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Feeding Value of Hybrid Napier Silage Incorporated with *Lactobacillus plantarum* in Crossbred Heifers in Kerala

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ABSTRACT

An experiment was carried out to assess the feeding value of grass silage incorporated with bacterial inoculum in crossbred heifers. Silage was prepared using hybrid Napier grass incorporated with *Lactobacillus plantarum* (GSL) at a concentration of 1 x 10^5 CFU per gram and ensiled for a period of 21 days. An in vivo feeding trail was conducted using twelve crossbred heifers for a period of thirty days. The animals were divided into two groups with six animals each and were allotted into two dietary treatments, T1 (Concentrate + fodder grass as control ration) and T2 (Concentrate + GSL). A digestibility trial of five days duration was conducted at the end of feeding trial. Body weight and serum biochemical parameters recorded at the start and end of the feeding trail were statistically similar between two treatment groups. The digestibility coefficient of dry matter and CP were similar between treatment groups. From the overall results, it can be concluded that hybrid Napier grass, ensiled for 21 days using *L. plantarum* can be effectively used for rearing of crossbred heifers without compromising the growth performance.

KEYWORDS: Hybrid Napier grass, *in vivo* feeding, *Lactobacillus plantarum,* silage

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INTRODUCTION

A consistent supply of fodder is extremely important to maximise the economic gain from cattle production, but the periodic nature of the fodder harvest and the substantial crop availability during the brief rainy season necessitate careful resource conservation (Gandra et al., 2016). Ensiling is a time-honored technique for preserving fresh forages and grains with the goal of ensuring year-round availability of tasty and nutrient-rich animal feed for cattle. Silage would preserve fodder's nutritional value by slightly altering its nutrient content. The majority of tropical and subtropical grasses are challenging to ensile due to its low dry matter and crude protein concentrations. Hence additives should be added to animal feed to improve its DM and nutritional content (Vivekanand et al., 2020).

Nutrient losses during ensiling is a significant constraint for effective silage production. Fodder crops with a high moisture content, mould growth and a shortage of substrates with soluble carbohydrates have an impact on the ensiling process. Therefore, strategies must be optimised to preserve the nutritional value of forages during ensiling (Balehegn et al., 2022). Silage is a byproduct of the anaerobic fermentation of roughages in a container and thus additives that promote the fermentation process are necessary. Lactic acid bacteria (LAB) help to convert water-soluble carbohydrates (WSC) into organic acids, predominantly lactic acid, during fermentation process. The resulting low pH will inhibit the growth of yeast and fungus and thereby prevent the deterioration of ensiled material (Khanday et al., 2021). Hence the present study has been envisaged to assess the feeding value of grass

silage incorporated with *Lactobacillus plantarum* in crossbred heifers.

MATERIAL AND METHODS

The present research was conducted at Department of Animal Nutrition, College of Veterinary and Animal Sciences, Mannuthy, Kerala and University Livestock Farm Fodder Research Development Scheme (ULF & FRDS), Mannuthy, Kerala.

Experimental animals

Twelve healthy crossbred heifers of twelve to sixteen months of age were selected from ULF&FRDS, Mannuthy formed the experimental subjects of the study. The animals were housed in well ventilated, clean and dry shed with facilities for individual feeding and watering.

The animals were divided into two treatment groups of six animal each and were randomly allotted to one of the two dietary treatments (T1 and T2) following the Completely Randomized Design (CRD). All the animals were dewormed before the commencement of the study and were maintained under uniform management conditions in the farm throughout the feeding trial of one month.

Experimental ration

All the experimental animals were fed with a standard concentrate mixture containing 20 per cent of Crude Protein and 68 per cent Total Digestible Nutrients. The two experimental rations were T1 (Control) with concentrate and mixed grass as roughage source and T2 with concentrate and grass silage incorporated with *L. plantarum* as roughage source to animals.

Mixed grass were offered *ad-libitum* and experimental animals were fed as per ICAR standards (ICAR, 2013). Ingredient composition of concentrate mixture offered to experimental animals as given in Table 1. Chemical composition of concentrate mixture, mixed grass and GSL is given in Table 2.

