

# DIETARY EFFECT OF SUGARCANE PRESS MUD ON GROWTH PERFORMANCE, NUTRIENT UTILIZATION, RUMEN FERMENTATION AND BLOOD PROFILE STATUS OF GROWING CROSSBRED CALVES

**M. Palanivel\***<sup>1</sup>

*Department of Animal Nutrition  
Veterinary College and Research Institute  
Tamil Nadu veterinary and Animal Sciences University  
Orathanadu, Thanjavur, Tamil Nadu, India*

## ABSTRACT

*Sugarcane press mud (SPM) is one of the potential agro-industrial by-products available in India and research exploring its utilisation in ruminant nutrition is scanty. In this direction, the present study evaluated the feasibility of dietary incorporation of SPM at graded levels in a feeding trial lasting 180 days to crossbred growing calves. A total of 18 numbers of Jersey crossbred growing calves were randomly distributed into three groups of six each based on comparable body weight ( $90.70 \pm 3.43$  Kg) and age (~5 Months) following a completely randomised design. The three dietary treatments were SP0, concentrate mixture without SPM; SP10, concentrate mixture comprising 10% SPM and SP20, concentrate mixture comprising 20% SPM on air-dry basis. The experimental calves were offered weighed quantity of designated isonitrogenous and isoenergetic concentrate mixture (coarse mash) along with ad libitum Co-FS 29 (chopped to 1-2 cm length) to fulfil nutrient requirements prescribed by Indian Council of Agriculture and a 6 days digestion trial was conducted towards end of the feeding trial. Representative pooled sub-sample of daily collected and acid preserved urine samples were analysed for purine derivatives to assess the microbial N supply to host animals. Blood samples were collected on 0, 60, 120, and 180<sup>th</sup> day of experiment to assess the metabolic status of growing calves. Results revealed no significant ( $P > 0.05$ ) differences in the intake and digestibility of basal nutrients, nitrogen balance, nutritive value of diets, average daily gain as well as feed conversion ratio among the treatment groups. Dietary Cr retained by growing calves was significantly ( $P < 0.05$ ) higher in SP20 as compared to SP0. Urinary purine derivatives concentrations and serum biochemical parameters were did not differ ( $P > 0.05$ ) among the treatments. The cost of formulated concentrate mixture (Rs/day) was reduced ( $P < 0.05$ ) in SP20 (Rs.36.80) followed by SP10 (Rs.39.70) when*

---

\*Email: palanivelvet@yahoo.co.in

<sup>1</sup>Assistant Professor

*compared to SP0 (Rs.42.44). These findings suggested that SPM could be safely fed up to 20% level in the concentrate mixture by substituting expensive traditional feed ingredients without negatively inflicting the performance of growing crossbred calves.*

**Key Words:** Growing Crossbred calves, Growth performance, Nutrient utilization, Sugarcane press mud

Received : 01.02.2022

Revised : 29.04.2022

Accepted : 29.04.2022

## INTRODUCTION

Integration of livestock production system with crop production has got great relevance for optimizing returns from the same land by way of getting additional revenue through the utilization of crop residues or agro-industrial by-products that are locally available with the farmer (Venkata *et al.*, 2018). Within this new scenario, it creates the need for more detailed nutritional information on the use of such waste in ruminant feeds (Barros *et al.*, 2009). The most important agro-industrial by-products of sugarcane farming are sugarcane bagasse, molasses, sugarcane sludge and press mud (Venkata *et al.*, 2018). Among these, sugarcane press mud (SPM) is a soft, spongy and amorphous dark brown material (Bhosale *et al.*, 2012), which is available to the tune of 8-10 million tons annually in India and constitutes about 3% of cane crushing (Solomon, 2011). In addition, Sahu *et al.* (2016) reported that SPM on DM basis contained relatively more CP (18.01±0.57%), Ca (5.90±0.27%), Linoleic acid (34.84% of the EE fraction) and low CF (12.38±0.33%) and ash (17.73±0.36%) content than the earlier reports.

The SPM has been efficiently utilized as dietary ingredient fed to ruminants (Gupta

and Ahuja, 1998; Mohamed and El-Saidy, 2003; Suresh *et al.*, 2006), swine (Sahu *et al.*, 2014) and poultry (Suma *et al.*, 2007; Suresh and Reddy, 2011), and as an ensiling agent (Tran, 2015). However, many feeding trials have not assessed the potential feeding value of SPM to young growing calves. The present experiment was designed to incorporate SPM as a component of concentrate mixture in graded levels to study its effects of nutrient intake and utilization, rumen microbial activity, growth performance, blood biochemical profile and economic feasibility in growing crossbred calves.

