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Growth Performance, Nitrogen Balance and Blood Biochemical Parameters on Feeding TMR Diet Containing Sugarcane Tops Silage Supplemented with Lactic Acid Bacteria Inoculants and Exogenous Fibrolytic Enzymes in Crossbred Calves

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ABSTRACT

Background: Preservation of green sugarcane tops (SCT) as silage is still challenging due to its low fermentation coefficient. Present study was undertaken to assess the effect of different combination of additives on nutrient utilisation and growth performance in crossbred (Karan fries) heifers fed SCT silage based total mixed diet.

Methods: Sugarcane tops (300 g DM/kg fresh matter) ensiled for 30 days in plastic jumbo silo bags (500 kg capacity) in three different treatments *viz.* SCTB1, SCTB2 and SCTB3 silages. Total mixed ration (TMR) TMRB1, TMRB2 and TMRB3 were prepared, containing 40 part concentrate and 60 part sugarcane tops SCTB1, SCTB2 and SCTB3 silages, respectively. Eighteen crossbred calves of similar body weights (115 kg) and age (11 months) were divided in three group and offered dietary treatments: TMRB1, TMRB2 and TMRB3 for sixty days. Feed intake (daily) and body weight (weekly) was recorded. Blood samples were collected (monthly) for glucose, creatinine, BUN, plasma calcium, ALT and AST levels estimates.

Result: On 30th day SCT silage samples were analysed, pH and NDF content was found lower (p<0.05) whereas lactic acid content was higher ($p<0.05$) in SCTB2 and SCTB3 than SCTB1 silage. Feed intake, growth performance, nitrogen balance and blood biochemical parameters were remained similar among the groups. Total tract digestibility of NDF and ADF was found higher (p<0.05) in groups TMRB2 and TMRB3 than TMRB1. It may be concluded that LAB and EFE supplementation on SCT silage improved fibre digestibility (NDF and ADF) of TMR diet however, feed intake, growth performance and blood parameters were not affected in crossbred calves.

Key words: Crossbred calves growth, Nutrient digestibility, Sugarcane top silage, TMR feeding.

INTRODUCTION

Agriculture wastes production increased at an escalating rate; at present India alone produces more than 512 metric tonnes of crop residue per annum, cereal and sugarcane crops are the major producers (Bhuvaneshwari *et al.*, 2019). The utilisation of agri (by) products (straws, sugarcane bagasse, sugarcane tops etc), conservation of surplus green forage as silage permits green fodder supply for livestock and also can address today's greater interest of clean and green livestock production (Kholif *et al.*, 2017). Usually without any proper utilisation seasonal accumulates of harvested sugarcane tops biomass are wasted in landfills or burnt in the field. The previous studies (Gandley *et al.*, 2003) have reported the poor digestibility and low nutritive value limits the use of fresh sugarcane tops in growing and lactating dairy diet. Supplementation of non-protein nitrogen and molasses additive on ensiled sugarcane tops improved DMI in goats (Kutty and Prasad, 1980), increased the nutrient digestibility and feed intake in sheep (Reddy and Prasad, 1983). Despite any inference, the evaluation of sugarcane tops use as potential feed for growing animal is inadequate and dangerous.

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Author has made urgent to identify cheap, renewable feedstocks (straws, sugarcane bagasse, sugarcane tops or agri-waste) that provide high apparent propionate yields through processing (ensiling) or utilising additives (such as exogenous fibrinolytic enzyme and different LAB inoculant strains) which can modify *in-vitro* rumen fermentation. The

fate of ensiling depends on anaerobiosis, lactic acid bacteria fermentation and prevent secondary fermentation. Various strains of lactic acid bacteria (LAB), *Lactobacillus*, *Lactococcus* and *Enterococcus* genera have been used as additives for silage quality improvement (Pedroso *et al.*, 2006). However, use of exogenous fibrolytic enzymes accelerates the rate of fibre degradation which avail soluble sugar substrate and influence microbial fermentation and nutrient utilisation in different ways (Beauchemin *et al.*, 2003; Wang *et al.*, 2001).