Table 1. Ingredient composition of concentrate mixture offered to experimental animals, %

Ingredients	Per cent
Deoiled rice bran	24.0
Maize	15.0
Coconut cake	15.0
Corn gluten fibre	15.0
Rice polish	14.0
Alfalfa	11.0
Black gram husk	3.0
Calcite	1.5
Salt	1
Mineral mixture	0.5
Total	100.0

Table 2. Chemical composition[1] of concentrates, mixed grass and silage in the study, %

Parameters	Concentrate	Mixed Grass	Silage
Dry matter	90.53 ± 0.64	20.60 ± 0.40	25.31 ± 0.06
Crude protein*	20.50 ± 0.33	9.87 ± 0.25	9.70 ± 0.07
Crude fibre*	10.19 ± 0.04	29.49 ± 0.17	28.42 ± 0.10
Ether extract*	4.10 ± 0.13	1.47 ± 0.39	2.18 ± 0.03
Total ash*	10.38 ± 0.12	10.26 ± 0.14	10.22 ± 0.12
Nitrogen free extract*	54.78 ± 0.44	48.91 ± 0.56	49.48 ± 0.09
Acid insoluble ash*	1.30 ± 0.05	1.30 ± 0.02	1.53 ± 0.12
Neutral detergent fibre*	71.04 ± 0.74	67.90 ± 0.70	60.44 ± 0.08
Acid detergent fibre*	51.52 ± 0.84	37.99 ± 0.01	49.30 ± 0.06

[1] Mean value are based on six replicates
* On DM basis

Preparation of grass silage for the feeding trial

Hybrid Napier grass harvested at 45 days after first plantation was obtained from ULF&FRDS, Mannuthy. The fodder grass was chopped with a chaff cutter to a size of 1.0-3.0 cm. About 150 kg of chopped fodder was packed into plastic drum of 300 L capacity. During filling, bacterial culture of *L. plantarum* were added uniformly into chopped fodder as additive at a concentration of 1 x 10^5 CFU per gram of green fodder. To remove air pockets and ensure good packing, pressure was applied manually. After proper compaction and filling, the top portion of the drums were covered and sealed with polythene sheet and the chopped fodder was ensiled for a period of 21 days.

Feeding trial

A feeding trial of one-month duration was carried out during the experiment. All animals were fed as per ICAR (2013) recommendations.

Feed intake

Weighed quantities of experimental rations were offered individually based on their requirement to all the animals in morning at 9 AM and in the afternoon at 2 PM. The feed residue if any, in the manger was collected manually and weighed daily for analyzing the moisture content and estimation of daily dry matter intake. Data on daily dry matter intake was recorded during the entire experimental period.

Body weight

Body weight of experimental animals were recorded at the beginning and at the end of feeding trial.

Digestion trial

A digestibility trial for five days duration was carried out towards the end of feeding trial by total collection method. During digestion trial, quantities of daily feed offered as well as feed residue left and feces voided were recorded. The dry matter content of the feed offered as well as residue left were determined daily. Feed samples were collected in double lined polyethylene bags and were stored in a deep freezer for further analysis. The dung voided by each animal was collected quantitatively uncontaminated with urine, feed residue or dirt as and when they were voided in individual containers, on a continuous 24-hour basis during the digestion trial. The quantity of dung voided by each animal during the previous 24 hours were weighed separately at 8 AM every day. The representative samples at the rate of one per cent of the total quantity voided were taken after thorough mixing. The samples so collected each day were stored in deep freezer (-20ºC) in double lined polyethylene bags for further analysis. At the end of the trial, samples of dung collected for the five consecutive days from each animal were pooled together and mixed thereafter, representative samples were taken after thorough mixing for chemical analysis. The

moisture and crude protein content in fecal samples were estimated using fresh samples. The proximate composition of feed, fodder and dung samples were done as per the standard procedure (AOAC, 2016). The neutral detergent fibre and acid detergent fibre were estimated by Van Soest method. The apparent digestibility coefficient of dry matter, crude protein, ether extract, crude fibre, nitrogen free extract, neutral detergent fibre and acid detergent fibre were calculated. Minerals like calcium and phosphorus in the feed samples were analyzed by conventional precipitation and titration method as per AOAC (2016).