## MATERIALS AND METHODS

Eighteen Jersey crossbred growing male calves of comparable body weight (90.70±3.43Kg) and age (~5 months) were randomly distributed into three dietary treatment groups of six animals each. Animals were individually fed with three experimental diets: SP0, concentrate mixture without SPM; SP10, concentrate mixture containing 10% SPM and SP20, concentrate mixture containing 20% SPM, respectively (Table 1).

The SPM was purchased from local sugar factories, sun-dried and incorporated in the experimental diets. All the animal trial

**Table 1. Ingredients and composition (%) of concentrate mixture containing graded levels of SPM fed to growing crossbred calves**

Ingredient	Treatment		
	SP0	SP10	SP20
Maize	42	42	42
Soybean Meal (46.72% CP)	24	24	24
De-oiled Rice Bran	31	21	11
Sugarcane Press mud	-	10	20
Mineral Mixture	2	2	2
Salt	1	1	1
<b>Nutrient composition</b>			
Organic Matter	93.33	91.54	91.08
Crude Protein	21.16	21.18	21.26
Ether Extract	2.81	2.91	2.96
Crude Fibre	5.28	5.48	5.51
Nitrogen Free Extract	61.48	61.83	61.46
Total Carbohydrate	69.32	67.48	66.80
Total Ash	6.67	8.46	8.92
Neutral Detergent Fibre	22.57	26.77	28.54
Acid Detergent Fibre	9.05	9.63	9.70
Hemi-Cellulose	13.52	17.14	18.84
Cellulose	7.10	7.57	7.66
Calcium	1.03	1.19	1.61
Phosphorus	1.01	1.04	1.09
Sulphur	0.16	0.18	0.22
Iron (ppm)	102.78	245.50	470.35
Copper (ppm)	9.85	10.72	11.65
Zinc (ppm)	42.65	42.83	43.02

related procedures done were duly approved by the Institutional Animal Ethics Committee (1859/PO/Re/16/CPCSEA). The calves were housed in a well ventilated experimental animal shed with facilities for individual feeding and watering. All the calves were dewormed with 2.5% Fenbendazole oral suspension (5 mg/kg BW) before commencing experimental feeding and proper sanitation was maintained throughout the experimental period of 180

days. Calves were fed with weighed quantity of concentrate mixture and ad libitum chopped Co-FS 29 fodder (1-2 cm length) daily to fulfil their nutrient requirements as per ICAR (2013) feeding standards. Calves were weighed individually at fortnight intervals before feeding and watering in the morning after overnight fast, and DM intake was adjusted according to growth rate of calves.

A digestion trial of 6 days duration was conducted with 18 calves (6 calves per treatment group) towards the end of growth trial in metabolism cages. Initial 3 days were allowed for adaptation of calves to metabolism cages followed by subsequent 6 days of collection period. Total DM offered, residue left, and total voidance of faeces and urine were recorded for preceding 24 h. An aliquot of 1/100<sup>th</sup> of the fresh faeces excreted by each calf was collected in a weighed glass bottle containing 15 ml of 25% (v/v) sulphuric acid during the collection period for determination of faecal N. Daily urine excreted by each calf was sampled at 1/20<sup>th</sup> level in plastic bottles containing 50% (v/v) sulphuric acid, and pooled for 6 days for determination of urinary N excretion. DM content of experimental feeds and residues were analysed by oven drying at 100°C for 24 h and daily DM intake was ascertained from them. Apparent digestibility of nutrient was worked out based on the difference in the dietary intake and faecal excretion of that nutrient. The TD N content was calculated as per modified Morrison (1961). The feeds, residues and faeces samples were dried for 48 h at 65±5°C, homogenised, ground to pass through 1.0 mm sieve and placed in airtight plastic bags until further analysis. The samples were analysed for EE, total ash, CP and CF as per AOAC (2005). Mixed samples of faeces (5 g) and urine (5 ml) were analysed for their N content using Kjeldahl apparatus (Pelican, India).