A wide range of silage additives have been utilised to influence fermentation characteristics, enhance nutritive value and metabolizable energy from poor quality fodder. Current study is based on hypothesis that addition of EFE and LAB additive combination during sugarcane top ensiling may influence the fermentation characteristics, individual volatile fatty acid profile, which may improve metabolisable energy utilisation and growth performance in animals. Each additive has a particular mode of action, LAB inoculant and supplemental EFE might have a synergistic effect (Zahiroddini *et al.*, 2004) or antagonistic effect on silage quality (Stokes, 1992) their consequences may further influence feed intake and performance in animals. In this contest, Addah *et al.* (2012) reported nutrient digestibility and feed efficiency has increased in growing steers fed maize silage treated with combination of LAB and EFE. The objective of the present study was investigating the effect of supplementary exogenous fibrolytic enzyme (EFE) and LAB inoculant (*Lactobacillus fertmentum* and *Pediococcus acidilatici*) combination on chemical composition, feed intake, nutrient utilisation and blood biochemical parameters in crossbred calves fed total mixed ration consisting sugarcane tops silage. The study also assessed the effect of adding, *Pediococcus acidilactici* LAB strain on additive pool.

MATERIALS AND METHODS

Ethical approval

The experiment was conducted with all ethical responsibilities given by Institutional Animal Ethics Committee (IAEC) constituted as per the article number 13 Control and Supervision on Experimentation on Animals (CPCSEA) rules (Government of India).

Silage preparation

The study was conducted at the Animal Nutrition Division, National Dairy Research Institute, Karnal, Haryana, India. Sugarcane tops was harvested at 300 g DM/kg fresh matter and ensiled for 30 days in plastic jumbo silo bags (500 kg capacity), total 15 bags were prepared (5 bags per treatment). Sugarcane tops were procured from Sugarcane Breeding Research Institute (Karnal, Haryana, India) during the harvest period of November to December. Using the electrical chaff cutter, whole sugarcane tops were chopped into particle lengths of 2-4 cm. Exogenous fibrolytic enzymes (Commercially available - BG Cellulose, Bio-Agro Tech. Ltd.) endoglucanse posses 1.6 lakh carboxymethycellulose NCU/g activity and Hostazym, Biovet, Huvepharma, Bulgaria) having 6000 EPU acid birchwood xylanase units/g, as specified by the manufacturer. The activity of cellulase (BG cellulose) is expressed 1 NCU is the amount of enzyme which degrades CMC to reducing carbohydrates with a reduction power corresponding to 1 µmol glucose per minute under standard conditions (Nguyen *et al.*, 2013). These products have been tested for cellulase (endoglucanase) activity (Wood and Bhat 1988) method, while have determined endo 1-4 xylanase activity (Bailey *et al.* 1992) procedure. Dose rate of xylanase (Hostazym) and cellulase (BG cellulose) supplementation on plant material was decided so that 0.055 mg xylose equivalents/min/mg of enzyme and 0.880 mg glucose equivalents/min/mg of cellulase enzyme suspension will be released. The facultative heterofermentative lactic acid bacteria (LAB) namely *Lactobacillus fermentum* NCDC No.-344 and homofermentative *i.e*. *Pediococcus acidilactici* NCDC No.-421 ampoules were obtained from NCDC (National collection of dairy cultures) in 10 ml of sterile De Man, Rogosa and Sharpe (MRS) broth (Himedia Laboratories Pvt. Ltd, Mumbai, India); broth pH was 6.5±0.2 at 25°C. The culture was developed by adding, 2% of LAB inoculum on MRS broth that incubated at 37°C for 24 h. When the growth reached to 10^6-10^8 LAB cfu/ml, the inoculants were added to the treatments.

