed additive supplementation.

Keywords: Body weight, cow, dry matter intake, feed efficiency, seaweed

Introduction
Seaweeds have been used as livestock feed for so many years. *Kappaphycus alvarezii* is red seaweed which belongs to the class rhodophyceae. It is versatile and easy to cultivate plant and is one of the most important commercial sources of carrageenans [1]. Seaweed extracts contain major and trace nutrients, amino acids, vitamins and biologically active compounds. The consumption of seaweed by human beings proved to be health-promoting and its benefits are well documented [2, 3]. Aquatic plants like seaweeds are the classic example of non-conventional feed resources, which are available in coastal areas even during draught period [4]. Seaweed meals and extracts have been used as the main commercial ingredients in animal feeds [5]. Brown kelps (*Laminaria digitata* and *Laminaria hyperborea*) were evaluated in North Ronaldsay sheep and found that DM intake was 1.4±0.2 kg (wet mass) daily. The DM and OM digestibility values were found to be 71.7 and 79.6% at 48 h, respectively. The high value of digestibility measured suggests that these seaweeds can be used as alternative feed source for ruminants [6]. There were no significant changes in feed intake, digestibility of nutrients and milk composition in Sahiwal cows when mineral mixture (3%) in the concentrate was replaced by 20% *Sargassum wightii* [7]. In view of these facts, the present experiment therefore was conducted to see the effects of supplementation of red seaweed (*Kappaphycus alvarezii)* based seaweed product on dry matter intake, body weight and feed conversion efficiency in crossbred cattle.

Materials and methods
Animal grouping, housing and feeding management
A total of eighteen lactating Karan fries cows were selected from the Livestock Research Centre of ICAR-National Dairy Research Institute, Karnal and divided randomly into three treatment groups on the basis of their milk yield, body weight, parity and days in milk. The experimental trial was carried out with the permission taken from CPCSEA. All the animals were housed in the experimental shed of Animal Nutrition Division, NDRI, Karnal which was well ventilated, spacious and having provision for individual feeding. Proper cleanliness and healthy surroundings were ensured throughout the experimental period. Proper deworming and vaccination were done to prevent occurrence of diseases. Animals in control treatment (T_1) group were fed concentrate mixture along with sugar-graze green fodder (concentrate mixture

and roughages as 40:60) for 150 days of feeding trial. While cows in treatment groups T_2 and T_3 group were offered ration consisting of 1.5 and 3% of sea weed powder (*K. alvarezii* powder: *Gracilaria salicornia powder*: *K. alvarezii* sap powder in 1: 1: 1 ratio) in their concentrate mixture respectively (Table 1). Individual feeding of cows was followed to meet their nutritional requirement [8]. Concentrate mixture and green sugar-graze fodder were offered twice a day at 9.00 A.M. in morning and at 4.00 P.M. in evening daily. Clean drinking water was offered ad libitum individually thrice a day.

Table 1: Chemical composition (% Dry Matter basis) of feed ingredients

Parameters	Concentrate mixture	Sugar-graze	Seaweed product
Dry matter	89.05	30.99	94.6
Organic matter	93.12	92.83	27.45
Crude Protein	19.16	7.31	5.58
Total ash	6.88	7.17	72.55
Ether extract	4.76	2.44	1.98
Neutral detergent fibre	27.37	56.72	15.03
Acid detergent fibre	13.33	32.69	9.92
Calcium (g/kg)	0.95	0.29	0.46
Phosphorus(g/kg)	0.76	0.23	0.056
Iron (mg/kg)	449.45	342.35	222
Copper (mg/kg)	28.33	7.15	*BDL
Zinc (mg/kg)	62.56	24.79	14
Manganese (mg/kg)	60.45	25.95	37

*BDL refer to below detectable limit

Dry matter intake

Dry matter intake (DMI) was recorded daily by subtracting the residual dry matter from the quantity of dry matter offered. For this, weighed amount of concentrate mixture, green sugar-graze fodder were offered daily and the residue was collected after 24 h. Average dry matter intake of each animal was calculated fortnightly to check any changes during the experiment.

Body weight

The animals were weighed before feeding and watering in the morning for two consecutive days at the start of experimental feeding and thereafter at fortnightly intervals during the experimental period of 150 days.

Feed Conversion Efficiency

Feed conversion efficiency was calculated in terms of kg milk yield/kg DMI, 4% FCM yield/kg DMI, ECM yield/kg DMI and SCM yield/kg DMI.

Where,

FCM is Fat corrected milk yield which was calculated by the equation [9]: 4% FCM (kg) = 0.4(kg milk yield) + (15 x milk fat % x kg milk yield)/100.