Fibre fractions including NDF and ADF were analysed as per Van Soest et al. (1991) without  $\alpha$ -amylase and sodium sulphite, and expressed on ash-free basis. While hemicellulose content was calculated

as difference between NDF and ADF, total carbohydrate (CHO) content was calculated by subtracting total ash, CP and EE from 100 (Sharma et al., 2014). The NFE was calculated by subtracting CF from CHO. The estimation of Ca and P (Talapatra et al., 1940) as well as Sulphur (AOAC, 2005) was carried out. The micro minerals including Fe, Zn and Cu were determined by Atomic Absorption Spectroscopy (Model 4141, ECIL, Hyderabad, India).

About 4 ml of blood sample was collected in a sterile container from the jugular vein of all animals at 0, 60, 120, and 180<sup>th</sup> day of experiment at 07.00 h of morning before feeding and watering, and analysed for haematological (Hb and PCV) and biochemical parameters. Collected blood samples were transferred to heparinized centrifuge tubes and separated serum was stored at -20°C till the estimation of different biochemical parameters. Glucose estimation was done immediately after harvesting serum by enzymatic GOD-POD method with Span Diagnostic Kit (Sacks, 1999). Total protein and albumin were estimated by Biuret method (Gornall *et al.*, 1949). The albumin content was deducted from Total protein to calculate globulin, and albumin-globulin ratio was calculated by dividing globulin from albumin content. Serum creatinine and serum urea concentrations were estimated as per procedures described by Roscoe (1953), and Kumar and Gill (2018), respectively. Aspartate Amino Transferase (AST) and Alanine Amino Transferase (ALT) activities were analysed as per method of Reitman and Frankel (1957), and Alkaline Phosphatase (ALP) activity was analysed as per method of Bowers and McComb (1975). Serum

cholesterol concentration was estimated using diagnostic kit with enzymatic method (Tietz, 1998).

The daily urine was collected from individual animals into clean plastic containers containing approximately 500 ml of 10% sulphuric acid to ensure that the final pH level remains below 3.0 to avoid precipitation of uric acid. A representative urine sample was taken as sub-sample and was mixed thoroughly and 20 ml aliquot was taken in two plastic vials and stored at -20°C for further analysis. Urine samples were thawed and distilled water was added to dilute urine in such a way that concentration of PD in the final sample would fall within the range of standards (5 to 50 mg/L) used in the assays for both uric acid and allantoin. Purine derivatives and creatinine content in urine samples were analyzed using Shimadzu HPLC system equipped with a UV detector using C18 reversed phase column following the method of Resines *et al.* (1992). Purine derivatives: creatinine (PDC) index was calculated as PDC index = [PD]/[Creatinine]×W<sup>0.75</sup>. The calculation of daily purines absorption (X, mmol/day) was done by using equation as X = (Y- Endogenous contribution xW<sup>0.75</sup>)/0.74, Where, Y represents daily urinary PD (mmol/day) excretion. Intestinal flow of microbialN (g N/day) from the microbial purines absorbed (X, mmol/day) was calculated as described by Chen and Gomes (1992).

$$\text{Microbial N (g/day)} = 70X \\ (0.116 \times 0.83 \times 1,000) = 0.727X$$

Where,

i) Digestibility of microbial purines is assumed to be 0.83.

ii) The N content of purines is 70 mg N/mmol.

iii) The ratio of purine N:total N in mixed rumenmicrobes is taken as 11.6:100.

The collected data in this experiment was expressed as Mean ± SE for all parameters and, analysed by one-way analysis of variance using Statistical Analysis System (SAS, 2012) and expressed at 5% level of probability (P<0.05).

## RESULTS AND DISCUSSION

### Growth performance and nutrient utilization

The total DM intake as well as total weight gain of growing crossbred calves were comparable (P>0.05) among the treatments (Table 2). Body weight changes of calves fed diets containing different levels of SPM was comparable among the treatment. Similarly, Muzaffarnagari lambs were shown comparable DM intake and growth performance while those fed with 10% or 20% SPM based diet (Kumar *et al.*, 2017). Digestibility of basal nutrients, fibre fractions and nutritive value of diets did not differ (P>0.05) irrespective of the dietary treatments. Similarly, dietary N balance was comparable (P>0.05) among the treatments (Table 3).