The first group SCT B1 silage was added with common additive (Urea 0.5%+ molasses 2% and NaCl 0.5% FM). The second group SCT B2 silage was added with common additives as SCT B1 + EFE and LAB inoculant additives (Cellulase @ 6000 NCU/kg + Xylanase @ 1500 EPU/kg FM + *Lactobacillus fermentum* @ $1x10^6$ cfu/g FM and the third group SCT B3 silage was added as per SCT B2 + *Pediococcus acidilactici* @ $2.1x10^6$ CFU/g FM.

Animal, diets and management

Eighteen crossbred dairy heifers (Karan fries) of average live body weight (BW: 115±11 kg) and age (8±0.33 mo) were selected from Livestock Research Complex, National Dairy

Table 1: Ingredients used in total mixed ration during experiment.

Ingredients composition	Content [g/kg DM]
SCT silage*	600
Ground yellow maize	140
Pearl millet	30
Ground nut cake (expeller extracted)	45
Soybean meal	55
Mustard oil cake (expeller extracted)	60
Wheat bran	55
Mineral mixture	10
Common salt	5

*different treatments of SCT silage *i.e*. SCT B1, SCT B2 and SCT B3 were used for TMR diet (TMR B1, TMR B2 and TMR B3).

Research Institute and randomly distributed in three groups (six in each) *viz*. TMRB1, TMRB2 and TMRB3. A feeding trial of 60 days, including 7 days metabolic trial was started during January, 2020 to investigate the effect of EFE and LAB inoculant additives on feed intake, growth performance, nutrient utilisation and blood biochemistry in crossbred calves. The crossbred calves in respective treatment groups were fed as per TMRB1, TMRB2 and TMRB3 containing 40 part concentrate and 60 part sugarcane tops silage from SCTB1, SCTB2 and SCTB3, respectively. The ingredient used in concentrate mixture and nutrient composition of SCT silage and TMR diets of different groups TMRB1, TMRB2 and TMRB3 are show in (Table 1 and Table 2). respectively.

Prior to start of the feeding experiment, all the animals were vaccinated and given deworming medication with fenbendazole orally and sub cut injection of ivermectin at prescribed doses to ensure parasite-free healthy condition. The animals were kept in feeding stall given proper ventilation and sun light, provided with asbestos roof and cement floored-house having the provision of individual feeding, drinking water and provided open paddock for exercise at least 1 h twice in a week. The nutrient requirement of individual growing crossbred calves was calculated as per (ICAR, 2013) and TMR diet was offered in the morning 9.00 am and evening 6.00 pm. After 10 days of preliminary feeding in all animals, different groups were fed on experimental diet for sixty days. Daily feed offered, residue left and accordingly the DM intake of the animals was recorded. The empty BW of the animals was recorded before the feeding on an electronic scale for two consecutive days and followed by fortnight interval. The average daily gain (ADG) and feed conversion ratio (kg feed consumed/ kg gain) were calculated. At the end of feeding experiment, animals were sifted to metabolic stall for two days of adjustment period, metabolic trial of 7 days. Daily representative samples of silage, residue, faeces and urine were collected to estimate nutrient utilisation and nitrogen balance in different groups.

Chemical analysis

Sampling was done at 30th days of ensiling, 20 g macerated silage sample was added to 180 mL of distilled water to prepare silage water extract. Water extract was used to estimation of Lactic acid (Barker and Summerson 1941) and pH content of silage sample by electrometric titration using a Eutech pH meter (Oakton Instruments, IL USA). For chemical analysis, samples of sugarcane tops silage, TMR diet offered, left-over residue and faeces were collected and dried at 65°C in a hot air oven (Labco, Delhi, India) till constant weigh to estimate DM (AOAC, 2005) and representative samples of each group were ground (Will mill) to 1 mm. The samples were analysed for proximate principles (AOAC, 2005) and fibre fractions (Van Soest *et al.* 1991). The N content of feaces and urine was estimated (AOAC, 2005). TDN was calculated by sum of the digestible fractions. Weiss *et al.* (1992), TDN (%) = tdNFC + tdCP + (tdFA x2.25) + tdNDF – 7, metabolic faecal TDN is equal to 7.

