RESEARCH ARTICLE

Effect of Dietary Supplementation of Soapnut *(Sapindus mukorossi)* on Nutrient Utilization and Body Weight of HF Crossbred Cattle

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Abstract

The present study was aimed to explore the effect of dietary supplementation of soapnut (*Sapindus mukorossi*) powder on nutrient utilization and body weight (BW) in cattle. Fifteen HF crossbred cattle of same age and sex were divided into three equal groups on the basis of BW and were offered three treatments for 70 days. The treatments were; T_0: control TMR (roughage: concentrate ratio 65:35), T_1: control TMR supplemented with 1% Soapnut powder, and T_2: control TMR supplemented with 2% Soapnut powder. Among the treatments BW gain observed was higher with lower level of soapnut supplement compared to higher soapnut level and control diet. The study revealed no adverse effect of dietary supplementation of soapnut powder on dry matter and other nutrient intake. The digestibility of nutrients was also not affected, except fibre fractions. Digestibility of CF, NDF and hemicellulose was adversely affected by 2% followed by 1% soapnut powder supplementation in TMR over the control diet.

Key words: Body weight, Cattle, Nutrient intake, Nutrient utilization.

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Introduction

According to the 20th Livestock Census, the current total population of livestock in our country is 535.78 million, wherein the total population of bovines including cattle, buffalo, mithun, and yak is 302.79 million. In Indian feeding conditions, poor-quality roughages are commonly used as the main component of animal diets. This practice leads to higher methane emissions and lowers microbial protein synthesis and gross energy intake. Rumen microbes have a vital role in the fermentation process and nutrient utilization in the rumen. The type of animal and diet are major factors contributing to changes in the rumen ecosystem (Johnson and Johnson, 1995). To enhance feed efficiency in ruminants, various additives are utilized, including probiotics, antibiotics, prebiotics, enzymes, hormones, PSM (plant secondary metabolite) and more. Recently PSM have been explored to manipulate rumen fermentation and reduce methane production to improve animal productivity (Knapp *et al*., 2014). Saponins are plants secondary compound found in the foliage and fruits of tropical and sub-tropical shrubs and trees.

Soapnut (*Sapindus mukorossi*) is a valuable medicinal plant found primarily in tropical and sub-tropical regions of India. Fruits have a high (approximately 10%) saponin content (Poornachandra *et al.,* 2019). Saponins from soapnut have been shown to manipulate the microbial ecosystem of the rumen, affecting microbial fermentation and inhibiting the methanogenesis process (Agarwal *et al*., 2006; Sultana *et al*., 2012; Meel *et al*. 2015; Poornachandra *et al*., 2019). The present study was conducted to investigate the effect of soapnut (*Sapindu smukorossi*) supplementation on nutrient utilization and body weight of HF crossbred cattle.

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Materials and Methods

Experimental Animals and Feeding

The study was carried out following approval of the Institutional Animal Ethics Committee (IAEC/376/ANRS/2022) at the Animal Nutrition Research Station, College of Veterinary Science and Animal Husbandry, Kamdhenu University, Anand on 15 HF crossbred heifers of same age, sex and BW using Completely Randomized Design. Soapnuts, as a supplemented source, were procured from the local market.

The selected heifers were divided into three equal groups, each of 5 animals, on the basis of BW and were offered three dietary treatments for 70 days. The treatments were; T_0: control TMR (roughage: concentrate ratio 65:35),

T_1: control TMR supplemented with 1% Soapnut powder, and T_2: control TMR supplemented with 2% Soapnut powder. The TMR contained cereal and legume straws and green fodder. All experimental animals were provided with total mixed ration (TMR) to meet their nutritional requirements in accordance with ICAR (2013) guidelines. The proximate composition of all three TMR was isometric, except lignin which was little higher in T_1 than T_0 and T_2 TMR. The green fodder on DM basis had lower CP, EE, and lignin, and higher CF, NFE, NDF, cellulose and hemicelluloses when compared with three TMR. The animals were fed separately twice a day, in the morning and evening. Controlled exercise sessions were provided for 2 h in the morning and 1 h in the afternoon, during which the animals had unrestricted access to clean and fresh drinking water.