ECM is Energy corrected milk yield which was calculated by the equation [9]: ECM (kg) = kg milk production x [(40.72 x g/kg fat yield) + (22.65 x g/kg protein yield) + 102.7)]/340.

ccccSCM is Solids corrected milk yield which was calculated by the equation [9]: SCM (kg) = 12.3 (kg fat) + 6.56 (kg solids-not-fat) + 0.0752 (kg milk yield).

Statistical Analysis

Data were statistically analysed by one-way analysis of variance technique using SPSS software (version 20.0, IBM SPSS Inc, USA) in accordance with Snedecor and Cochran [10].

Results and Discussion

Fortnightly DM intake

The DM intake of the crossbred cows observed at fortnightly intervals has been presented in Table 2. The DM intake varied from 11.10 to 13.18, 11.06-12.85 and 11.07-13.30 kg/d in treatments T_1, T_2 and T_3, respectively with corresponding values of 2.64-3.13, 2.54-3.12 and 2.64-3.22 kg/100 kg BW across 10 fortnights. The overall average DM intake in treatments T_1, T_2 and T_3 was 12.22, 11.65 and 12.00 kg/d, respectively while the corresponding values of DM intake expressed on kg/100 kg BW were found to be 2.89, 2.83 and 2.90. The feed intake was found to be similar in all 3 treatments irrespective of level of seaweed product supplementation. No significant effect was reported on DM intake in lactating Sahiwal cows given *Sargassum wightii* sea weed powder in concentrate mixture at 20% level [11]. On the other hand, it was reported that supplementation of sea weed meal @ 1% in lambs diet increased DMI, however, FCR was better in group given no sea weed meal [12].

Table 2: Effect of supplementation of *K. alvarezii* based feed additive on fortnightly dry matter intake

Fortnight	DMI (kg/d)			DMI (%BW)		
	Treatment groups			Treatment groups		
	T_1	T_2	T_3	T_1	T_2	T_3
0	12.11±0.53	11.31±1.01	11.49±0.51	2.91±0.11	2.79±020	2.83±0.13
1	12.50±0.87	12.05±0.73	12.17±0.60	2.99±0.13	2.97±0.11	2.99±0.12
2	12.28±0.82	11.52±0.58	11.56±0.56	2.95±0.13	2.85±0.09	2.84±0.09
3	11.10±0.84	11.06±0.57	11.25±0.59	2.64±0.14	2.71±0.07	2.74±0.10
4	11.61±0.93	11.05±0.50	11.79±0.63	2.75±0.19	2.69±0.06	2.85±0.11
5	13.26±1.00	12.85±0.55	13.30±0.76	3.13±0.18	3.12±0.09	3.22±0.15
6	12.81±0.75	12.09±0.57	12.45±044	3.01±0.10	2.92±0.05	3.00±0.05
7	13.18±1.04	12.85±0.55	13.30±0.76	3.09±0.19	3.10±0.09	3.20±0.15

8	12.39±0.75	11.64±0.60	12.07±0.45	2.90±0.11	2.79±0.06	2.89±0.06
9	11.39±0.75	10.64±0.60	11.07±0.45	2.66±0.11	2.54±0.07	2.64±0.06
10	11.82±0.38	11.14±0.60	11.57±0.45	2.77±0.08	2.66±0.07	2.76±0.06
Overall average	12.22±0.24	11.65±0.19	12.00±0.18	2.89±0.04	2.83±0.03	2.90±0.03

Values expressed as mean ± standard deviation. T_1 refer to control group, T_2 and T_3 refer to groups supplemented with 1.5 and 3% sea weed powder in ration.

Fortnightly body weights

The body weights of the crossbred cows taken at different fortnights have been presented in Table 3. The body weights at the beginning of experiment were 415.85, 403.38 and 406.63 kg in treatments T_1, T_2 and T_3, respectively with corresponding values of 426.88, 417.19 and 418.40 kg at the end of 150 days of experiment. The changes in body weights were found to be almost similar in all the 3 groups indicating that the sea weed product had no significant effect on the body weights of the animals. After 3rd fortnight, there was increasing trend in the body weights of the animals in all the treatments. In general, the milk yield increases more rapidly than the feed intake up to peak lactation and there could be body weight loss up to this stage. But in the present study, the animals had crossed peak yield stage, therefore, the changes in body weights were not significant among the groups. Similar trend was reported in lactating Sahiwal cows given *Sargassum wightii* sea weed powder in concentrate mixture at 20% level [11]. This might be attributed to the similar nutrient utilization as also reported earlier in cattle and pigs involving seaweed extract or seaweed meal [13, 14]. Seaweed meals and extracts have been used as the main commercial ingredients in animal feeds [5].