Analysis of blood metabolites

Blood samples of all the animals from different groups were collected by jugular puncture at the start of experiment and then on day 30, 60 of the experiment. After proper mixing of anticoagulants heparin blood samples were transferred to the

Table 2: Chemical composition (mean % based on dry matter ± standard error) of SCT silage and TMR[1] diet with different treatments.

Attributes	SCT silage B1	TMR B1	SCT silage B2	TMR B2	SCT silage B3	TMR B3
Fermentation characteristics						
pH	6.14^{a}± 0.01		4.00^{b}±0.00		4.18^{b}±0.00	
Lactic acid (g/kg DM)	5.22^{a} ± 0.01		9.35^{b} ± 0.02		9.27^{b}± 0.01	
Chemical composition						
DM (% FM)	33.09± 0.10	48.86± 0.23	32.24± 0.16	48.37±0.07	31.41± 0.18	51.36±0.13
OM (% DM)	90.33±1.61	89.68± 0.16	90.25± 2.04	88.59±0.21	90.22± 0.32	89.41±0.44
CP (% DM)	8.96±0.82	14.18 ±0.11	9.77± 0.05	14.89±0.12	8.90±0.19	13.80±0.11
EE (% DM)	1.88±0.06	2.55±0.05	2.19± 0.01	3.07 ± 0.06	2.95± 0.08	3.13±0.09
NDF (% DM)	69.45^{a}± 0.63	53.09± 0.30	65.22^{b}± 0.24	53.02±0.21	65.42^{b}± 0.19	52.29±0.12
ADF (% DM)	40.55± 0.14	30.40± 0.24	40.42±0.21	30.31±0.13	39.49± 0.41	30.85±0.34
[2]ME (Mcal/kg DM)	1.81 ±.0004	2.14± 0.001	1.81±.0004	2.11±0.050	1.81±.0003	2.11±0.001
ME (MJ/kg DM)	7.58 ±.002	8.95± 0.005	7.59 ±.002	8.81±0.003	7.58 ±.002	8.84±0.007

DM, dry matter; FM, fresh matter; SCT, Sugarcane tops; TMR, total mixed ration; DM, dry matter; NDF, neutral detergent fiber; ADF, acid detergent fiber; ME, metabolizable energy.

SCT B1 silage added common additives (0.5% urea + 2% Molasses and 0.5% NaCl on fresh matter basis), SCT B2 silage added common additive plus Cellulase @ 6000 NCU/ kg + Xylanase @ 1600 IU/ kg + *Lb. fermentum* @ (1x10^{6}cfu/g). SCT B3 silage prepared with common additive plus Cellulase @ 6000 NCU/ kg + Xylanase @ 1600 IU/ kg + *Lb. fermentum* @ (1x10^{6}cfu/g) + *Pediococcus acidilactici* (2x10^{6} cfu/g) on fresh matter basis.

[1]TMR were prepared with respective sugarcane tops (SCT) silage treatment and concentrate mixing in 60:40 ratio.

[2]Calculated according to equation of NRC (2001).

The values with different superscript within the same row are significantly different at 5% level of significance.

laboratory for further processing. Blood samples were centrifuged at 3000 rpm for 15 min to separate the plasma. Plasma samples were frozen at –20°C till analysis. Concentration of glucose, creatinine, Alanine transaminase (ALT), Aspartate aminotransferase (AST), blood urea nitrogen (BUN) and calcium level were determined by using commercial diagnostic kits (Recombigen Laboratotries, Delhi, India).

