EFFECT OF BAGASSE AS A ROUGHAGE SOURCE ON NUTRIENT DIGESTIBILTY AND GROWTH PERFORMANCE OF GROWING CROSSBRED DAIRY CALVES

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ABSTRACT

A study was undertaken with an objective to evaluate the effect of sugarcane bagasse as analternate roughage source on the feed intake, nutrient digestibility and growth performance in crossbred calves. Eighteen crossbred calves aged one year with an average body weight of154.28 kg were utilised in the study for 6 months. The animals were divided into 3 groups and fed with two different inclusion levels of sugarcane bagasse (25% and 50%) replacing conventional fodder and a control diet based on roughage and concentrates, commonly adopted in the region. There was no significant ($p>0.05$) difference between control and treatment groups in the digestibility of DM, OM, CF, NFE, however the digestibility of EE differed significantly ($p<0.05$).Even though DCP showed highly significant difference among the groups, the TDN contents were similar to the control diets for both treatment groups. The dry matter intake did not differ significantly for the 1st and 2nd months. There was no significant ($p>0.05$) difference in the bodyweight of the animals in the entire study period.Therefore sugarcane bagasse can be safely included up to the level of 50% in the diet and can potentially replace the conventional green fodder without affecting the growth and daily dry matter intake in crossbred growing calves.

Key words: Sugarcane bagasse, Molasses, Crossbred calves, Digestibility, Dry matter intake.

INTRODUCTION

Sugarcane industry is the second largest agro industry in India followed by cotton and has a considerable role in determining the economy, trade and livelihood of our country. India is the world's largest producer of sugarcane and second largest producer of sugar after Cuba.There are four

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major byproducts of sugarcane industry viz. cane tops, bagasse, molasses and press mud. Sugarcane bagasse can be used as a supplement with other feed materials of high nutrient content for the formulation of a complete ration for feeding ruminants (Saraye, 2009). A sugar factory produces nearly 30 tons of wet bagasse for every 100 tons of sugarcane crushed (Hofsetz and Silva, 2012). It is estimated that over 75–90 million tones of wet bagasse are produced annually from 600 operational sugar mills in India (Quereshi *et al.,* 2020). Usually bagasse is used as a source of energy in the sugar mills and in the manufacture of paper, plastic and light weight concrete. Sugarcane bagasse has the potential to be used as animal feed. Sugarcane bagasse could be used as an alternate source of roughage for beef and dairy cattle (Leme *et al.,* 2003). Therefore, the increase in volume of sugarcane bagasse produced in recent years represents an increasing potential source of ruminant feed. There is now renewed interest in investigating the optimal level of sugarcane bagasse for dairy cows since nutritional requirements of dairy cows differ from beef cattle and there is dearth of data on using sugarcane bagasse as exclusive roughage for this category of animals. An optimal level of nutrition in early life of cow favours faster growth and early maturity. Calves should be reared on good plane of nutrition andeconomically also to obtain optimum gain in body weight, so that they attain about 70-75 per cent of mature body weight at puberty. Growth in calves is a good indicator of any nutritional deficiency and hence the present study was planned to evaluate the effect of replacement of a part of roughage with sugarcane bagasse in terms of feed intake, digestibility and growth parameters.

MATERIALS AND METHODS

Location

The experiment was carried out at the Livestock Farm Complex, Madhavaram Milk Colony, TANUVAS, Chennai, which lies between latitudes 12° 9’ and 13° 9’ and longitudes 80° 12’ and 80° 19’ E with an altitude of 22 m above the MSL. The experiment was conducted for a period of 6 months (April – September, 2020).

Animal and diets

Eighteen one-year old crossbred calves (Jersey Crossbred) with an average initial body weight of 154.28 kg were used for this study. The study period lasted for six months. The calves were housed in a separate shed, with individual feeders and drinkers. The diets consisted of two different levels of sugarcane bagasse replacing green roughage (25% and 50%) and a control diet commonly adopted in the region for calf, based on roughage and concentrate feed (Table 1). Concentrate feed were procured from the Central Feed Technology Unit, TANUVAS. The feed was prepared by using maize, soya bean, deoiled rice bran, mineral mixture and salt. Green fodder (Hybrid Napier, Co4) was harvested daily from the fodder farm of the Livestock Farm Complex, Chennai, Tamil Nadu. Bagasses and molasses were mixed in the ratio of 3:1 and was supplied to the experimental station by the EID, Parry Private Ltd., Chennai.