In earlier studies, lambs fed 3% SPM based concentrate mixture (Suresh *et al.*, 2006) and calves fed 20% SPM based concentrate mixture (Malapure *et al.*, 2015) had shown comparable nutrient utilization among the diets. As nutritive value is dictated by intake and digestibility, it is obvious that three diets contained similar nutritive value expressed as

**Table 2. Growth performance and feed conversion efficiency of growing crossbred calves fed graded levels of SPM based diet**

Attributes	Treatment(Mean ± SE)		
	SP0	SP10	SP20
Initial body weight (Kg)	90.93±3.41	90.73±3.38	90.80±3.40
Final body weight (Kg)	175.27±4.04	172.80±4.11	168.23±3.98
Total weight gain (Kg)	84.33±1.78	82.07±2.13	77.43±1.82
Average daily gain (g)	468.52±9.88	455.93±8.73	430.19±8.88
Total DM intake (Kg)	641.16±14.30	640.17±13.18	637.28±14.12
FCR	7.62±0.22	7.80±0.26	8.34±0.28

**Table 3. Nutrient intake and its digestibility (%) of growing crossbred calves fed graded levels of SPM based diet**

Attributes	Treatment(Mean ± SE)		
	SP0	SP10	SP20
Dry Matter	60.61±0.36	60.34±0.32	60.58±0.29
Organic Matter	62.93±0.33	62.47±0.36	62.83±0.39
Crude Protein	67.86±0.31	67.97±0.28	67.31±0.34
Ether Extract	57.36±0.62	57.10±0.66	56.84±0.58
Total Carbohydrate	62.42±0.68	61.88±0.86	62.39±0.81
Neutral Detergent Fibre	57.65±0.46	57.07±0.44	56.91±0.49
Acid Detergent Fibre	53.76±0.58	53.29±0.56	53.09±0.51
Hemi-cellulose	64.24±0.59	63.07±0.61	62.81±0.52
Cellulose	58.58±0.52	58.47±0.59	58.25±0.56
<b>Nitrogen Balance</b>			
Nitrogen Intake (g/day)	74.89±0.52	74.82±0.58	74.32±0.56
Nitrogen Intake (g/kgW <sup>0.75</sup> )	1.63±0.01	1.65±0.02	1.66±0.01
Faecal N (g/day)	24.06±0.33	23.98±0.30	24.30±0.38
N Absorption (g/day)	50.83±0.44	50.85±0.42	50.03±0.48
Urinary N (g/day)	29.64±0.52	29.68±0.57	30.69±0.56
N retention (g/day)	21.19±0.68	21.17±0.61	19.34±0.69
N retention (g/kgW <sup>0.75</sup> )	0.46±0.03	0.46±0.02	0.43±0.03
N retention (% intake)	28.33±0.88	28.28±0.82	26.02±0.91
N retention (% absorption)	41.62±1.18	41.60±1.21	38.65±1.13
<b>Nutritive value of diet (%)</b>			
DCP	6.98±0.07	7.04±0.08	6.98±0.08
TDN	60.38±0.35	59.45±0.28	59.68±0.31

DCP and TDN. Comparable pattern of DM intake and nutrient digestibility observed in the present study deduces that SPM holds potential as feed for growing calves without affecting palatability and digestion.

Calves fed SP20 diet had shown significantly ( $P < 0.05$ ) higher Ca retention as compared to those fed SP0 diet (Table 4). The intake and absorption of Ca (g/day) was higher ( $P < 0.05$ ) in SPM fed groups as compared to Control, and more Ca retained (g/day or g/KgW<sup>0.75</sup>) by calves fed SP10 and SP20 diets as compared to those fed SP0 diet (Table 3). This deduces that Ca from SPM inclusive diets is well utilised by the growing calves. SPM as a source of utilisable Ca has already been reported in commercial layers tested for a period of 84 days without affecting retention and serum mineral status (Suresh *et al.*, 2010). Similarly, growing pigs fed diets containing graded levels of SPM had shown higher Ca retention on feeding 15% SPM based diet (Sahu *et al.*, 2021). In India, a filter press sugarcane cake containing more than 30% Ca (which is a highly unusual value) was proposed as a potential Ca source for livestock (Lalland Prasad, 1989). Overall, the absorption coefficient for Ca by calves fed SPM based diet is in accordance with the earlier study of Mahto *et al.* (2007).