Table 3: Effect of supplementation of *K. alvarezii* based feed additive on fortnightly body weight (kg)

Fortnight	Treatment groups		
	T_1	T_2	T_3
0	415.85±13.10	403.38±14.10	406.63±10.15
1	414.66±13.17	403.99±13.95	406.52±10.06
2	413.85±13.40	403.08±14.02	405.75±9.98
3	417.59±13.01	407.34±14.30	409.46±9.86
4	420.50±12.75	410.2±14.42	412.04±9.92
5	421.82±12.36	411.07±13.90	412.87±10.30
6	422.97±12.30	412.82±13.84	414.24±10.06
7	423.60±11.90	413.73±13.60	414.86±10.08
8	425.60±11.81	415.95±13.93	417.34±9.82
9	426.31±11.97	416.82±13.79	417.98±9.80
10	426.88±12.02	417.19±13.71	418.40±9.76
Overall average	420.88±3.52	410.50±3.92	412.37±2.82

Values expressed as mean ± standard deviation. T_1 refer to control group, T_2 and T_3 refer to groups supplemented with 1.5 and 3% sea weed powder in ration.

Feed conversion efficiency

The data on feed conversion efficiency of lactating dairy cows have been given Table 4. The average values of feed efficiency in terms of milk yield/DMI (kg/kg), FCM yield/DMI (kg/kg), ECM yield/DMI (kg/kg) and SCM yield/DMI (kg/kg) were found to be 1.12, 1.14 and 1.15; 1.19, 1.22 and1.20; 0.42, 0.43 and 0.43; 1.38, 1.42 and 1.40 in treatments T_1, T_2 and T_3, respectively. Although the values were not significant, the supplementation of seaweed powder expressed some good effect on milk yield. But values for conversion into FCM, ECM and SCM yield were not influenced by the supplementation of red seaweed powder in the ration. Similar feed efficiency values were observed in crossbred cows in mid to late lactation [15].

Table 4: Effect of supplementation of *K. alvarezii* based feed additive on feed conversion efficiency

Month	Treatment groups		
	T_1	T_2	T_3
Milk yield/DMI			
0	1.19±0.08	1.18±0.06	1.14±0.04
1	1.19±0.05	1.22±0.07	1.22±0.06
2	1.35±0.06	1.23±0.07	1.27±0.04
3	0.99±0.06	1.06±0.04	1.06±0.04
4	0.95±0.10	1.03±0.04	1.03±0.04
5	1.07±0.13	1.13±0.08	1.18±0.05
Overall average	1.12±0.04	1.14±0.02	1.15±0.02
FCM yield/ DMI			
0	1.20±0.09	1.19±0.07	1.11±0.05
1	1.17±0.03	1.33±0.06	1.25±0.04
2	1.48±0.05	1.31±0.09	1.27±0.03
3	1.13±0.05	1.09±0.05	1.15±0.04
4	1.03±0.07	1.15±0.05	1.13±0.03
5	1.64±0.09	1.27±0.11	1.30±0.07
Overall average	1.19±0.03	1.22±0.03	1.20±0.02
ECM yield/DMI			
0	0.44±0.03	0.44±0.02	0.42±0.01
1	0.44±0.01	0.46±0.02	0.45±0.02
2	0.51±0.02	0.46±0.02	0.47±0.01
3	0.38±0.02	0.39±0.01	0.40±0.01
4	0.36±0.03	0.39±0.01	0.39±0.01
5	0.40±0.04	0.43±0.03	0.45±0.02
Overall average	0.42±0.01	0.43±0.01	0.43±0.01
SCM yield/DMI			
0	1.36±0.10	1.36±0.07	1.35±0.07
1	1.35±0.03	1.51±0.06	1.42±0.04
2	1.75±0.06	1.55±0.10	1.51±0.04
3	1.30±0.05	1.30±0.04	1.33±0.04
4	1.20±0.08	1.35±0.05	1.32±0.03
5	1.33±0.12	1.46±0.13	1.49±0.07
Overall average	1.38±0.04	1.42±0.03	1.40±0.02

Conclusion

As per the findings of this research, we can see that the difference in the values of dry matter intake and body weight among 3 groups at the start and end of the experiment is same. Feed conversion efficiency also did not vary as per dry matter intake. Therefore, it was concluded that the supplementation of red sea weed (*K. alvarezii*) powder at 1.5 or 3.0% of ration had no significant effect on dry matter intake, body weight and feed conversion efficiency in lactating crossbred cows.

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