Statistical analysis

The fermentation quality and chemical composition of TMR silage were analysed by one-way ANOVA. Data regarding intake, digestibility, rumen parameters, and nitrogen balance were analyzed by one-way ANOVA using software package SPSS version 20.0 (SPSS Inc., Chicago, IL, USA, 2012) the following model:

$$Yijkl = \mu + Ti + Pj + Ak + eijkl$$

Where

Yijk is observation, μ is the overall means, *Ti* is the fixed effect treatment feed, *Pj* is the fixed effect of the period, *Ak* is the random effect of the animal and *eijkl* is the residual error. The values are expressed as means ± SE and difference between the means was compared by Duncan's Multiple range Test at the 5% level of statistical significance as per Snedecor and Cochran (1994).

RESULTS AND DISCUSSION

Chemical composition of SCT silage and TMR diet

Silage SCTB2 and SCTB3 produced (p <0.05) lower pH and NDF content than did SCTB1 (Table 2) while the lactic acid content was found (p <0.05) higher in SCTB2 and SCTB3 than SCTB1. Similarly, the chemical and nutritional composition of three TMR diets used are also presented in (Table 2).

Table 3: Dry matter and nutrient intake, plane of nutrition and performance of cross bred calves fed treatment TMR diets contained SCT silage with different EFE and LAB inoculant supplements.

Attribute	Treatment			
	TMR B1	TMR B2	TMR B3	SEM
Dry matter intake (kg/d)				
SCT Silage	2.14	2.17	2.24	0.07
Concentrate	1.40	1.43	1.38	0.03
Total	3.54	3.58	3.50	0.08
kg/100 kg B.W.	2.79	2.78	2.68	0.03
kg/kg $W^{0.75}$	0.099	0.104	0.095	0.002
Overall average (60 d)	3.60	3.59	3.62	0.07
Digestibility (%)	64.71	64.18	64.75	0.57
Organic matter				
Intake (kg/d)	3.24	3.23	3.22	0.08
Digestibility (%)	66.66	65.84	65.63	0.83
Crude protein				
Digestibility (%)	62.00	61.27	62.23	0.60
DCP intake (g/d)	325	322	325	062
Ether extract				
Digestibility (%)	72.55	73.17	68.54	0.09
NDF				
Digestibility (%)	54.68^{b}	58.68^{a}	58.67^{a}	0.59
ADF				
Digestibility (%)	34.12^{b}	40.53^{a}	41.92^{a}	1.16
Nutritive value and plane of nutrition				
Nitrogen (g/kg DM)	25.05	24.02	23.84	0.19
Metabolisable energy (MJ/kg DM)	8.65	8.61	8.74	0.04
Nitrogen: metabolisable energy	2.89	2.79	2.73	0.02
Digestible energy intake (MJ/kg $W^{0.75}$)[2]	1.04	1.06	1.01	0.01
Metabolisable energy intake (MJ/kg $W^{0.75}$)	0.85	0.87	0.83	0.02
TDN Intake (kg/d)	2.27	2.30	2.24	0.05
TDNI (kg/100 kg B.W.)	1.79	1.78	1.74	0.05
TDNI (kg/kg $W^{0.75}$)	0.064	0.068	0.063	0.002

DM, dry matter.

[2]Digestible energy = Metabolisable energy ÷ 0.82 (NRC, 2001).

The values with different superscript within the same row are significantly different at 5% level of significance.

Nutrient intake, performance and nitrogen balance

Effect of feeding SCT silage based TMR with or without inoculant and exogenous enzyme supplementation on nutrient intake and plane of nutrition has been shown in (Table 3). The DM, OM, CP intakes remained similar among the three groups. Overall, DMI either kg/d or kg/100 kg BW or kg/kg $W^{0.75}$ stayed similar among the three groups with or without bacterial inoculant and exogenous enzyme treatment. Digestibility coefficient for DM, OM, CP and EE in cross bred calves was comparable among the three groups (Table 3). TMRB2 and TMRB3 showed higher (p <0.05) NDF and ADF digestibility than TMRB1. Nitrogen metabolism, nitrogen balance average daily gain (ADG) and fortnightly live weight gain were not affected (p <0.05) on feeding SCT silage based diet with or without additive treatments (Table 4).