### **Rumen Fermentation Status**

Urinary PD excretion was used to estimate the rumen microbial N supply in this experiments designed for examining the dietary effects on the efficiency of microbial N supply to the host animal (Table 5). Microbial N supply to the host animal varies with dietary DM intake as reported in sheep (Chen

*et al.*, 1992). In our study, as dietary DM intake of growing calves is comparable among the treatments, microbial N supply to growing calves is also similar among the treatments. Duodenal purine bases, as a microbial marker, are efficiently absorbed in the small intestine and the majority of their metabolites are excreted via the kidney with urinary recovery (Belenguer *et al.*, 2002). In our study, allantoic acid was the major PD, accounting for 78-85% of total PD. The value is consistent to the finding by Chen *et al.*, (1992) who fed sheep with a mixed hay and barley diet. Hypoxanthine and Xanthine can be converted to uric acid and further to allantoin by enzymes in ruminants, which may be the reason for allantoin being predominantly present in urine.

Creatinine is a metabolic product of creatine and phosphocreatine, both being found almost exclusively in muscle (Van Niekerk *et al.*, 1963). Thus, creatinine production and urinary excretion are proportional to muscle mass and vary little from day to day in response to changing feed or nutrient supply. If daily creatinine excretion is predictable, then the creatinine:PD ratio in 'spot' samples of urine can be used to predict daily PD excretion which in turn can be used to predict the daily outflow of purines and microbial protein from the fore stomachs.

### **Blood Biochemical Profile**

Inclusion of SPM at 10 and 20% levels did not have any effect on haematological and biochemical parameters among the treatments (Table 6). Blood metabolites are frequently used to monitor the metabolic health status of animals and the values of different blood biochemical parameters in present study were

**Table 4. Dietary Calcium and Phosphorus balance in growing crossbred calves fed graded levels of SPM based diet**

Attributes	Treatment (Mean $\pm$ SE)		
	SP0	SP10	SP20
Calcium balance			
Ca Intake (g/day)	35.10 $\pm$ 1.19 <sup>c</sup>	37.86 $\pm$ 1.61 <sup>b</sup>	45.05 $\pm$ 1.38 <sup>a</sup>
Ca Intake (g/kgW <sup>0.75</sup> )	0.76 $\pm$ 0.03 <sup>c</sup>	0.83 $\pm$ 0.02 <sup>b</sup>	1.01 $\pm$ 0.08 <sup>a</sup>
Faecal Ca (g/day)	16.49 $\pm$ 0.93 <sup>c</sup>	18.28 $\pm$ 1.06 <sup>b</sup>	24.49 $\pm$ 1.18 <sup>a</sup>
Ca Absorption (g/day)	18.62 $\pm$ 0.23 <sup>c</sup>	19.58 $\pm$ 0.38 <sup>b</sup>	20.55 $\pm$ 0.42 <sup>a</sup>
Urinary Ca (g/day)	0.97 $\pm$ 0.02 <sup>b</sup>	1.03 $\pm$ 0.04 <sup>ab</sup>	1.08 $\pm$ 0.03 <sup>a</sup>
Ca retention (g/day)	17.65 $\pm$ 0.33 <sup>b</sup>	18.55 $\pm$ 0.64 <sup>ab</sup>	19.47 $\pm$ 0.61 <sup>a</sup>
Ca retention (g/kgW <sup>0.75</sup> )	0.38 $\pm$ 0.01 <sup>b</sup>	0.41 $\pm$ 0.03 <sup>ab</sup>	0.43 $\pm$ 0.06 <sup>a</sup>
Ca retention (% intake)	50.25 $\pm$ 1.04 <sup>a</sup>	48.95 $\pm$ 1.11 <sup>a</sup>	43.07 $\pm$ 1.27 <sup>b</sup>
Ca retention (% absorption)	94.78 $\pm$ 0.11	94.73 $\pm$ 0.12	94.68 $\pm$ 0.11
Phosphorus balance			
P Intake (g/day)	22.14 $\pm$ 0.30	22.70 $\pm$ 0.29	23.31 $\pm$ 0.31
P Intake (g/kgW <sup>0.75</sup> )	0.48 $\pm$ 0.01	0.50 $\pm$ 0.01	0.52 $\pm$ 0.01
Faecal P (g/day)	10.48 $\pm$ 0.21	10.96 $\pm$ 0.23	11.49 $\pm$ 0.18
P Absorption (g/day)	11.66 $\pm$ 0.10	11.74 $\pm$ 0.11	11.82 $\pm$ 0.09
Urinary P (g/day)	2.11 $\pm$ 0.09	2.21 $\pm$ 0.10	2.32 $\pm$ 0.11
P retention (g/day)	9.55 $\pm$ 0.15	9.53 $\pm$ 0.18	9.50 $\pm$ 0.12
P retention (g/kgW <sup>0.75</sup> )	0.21 $\pm$ 0.003	0.21 $\pm$ 0.004	0.21 $\pm$ 0.003
P retention (% intake)	43.13 $\pm$ 0.55	41.97 $\pm$ 0.61	40.71 $\pm$ 0.58
P retention (% absorption)	81.93 $\pm$ 0.95	81.16 $\pm$ 0.89	80.30 $\pm$ 0.91