Table 1. Chemical composition (%) of concentrate feed, green fodder and bagasse molasses combination used in the experimental diets and quantity fed to the crossbred growing calves

Parameter	Concentrate Feed	Green Fodder	Bagasse + Molasses
Moisture (%)	11.07	82.27	11.84
Crude Protein (%)	26.24	11.8	3.09
Crude Fibre (%)	6.37	29.39	35.18
Ether Extract (%)	2.00	2.12	0.59
Total Ash (%)	8.77	12.65	4.69
Acid Insoluble Ash (%)	2.81	3.37	2.64
Nitrogen free Extract (%)	56.62	44.04	56.45
Neutral Detergent Fiber (NDF) (%)	14.44	62.37	74.43
Acid Detergent Fiber (ADF) (%)	6.04	37.73	51.5
Hemi Cellulose (%)	8.40	24.64	22.93
Cellulose (%)	5.70	33.61	40.85
Lignin (%)	1.30	5.07	10.78
Feed Composition			
Control (kg)	01	15.00	00
Treatment I (kg)	01	11.25	01
Treatment II (Kg)	01	7.50	02

Experimental design

Eighteen crossbred calves were divided into three groups based on randomized group design with six calves in each group. Animal shed was designed for separate feeding for each animal and ad libitum water was made available to all the animals. Each group of animals was subjected to a feed ingregimenie., first group,control, in which animals were fed with concentrate (1 kg) + green fodder (15 kg), second group (T1) of animals, was fed with concentrate feed + 25 % green fodder replaced with 1 kg of bagasse and third group (T2) of animals was fed with concentrate feed + 50 % green fodder replaced with 2 kg of bagasse. Bagasses and molasses were mixed in a ratio of 75:25 for animal feeding. The body weights of the calves were recorded at fortnightly interval for the entire study period and the daily amount of feed fed and the amount of residual feed were measured to arrive at the quantity of feed intake. A digestibility trial was conducted in the mid of the study period with 6 day collection period. Total feces voided in 24 hours was collected for a period of six days and was subjected to moisture, crude protein, crude fiber, ether extract and total ash (AOAC, 2000) estimation.

Chemical analysis

Representative faecal sample, pooled for three days, were analyzed along with concentrate feed, green fodder,combined bagasse andmolasses, for their chemical composition as per the method of AOAC (2000) while fiber fractions were estimated as per the methods suggested by Soest *et al.* (1991). Digestibility was calculated. Total Digestible Nutrient was expressed in the form of TDN intake (g) per day and Digestible Crude Protein was expressed in the form of DCP intake (g) per day.

Statistical analysis

The results of the feeding and digestibility trials were subjected to statistical analysis. The data were analyzed using one-way analysis of variance procedures (IBM SPSS Statistics 25.0). Differences among treatments were determined by Tukey's test ($p<0.05$). Results are presented as means and standard error of means.

RESULTS AND DISCUSSION

Chemical composition

The chemical composition of the concentrate feed, green fodder and bagasse molasses combination are presented in Table 1. The bagasse and molasses combination was high in fiber and low in crude protein when compared to the green fodder hybrid Napier on dry matter basis. In this study, the CP content (3.09 %) of the sugarcane bagasse – molasses combination was higher than the values reported by Gunun *et al.* (2017), Balgees *et al.* (2007) and Ahmed *et al.* (2013) who accounted that untreated sugarcane bagasse contained 2.1 - 2.9% CP. Inclusion of molasses that contained 6 % crude protein and mixed in the ratio of 3 (bagasse):1 (molasses) improved the protein content of the combination.

Dry matter intake

The results of dry matter intake are presented in Table 2. The results show that there was no significant ($p>0.05$)difference in the parameter for the 1st and 2nd months while, the 3rd, 5th and 6th months showed significant differences ($p<0.05$), and 4th month showed highly significant differences ($p<0.01$) between the groups, with highest dry matter intake in T2 followed by T1 and control group. Initially the intake of treatment groups was comparable to that of control as the calves were in the adaptation period. When animals are fed high fiber feeds, intake is primarily controlled by physical factors, such as passage rates and rumen fill (NRC, 1996). Experiments with whole unprocessed bagasse generally used in higher levels to replace conventional fodder reduced the feed intake and performance (Brown *et al.,* 1954). Whereas in the present animal feeding study, increased dry matter intake in the bagasse fed calves might be due to addition of molasses in 3:1 ratio. It is well known fact that cane molasses increases the dry matter intake in ruminants and reduces cow sorting activity. It also enhances the energy part of the ration without interfering with the fibre and enhances low-quality fodder and cereal grains (DeVries and Gill, 2012).