Throughout the feeding trial, the daily feed intake of each experimental animal was diligently recorded. The animals were weighed bi-weekly before feeding and watering during entire experimental period using electronic weighing balance.

Digestion Trial and Chemical Analysis

The quantitative collection of faeces was made during the digestion trial of nine days. The wet faeces mixed with conc. H_2SO_4 for CP estimation, and dried samples of faeces, leftover as well as feed were collected, pooled, ground, preserved and analyzed for proximate principles as per AOAC (2005) and for fibre fractions per Van Soest (1991) at the end of digestion trial.

Statistical Analysis

The data collected was analyzed using the two-way analysis of variance (ANOVA) with Hisar Statistical Package for Agricultural Scientists (OPISTAT). The treatment and period means were compared by Duncan's multiple range test (Snedcor and Cochran, 1994).

Results and Discussion

Nutrient Intake and Body Weight

The use of soapnut @ 1 % and 2 % in TMR had no adverse effect on dry matter intake (kg/d and kg/100 kg b.wt.), crude protein (g/d) and DCP (%) intake, as well as DCP and TDN intake, though apparently the values were higher in T_1 followed by T_0 than in T_2 treatment (Table 1). These findings were in accordance with Sultana *et al*. (2012), Meel *et al.* (2015), Jadhav *et al*. (2017) and Kumar *et al*. (2017), who also reported no adverse effects of saponin sources on nutrient intake. While Lovett *et al*. (2006) and Poornachandra *et al.* (2019) observed reduced CPI with adding of saponin sources in the diet of ruminants. In the present study TDN % gradually and non-significantly decreased with T_1 and T_2 as compared to T_0 control diet.

Soapnut treatment though did not affect the final body weight, the average weight gain observed was significantly ($p<0.05$) higher in T_1 compared to T_2, while the value in T_0 was statistically intermediate between other two groups at the end of trial (Table 1). Thalib *et al.* (1996), Hu *et al.* (2006) and Meel *et al.* (2015) reported improved body weigh in sheep, Boer goat and Rathi calves, respectively, by dietary treatments of different saponin sources compared to the control group, while Sultana *et al*. (2012) and Holtshausen *et al*. (2009) reported no significant difference ($p>0.05$) in the final live weight of Native bulls and Holstein dairy cows, respectively.

Digestibility of Nutrients

The data pertaining to digestibility of nutrients are presented in Table 2. The study revealed that there was no adverse effect of Soapnut on digestibility of nutrients like DM, OM, CP, EE, NFE, ADF, and Cellulose, though the values gradually decreased with 1 % and 2 % supplement over the control diet. In fact the digestibility of CP was insignificantly improved in T_1 over T_0 group. Further, the digestibility of fibre fractions

Table 1: Effect of soapnut on body weight and nutrient intake

Variable	T_0	T_1	T_2	SEM	P value
Initial BW (kg)	263.68±6.30	264.56±5.91	265.86±5.71	5.98	0.97
Final BW (kg)	298.12±5.67	303.60±5.15	297.5±4.68	5.16	0.67
Avg. wt. gain (kg)	34.44 ± 1.46^{ab}	39.04 ± 1.37^{b}	31.04 ± 1.49^{a}	1.44	0.01
DMI (kg/d)	7.02±0.15	7.31±0.12	6.87±0.20	0.23	0.43
DMI (kg/100 kg BW/d)	2.48±0.04	2.55±0.03	2.42±0.06	0.04	0.34
CPI (g/d)	746.01±16.74	789.14±13.21	754.56±23.63	14.11	0.62
DCP %	52.24±2.07	55.96±3.03	51.49±1.99	1.39	0.40
TDN %	55.82 ± 0.41^{b}	53.89 ± 0.85^{ab}	51.54 ± 0.80^{a}	0.60	0.004
DCPI (g/d)	390.91±12.12	441.73±12.41	388.43±13.56	11.65	0.08
TDNI (kg/d)	3.92±0.08	3.94±0.07	3.64±0.11	0.07	0.19

Mean ± SE values with different superscripts (a, b) within row differ significantly ($p<0.05$).