<sup>abc</sup>Mean values showing common superscripts in a row did not differ significantly (P>0.05)

**Table 5. Urinary excretion of purine derivatives and microbial N supply to growing crossbred calves fed graded levels of SPM based diet**

Attributes	Treatment (Mean $\pm$ SE)		
	SP0	SP10	SP20
PD (mmol/day)	25.20 $\pm$ 0.47	24.94 $\pm$ 0.52	24.76 $\pm$ 0.39
Allantoin (mmol/day)	20.75 $\pm$ 0.32	20.60 $\pm$ 0.38	20.61 $\pm$ 0.31
Uric acid (mmol/day)	4.45 $\pm$ 0.17	4.33 $\pm$ 0.16	4.14 $\pm$ 0.20
Creatinine (mmol/day)	31.43 $\pm$ 1.07	31.11 $\pm$ 1.03	30.95 $\pm$ 0.98
PDC Index	37.14 $\pm$ 1.27	37.11 $\pm$ 1.23	36.34 $\pm$ 1.81
PD absorption (mmol/day)	13.83 $\pm$ 0.65	13.82 $\pm$ 0.68	13.89 $\pm$ 0.56
Microbial N (g/day)	10.06 $\pm$ 0.51	10.05 $\pm$ 0.48	10.09 $\pm$ 0.55

**Table 6. Haematological and blood biochemical profile of growing crossbred calves fed graded levels of SPM based diet**

Attributes	Treatment (Mean $\pm$ SE)		
	SP0	SP10	SP20
Haemoglobin (g/dl)	10.86 $\pm$ 0.31	11.49 $\pm$ 0.43	11.03 $\pm$ 0.38
PCV (%)	29.30 $\pm$ 0.75	29.90 $\pm$ 0.34	29.83 $\pm$ 0.61
Glucose (mg/dl)	67.50 $\pm$ 0.43	68.66 $\pm$ 0.38	67.86 $\pm$ 0.82
Total Protein (g/dl)	7.19 $\pm$ 0.17	7.28 $\pm$ 0.16	7.10 $\pm$ 0.14
Albumin (g/dl)	3.17 $\pm$ 0.26	3.14 $\pm$ 0.22	3.11 $\pm$ 0.20
Globulin (g/dl)	4.03 $\pm$ 0.42	4.13 $\pm$ 0.29	3.99 $\pm$ 0.47
A:G ratio	0.79 $\pm$ 0.51	0.77 $\pm$ 0.55	0.79 $\pm$ 0.56
Urea (mg/dl)	40.24 $\pm$ 0.99	40.30 $\pm$ 0.92	40.33 $\pm$ 0.89
Creatinine (mg/dl)	1.17 $\pm$ 0.88	1.15 $\pm$ 0.68	1.16 $\pm$ 0.73
Cholesterol (mg/dl)	83.28 $\pm$ 0.96	83.76 $\pm$ 0.68	83.02 $\pm$ 0.69
AST (IU/L)	87.74 $\pm$ 0.96	88.19 $\pm$ 0.59	88.85 $\pm$ 0.59
ALT (IU/L)	25.08 $\pm$ 0.99	25.04 $\pm$ 0.89	25.16 $\pm$ 0.81
ALP (IU/L)	126.30 $\pm$ 0.87	124.67 $\pm$ 0.78	126.81 $\pm$ 0.83

within normal range reported for growing calves (Kaneko *et al.*, 1997). The findings of present study indicated that feeding the diets containing upto 20% SPM did not show adverse effect on blood haematology, liver and kidney function and metabolism of nutrients.