Table 2. Dry matter (g) intake of the calves fed with inclusion of sugarcane bagasse replacing green fodder in comparison with control group (Mean# ± S.E)

DMI (g)	Control	T1	T2	Significance
Month 1	2797.08 ± 159.02	2555.6 ± 120.65	2687.5 ± 146.06	0.504
Month 2	3108.0 ± 112.41	2998.6 ± 84.39	3220.9 ± 81.89	0.277
Month 3	3267.1^{a} ± 50.25	2897.9^{b} ± 114.75	3329.4^{a} ± 57.50	0.003
Month 4	3297.17^{b} ± 47.11	3144.81^{b} ± 101.89	3746.0^{a}± 25.95	0.000
Month 5	3290.80^{b} ± 77.77	3210.99^{b} ± 71.09	3649.40^{a} ± 37.53	0.001
Month 6	3292.15^{b} ± 59.73	3268.68^{b} ± 111.94	3660.02^{a} ± 46.19	0.004

#Mean of six observations

Values bearing different superscripts within a row differ significantly ($p<0.05$) with each other

Body weight change

The body weight change in the control and the treatment groups ispresented in the Table 3. There was no significant ($p>0.05$) difference among the control group and treatment group in body weight change, even though there was reduction in the crude protein digestibility in the 50 % replacement group compared to control group.The increased dry matter intake justified the absence of significant difference among the groups. In a similar study conducted by Singhal, (2009), it was shown that sugarcane bagasse can be used economically as an alternative source of forage to replace 30% of wheat straw in feed block, without any adverse effect on the growth of crossbred calves.

Digestibility

The digestibility of the feed is presented in Table 4. The results revealed no significant ($p>0.05$) difference in digestibility of DM, OM, CF and NFE among the control and the treatment groups. However, the EE showed significant ($p<0.05$) difference among the groups while the CP ($p<0.01$) and DCP ($p<0.01$) showed highly significant difference among the groups. Even though the digestibility of the crude protein was less among the treatment groups in comparison with control group, there was no significant difference in the TDN (g/day) as there was in fact an increasein the dry matter intake in T2 followed by T1 compared to control group. Similarly, Kirk *et al.* (1969) reported that bagasse products could be used to replace cottonseed hulls and grass hay without significantly affecting rate of gain.

Table 3 Body weight (kg) change in the calves fed with inclusion of sugarcane bagasse replacing green fodder in comparison with control group for a period of 6 months (Mean# ± S.E)

Period	Control	T1	T2	Significance
Day 0	146.83 ± 16.11	158.60 ± 13.43	157.43 ± 15.12	0.830
Month 1	149.52 ± 14.93	155.85 ± 12.18	162.15 ± 15.31	0.823
Month 2	160.78 ± 17.13	167.10 ± 13.13	166.73 ± 14.51	0.946
Month 3	166.87 ± 17.1	172.85 ± 11.97	174.22 ± 14.69	0.932
Month 4	174.53 ± 16.48	172.53 ± 11.28	182.58 ± 14.82	0.873
Month 5	170.48 ± 15.36	172.03 ± 9.89	185.45 ± 13.53	0.682
Month 6	175.13 ± 15.37	183.68 ± 10.36	191.08 ± 14.36	0.712

#Mean of six observations

Table 4 Digestibility (%) of nutrients in the calves fed with inclusion of sugarcane bagasse replacing green fodder in comparison with control group (Mean# ± S.E)

Attribute	Control	T1	T2	Significance
DM (%)	64.67 ± 1.09	61.93 ± 1.68	60.75 ± 0.85	0.110
OM (%)	66.23 ± 1.01	63.31 ± 1.59	63.74 ± 0.61	0.186
CP (%)	77.18^{c} ± 0.88	73.59^{b} ± 1.08	69.84^{a} ± 0.87	0.000
CF (%)	66.83 ± 0.91	64.28 ± 1.58	66.68 ± 0.90	0.259
EE (%)	59.04^{ab} ± 1.23	64.13^{a} ± 2.52	54.70^{b} ± 1.97	0.015
NFE (%)	62.55 ± 1.34	60.01 ± 1.81	61.19 ± 0.65	0.434
Nutritive Value of Feed				
DCP (g/day)	392.63^{c} ± 8.31	339.54^{b} ± 10.04	287.94^{a} ± 4.42	0.000
TDN (g/day)	1929.77± 68.54	2001.56 ± 94.89	2180.34 ± 42.44	0.069

#Mean of six observations

Values bearing different superscripts within a row differ significantly ($p<0.05$) with each other

CONCLUSION

Sugarcane bagasse and molasses in 3:1 combination contained about 35% crude fibre, 74% neutral detergent fibre and 51% acid detergent fibre. Replacing up to 50% of the green fodder requirement with this combination was found to maintain body weight without affecting normal metabolic activity in growing crossbred calves. The reduction in digestible crude protein in the sugarcane bagasse group was compensated through increase in dry matter intake. Replacement of roughage with this byproduct of sugar industry could be economical to the farmers.Further research is necessary to investigate the effects of inclusion of sugarcane bagasse - molasses combination in milch cows to assess the effect of this combination on milk production and thus itspractical applicability in farm conditions.

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