Table 2: Average digestibility coefficient (%) of nutrients

Attributes (%)	T_0	T_1	T_2	SEM	P value
DM digestibility	53.07±1.21	52.01±0.70	50.67±0.60	0.88	0.19
OM digestibility	56.64±1.21	55.15±0.76	53.64±0.54	0.88	0.09
CP digestibility	52.24±2.07	55.95±3.03	51.48±1.98	2.41	0.40
EE digestibility	54.82±3.21	53.87±1.54	50.38±1.75	2.29	0.38
CF digestibility	51.86±1.13^b	52.30±0.98^b	48.49±0.99^a	1.04	0.05
NFE digestibility	62.32±1.09	61.67±1.21	60.76±0.84	1.06	0.59
NDF digestibility	52.44±1.16^b	48.39±0.67^a	49.26±0.65^a	0.86	0.02
ADF digestibility	50.67±1.76	49.60±1.02	50.39±1.06	1.33	0.84
Cellulose digestibility	59.54±1.55	57.94±1.02	58.19±1.19	1.27	0.65
Hemicellulose digestibility	53.09±0.81^b	47.26±1.17^a	46.53±1.75^a	1.31	0.01

Mean ± SE values with different superscripts (a, b) within row differ significantly ($p<0.05$).

Table 3: Cumulative feed consumption, total feed cost and daily feed cost

Attributes	T_0	T_1	T_2	CD	SEM	CV%
Cumulative TMR consumption (kg/h/70 days)	398.80±4.14	402.60±2.91	397.00±8.46	NS	5.66	3.01
Cumulative green consumption (kg/h/70 days)	418.21±7.57	421.40±3.36	415.60±14.81	NS	4.62	4.88
Total feed cost (Rs.)	8065.61±96.22^a	8714.99±63.15^b	9161.73±218.4^c	170.87	58.19	6.38
Daily feed cost (Rs.)	115.22±1.37^a	124.50±0.90^b	130.88±3.12^c	209.27	71.27	6.38

Mean ± SE values with different superscripts (a, b) within row differ significantly ($p<0.05$).

i.e., CF, NDF and hemicelluloses were found to be decreased significantly with inclusion of both the levels of soapnut in the diet of heifers over control. The non-significant results of nutrient digestibility are in accordance with Nasri and Salem (2012), Jacob *et al.* (2012) and Aazami *et al.* (2013). The reduction in digestibility observed may be due to defaunating effect of saponins (Jadhav *et al*., 2016). Saponin may be toxic at higher level to rumen microbes, since approx. 20% of fibre degradation is contributed by protozoa (Dijksha and Tamminga, 1995). Our findings supported the previous observations of Hess *et al*. (2003), Nasri and Salem (2012), and Jadhav *et al.* (2017) for a reduction ($p<0.05$) in NDF degradation, while Aazami *et al.* (2013), Kumar *et al*. (2017) and Poornachandra *et al.* (2019), failed to find variation in the digestibility of various nutrients by saponin treatments of the diet.

Economics of Feeding

The cumulative consumption of TMR and green fodder (kg/h/70 days) of experimental animals in T_0, T_1, T_2 groups was statistically similar (Table 3). The daily cost and total cost of feed (Rs/h/70 days) however differed significantly ($p<0.05$) between treatments, and values were significantly higher in T_2 than T_1 and the control group T_0. These results revealed that feeding soapnut powder is costlier, and had no beneficial effect on nutrient intake or their digestibility and in fact both were somewhat suppressed with higher level (2 %) of soapnut in the diet.

Conclusions

The findings of this study revealed that the soapnut (*Sapindus mukorossi*) supplementation at the rate of 1% and 2% in TMR (roughage: concentrate 65:35) did not adversely affect the final body weight, nutrient intake and digestibility, except fibre fractions, which was significantly suppressed. Though the low level of soapnut (1%) enhanced the flow of microbial protein from rumen and observed higher body weight gain in crossbred heifers. These results revealed that feeding soapnut powder is costlier, and had no beneficial effect on nutrient intake or their digestibility.

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