Blood metabolites

Serum biochemical parameters like glucose, creatinine, BUN, SGOT, SGPT and Ca levels did not differ and were statistically similar (p <0.05) among the three groups (Table 5).

Chemical composition of SCT and TMR diet

The chemical composition and nutritive values of sugarcane tops silage was found in range of previous studies (Chen *et al*., 2017; Akinbode *et al*., 2017). Fresh sugarcane tops are low in DCP and TDN concentrations, 4.09% and 52.92%, respectively which limits the use of fresh sugarcane tops in growing and dairy animal diet (Gendley *et al*., 2003). Various additives previously have been used for improving the nutritive value and digestibility of SCT. Ensiling facilitates anaerobic fermentation of organic material like lignocellulose and adds fermentation energy. The energy content of ensiled sugarcane tops was as higher as NFC content of ensiled sugarcane tops increased in comparison to the fresh SCT (Akinbode *et al*., 2017). The addition of the urea and molasses with exogenous enzymes and LAB inoculants either in combinations or alone have been frequently used for improving silage quality (Zahiroddini *et al*., 2004).

Nutrient intake, performance and nitrogen balance

The present study was undertaken to evaluate the potential of TMR diet consists of 60 parts sugarcane tops (SCT) silage with or without additive and 40 parts concentrate for growth performance in crosssbred (KF) heifers. Various additives previously have been used for improving the nutritive value and digestibility of SCT. Urea and molasses are added to improve the ruminal fermentation of fresh sugarcane tops (Gendley *et al.*, 2003). Similarly, other studies have also reported an improvement in feed conversion ratio on feeding sugarcane tops after treatment with 5% ammonium sulfate plus 1% molasses or 45% of broiler litter (Deville *et al.*, 1979; Mthiyane *et al.*, 2001). Ensiling facilitates anaerobic fermentation of organic material like lignocellulose and adds fermentation energy.

Nutritive value of SCT silage based TMR diet was as per tabular recommendations (ICAR, 2013) for growing crossbred calves. In current study, no change in DM intake was found in with or without LAB inoculant and exogenous enzyme supplemented groups. These finding has accordance with the study, Pedroso *et al.* (2010) reported no effect of heterofermentative (*L. buchneri*, $3.64x10^5$cfu/g) inoculant treatment on DM intake in Holstein heifers fed sugarcane silage. Similar to previous report (Pedrosso *et al.*, 2006) the CP, NDF, ADF and total digestible nutrient (TDN) intake beside DM, CP and EE digestibility found in this study did not affect on EFE and LAB inoculants additives treatment.

However, previous study (Malik and Bandala, 2010) has reported OM, NDF and ADF digestibility was improved significantly in buffalo calves given dietary treatment of probiotoc and exogenous fibrolytic enzymes supplementation.

Table 4: Nitrogen balance (g/d) and growth performance (g/d) in crossbred calves fed TMR diet contained SCT silage treated with different combinations of EFE and LAB.

Parameter	Treatment			SEM
	TMR B1	TMR B2	TMR B3	
N intake (g/d)	84.1	88.3	88.2	1.65
N voided in feaces (g/d)	30.2	32.0	30.8	0.09
N voided in urine (g/d)	39.24	38.15	41.25	0.22
Total N outgo (g/d)	69.14	68.07	71.01	0.29
Absorbed N (g/d)	53.24	57.22	58.12	0.22
N Balance (g/d)	15.85	14.88	17.25	0.30
N Retention (% N intake)	17.11	18.47	20.03	2.43
N Absorbed (% N intake)	63.00	64.27	66.03	0.78
Initial body weight (kg)	113.83	116.25	116.87	10.52
Final body weight (kg)	149.05	148.89	149.99	15.21
ADG (g)	550	544 ± 19.3	552	10.12
Live weight gain (kg)	35.30	32.64	33.13	2.02

ADG, average daily gain (g).

Table 5: Blood biochemical parameters of crossbred calves fed TMR diet contained SCT silage treated with different combinations of EFE and LAB.