Blood biochemical parameters

Blood samples were collected from all animals at the beginning and at end of the feeding trial. Serum was separated after centrifugation at 3000 rpm for 10 minutes. Serum samples were used to determine the serum calcium (Modified OCPC method), serum phosphorus (Phosphomolybdate method), serum glucose (GOD-PAP method), total protein (Jong and Vegeter, method) and albumin (Bromo cresol green method) using standard kits supplied by M/s. Agappe Diagnostics Limited, Ernakulam, Kerala.

Statistical analysis

Data obtained on various parameters during the experiment were analyzed statistically as per Snedecor and Cochran (1994) by analysis of variance (ANOVA) technique, using the software Statistical Programme for Social Sciences (SPSS) version 24.0.

RESULTS AND DISCUSSION

Digestibility of nutrients

Digestibility coefficient of nutrients in two dietary treatments is given in Table 3. Bureenok et al. (2012) observed that the digestibility coefficient of DM was 75.64 per cent in crossbred heifers fed with Hybrid Napier silage. Khaleduzzaman et al. (2016) reported that the digestibility coefficient of CP in indigenous crossbred cattle maintained on different categories of Napier silage was found to be 55.47 per cent, which was in accordance with the observation recorded during the present study. Pratama and Jayanegara (2021) reported that there was significant difference in CF digestibilities for cows fed with grass silage compared to those fed with grass as a roughage source and the observed values were 69.90 and 63.76 per cent, respectively. In a similar study, Pratama and Jayanegara (2021) reported that there were significant difference in the EE digestibility of dairy cows fed with grass silage compared to those fed with grass as a roughage source and the values were 62.40 and 54.09 per cent, respectively. Tahuk et al. (2021) reported no significant difference in the digestible coefficient of NFE for goats fed with either natural grass silage or Napier grass and the values ranged from 88.51 to 88.89 per cent.

Table 3. Digestibility coefficient[1] of nutrients in two dietary treatments, %

Parameters	Dietary treatments		p-value
	T1	T2	
Dry matter	75.9 ± 0.87	75.61 ± 0.96	0.817^{ns}
Crude protein	51.7± 1.34	52.7 ± 0.86	0.52 ^{ns}
Crude fibre	69.9^{b} ± 1.26	75.1^{a} ± 0.48	0.03*
Ether extract	64.9^{a} ± 0.61	51.4^{b} ± 1.49	0.02*
Nitrogen free extract	64.9^{a} ±1.23	58.09^{b} ± 1.46	0.03*
Neutral detergent fibre	65.3^{a} ± 1.23	60.3^{b} ± 1.45	0.24*
Acid detergent fibre	61.09 ± 1.26	63.8 ± 1.39	0.17 ^{ns}

[1] Mean value are based on six replicates
* Means bearing different superscript in a row differ significantly ($p<0.05$)
ns – non significant

Dry matter intake

The total dry matter intake and average daily dry matter intake of experimental animals in two dietary treatments is given in Table 4. Zahiroddini et al. (2004) observed that DMI of steers fed with barley silage treated with inoculum containing LAB were comparable to control group fed with grass and straw. Khaleduzzaman et al. (2016) reported that there was no significant difference in DMI of indigenous cattle maintained on silages compared to those fed with fresh grass.

Body weight and average daily gain

The total weight gain and average daily gain of experimental animals in two dietary treatments is given in Table 4. Zahiroddini et al. (2004) reported that average daily weight gain of steers fed with LAB inoculant treated barley silage were comparable to that of control diet (grass and straw). In a similar study, Nazli et al. (2018) studied body weight gain of beef cattle maintained on corn silage, rice straw and combination of both and recorded no significant differences in the final live weight. Sarker et al. (2019) studied the effect of feeding Napier grass silage in bull calves and reported that average daily weight gain, initial and final body weight were comparable to control groups. Similarly, Verma et al. (2021) studied body weight gain of Hariana heifers maintained on corn silage as replacement to green fodder and recorded no significant differences in the final live weight. The results obtained in the present study was similar to above observations.