Parameter	TMR B1	TMR B2	TMR B3
Glucose (mg/dL)	53.12±1.38	54.10±1.66	53.45±1.41
Creatinine (mg/dL)	1.23 ± 0.10	1.21 ± 0.06	1.28 ± 0.08
SGOT (U/L)	30.91±1.35	31.07±1.78	30.93±1.49
SGPT (U/L)	14.74 ± 0.79	14.59± 0.80	14.67 ± 0.79
BUN (mg/dL)	14.02 ± 0.39	14.25± 0.50	14.34 ± 0.29
Ca (mg/dL)	9.54±0.30	9.16±0.28	9.77±0.25

SGOT, serum glutamic oxaloacetic transaminase; SGPT, serum glutamic pyruvic transaminase ; BUN blood urea nitrogen.

In the present study total tract digestibility NDF and ADF was improved in treatment groups of EFE and LAB inoculant which is in agreement with the previous study (Reference) (Addah *et al.,* 2012). However same additive combination was failed to reproduce similar results in finishing steers (Addah *et al.* 2014). Similarly, Adesogan *et al.* (2009) reported OMD, DMD and NDF digestibility was higher for grass silage treated with homofermentative LAB inoculants, but not respond for alfalfa silage. These discrepancies in finding might be due to differences in factors like stage and type of forage, the particle size of forage, lactic acid bacteria inoculants or enzyme types, supplementation level, method of application, and the experimental condition and animals (Beauchemin *et al.*, 2003).

Growth performance in present experiment was not affected, other study (Addah *et al.*, 2016) also did not found any improvement in growth performance in feedlot steers supplemented LAB inoculant and exogenous fibrolytic enzyme preparation. In contrast to our findings, Pedroso *et al.* (2006) reported improvement in average daily gain and feed conversion ratio in heifers fed sugarcane silage after treatment with heterofermentative LAB (*L. buchneri*) inoculants. Furthermore, study (Malik and Bandla, 2010) on male buffalo (*Bubalus bubalis*) calves reported that fortification of diet with probiotics and EFE together had more impact on feed efficiency and growth performance which might have variables effects of crops, animals or doses of enzymes and inoculants used.

Blood biochemical parameter

Blood biochemistry of different groups remained unaffected and results had similarities with previous study (Suliman *et al.*, 2016) noted blood biochemical parameters (total protein, creatinine, glucose, albumin and globulin) of goats fed with silage. The results from *in vitro* experiment suggesting additive combination increased propionate production which is a particular precursor glucose. Blood glucose was estimated as maker guided for energy metabolism was found to be similar among three groups, the energy content (ME) of diet or the efficiency of energy utilisation was not affected. The present study is in the line with Bayatkouhsar *et al.* (2011) reported that the plasma glucose level did not show any significant difference between groups fed silage added LAB inoculant additives. A plasma creatinine levels of crossbred calves was residing within the physiological range (1-2 mg/dL) of healthy calves in the Merck veterinary manual (2005). Plasma calcium level was not influenced due to the various treatment of sugarcane tops silage feeding in the present study. Sugarcane top is rich in oxalate content which may form crystalline insoluble calcium salts which reduce their bioavailability through feed in the animal. However, Tadesse *et al.* (2014) observed that fresh sugarcane tops (3.94 gm/kg) rich in oxalate content, which was significantly reduced by 52.28 percent on ensiling with urea treatment (1.88 gm/kg). Ahuja *et al.* (1998) suggested during ensiling oxalate content degraded by anaerobic microbes to carbonate than corban dioxide.

CONCLUSION

It may be concluded that ensiled sugarcane tops have sufficient potential to support the growth performance and can be utilised in a total mixed ration of growing animals. Use of exogenous fibrolytic enzyme and lactic acid bacteria inoculant improved the total tract fibre digestibility, however, intake, growth performance and blood biochemistry of cross bred calves were comparable to control.

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