Table 4. Summarized data on body weight[1], total weight gain, total dry matter intake (kg/animal), average daily dry matter intake (kg/animal) and average daily gain (kg) of crossbred heifers maintained on two dietary treatments

Parameter	T1	T2	p-value
Initial body weight (kg)	221.21 ± 11.6	221.38 ± 7.16	0.991^{ns}
Final body weight (kg)	234.96 ± 11.9	235.81 ± 7.23	0.953^{ns}
Total weight gain (kg)	13.75 ± 0.76	14.43 ± 0.91	0.579 ^{ns}
Average daily gain (kg)	0.45 ± 0.02	0.48 ± 0.03	0.594 ^{ns}
Total dry matter intake (kg/animal)	158.44 ± 1.04	158.70 ± 1.05	0.787 ^{ns}
Average daily dry matter intake (kg/animal)	5.28 ± 0.03	5.29 ± 0.05	0.787 ^{ns}

[1] Mean value are based on six replicates; ns – non significant

Blood biochemical parameters

Blood biochemical parameters of crossbred heifers maintained on two dietary treatments is given in Table 5. The concentration of average serum glucose in the experimental heifers maintained on T1 and T2 were 71.74 and 70.59 mg/dL respectively at the end of the experiment. Statistically there was no significant variation observed in the serum glucose concentration of experimental animals maintained on two dietary treatments and the values recorded were in the normal range (45-75 mg/dL) for the heifers (Kaneko et al., 2008). Rezaei et al. (2015) reported that blood calcium and phosphorus concentration in lactating Holstein cows maintained on maize silage were 7.2 mg/dL and 5.13 mg/dL respectively which were similar to the observations made in the present study. In agreement to the results of present study, Dewhurst et al. (2009) observed a no significant difference in total protein for Holstein cows fed with grass silages. The reported values were 6.92 and 6.85 g/dL respectively. The values recorded for serum albumin during present study lies within the normal range (2.4-3.0 g/dL) reported for the heifers (Kaneko et al., 2008).

Table 5. Blood biochemical parameters of crossbred heifers maintained on two dietary treatments

Parameter	Time of blood collection	Group		p-value
		T1	T2	
Serum glucose, mg/dL	Initial	74.2 ± 2.27	71.2 ± 1.44	0.285[ns]
	Final	71.7 ± 2.18	70.6 ± 0.10	0.620 [ns]
Serum calcium, mg/dL	Initial	7.56 ± 0.14	7.49 ± 0.13	0.747 [ns]
	Final	7.22 ± 0.22	7.46 ± 0.20	0.440 [ns]
Serum phosphorus, mg/dL	Initial	4.30 ± 0.11	4.75 ± 0.17	0.055 [ns]
	Final	5.25 ± 0.11	5.48 ± 0.07	0.128 [ns]
Total protein, g/dL	Initial	4.40 ± 0.06	4.30 ± 0.08	0.367 [ns]
	Final	4.48 ± 0.13	4.64 ± 0.04	0.308 [ns]
Albumin, g/dL	Initial	2.84 ± 0.05	2.88 ± 0.04	0.560 [ns]
	Final	2.83 ± 0.04	2.80 ± 0.04	0.650 [ns]

[1] Mean value are based on six replicates; ns - non significant

CONCLUSION

Evaluation of the data revealed that body weight and serum biochemical parameters (glucose, calcium, phosphorus, total protein and albumin) were similar between two treatment groups. The digestibility coefficient of dry matter and CP were comparable between treatment groups. Hence, hybrid Napier grass, ensiled for 21 days using *L. plantarum* can be effectively used for rearing of crossbred heifers without compromising the growth performance.

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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