Such results confirm the results of the study of Moeini *et al.* (2014), who observed that dietary inclusion of sugarcane industrial by-product, molasses distillers soluble in the diet of lambs had no significant effect on blood metabolites including glucose, cholesterol, triglycerides, urea, creatinine and albumin concentrations as well as on serum concentrations of minerals including sodium, potassium, calcium and phosphorus. Also in the study of Kumar *et al.* (2015), feeding sugarcane press mud at the level of 10% or 20% of concentrate had no significant ( $P>0.05$ ) effect on chemical composition of *Longissimus dorsi* muscle of lambs.

Furthermore, economically feed cost of concentrate mixture (Rs/day) formulated with graded level of inclusion of SPM was significantly ( $P<0.05$ ) reduced in SP20 (Rs.36.80) followed by SP10 (Rs.39.70) as compared to SP0 (Rs.42.44).

### CONCLUSION

Upto 20% SPM could be included in the diet of growing Jersey crossbred calves without any adverse effects on nutrients intake, nutrients utilization, rumen microbial N supply and blood biochemical profile to them.

### REFERENCES

AOAC, (2005). Official Methods of Analysis, Association of Official Analytical Chemists, 18<sup>th</sup>edn. AOAC International, Gaithersburg, USA.

Barros, R.C., Rocha Junior, V. R. and Silva, F.V. (2009). Sugarcane or sugarcane bagasse ammoniated with urea replacing for sorghum silage for beef cattle in feedlot. *Revista Brasileira de Saude e Producao Animal*, **10**:278-292.

Belenguer, A., Yanez, D., Balcells, J., Baber, N.H.O. and Gonzales Ronquillo, M. (2002). Urinary excretion of purine derivatives and prediction of rumen microbial outflow in goats. *Livestock Production Science*, **77**:127-135.

Bhosale, P.R., Chonde, S.G., Nakade, D.B. and Raut, P.D. (2012). Studies on physico-chemical characteristics of waxed and dewaxed pressmud and its effect on water holding capacity of soil. *Journal of Biological Sciences*, **1**:35-41.

Bowers, G.N and McComb, R.B. (1975). Measurement of total Alkaline Phosphatase activity in human serum. *Clinical Chemistry*, **21**:1988-1995.

Chen, X.B. and Gomes, M. J. (1992). Estimation of microbial protein supply to sheep and cattle based on urinary excretion of purine derivatives. International Feed Resources Unit. Rowett Research Institute, Bucksburn, Aberdeen AB2 9SB, UK.

Chen, X.B., Chen, Y.K., Franklin, M.F., Orskov, E.R. and Shand, W.J. (1992). The effect of feed intake and body weight on purine derivative excretion and microbial protein

- supply in sheep. *Journal of Animal Science*, **70**: 1534-1542.
- Gornall, A.G., Bardawill, C.J. and David, M. M. (1949). Determination of serum proteins by means of the biuret reaction. *Journal of Biological Chemistry*, **177**:751-766.
- Gupta, N.S. and Ahuja, A.K. (1998).Use of sugarcane press mud as cattle feed. *Feed Trends*,**15**:6.
- ICAR, (2013).Nutrient Requirements of Cattle and Buffalo. Indian Council of Agricultural Research, Krishi Anusandhan Bhawan, Pusa, New Delhi, India.
- Kaneko, J.J., Harvey, J.W. and Bruss, M.L. (1997). Clinical Biochemistry of Domestic Animals, 5<sup>th</sup>edn. Academic Press, San Diego, California, USA.
- Kumar, R., Saha, S.K., Dinesh Kumar., Mahesh, M.S. and Malapure, C.D. (2017). Effect of dietary utilisation of sugarcane press mud on production performance of Muzaffarnagari lambs.*Tropical Animal Health and Production*, **49**:1439-1446.
- Kumar, V. and Gill K.D. (2018). Estimation of urea in serum and Urine. *Basic concepts in Clinical Biochemistry*, 67-70.
- Kumar.R., Saha, S.K. and Mendiratta, S.K. (2015). Effect of feeding sugarcane press mud on carcass traits and meat quality characteristics of lambs. *Veterinary World*. **8**: 793-797.
- Lall, D. and Prasad, T. (1989). Compositional quality of certain unconventional calcium and phosphorus sources in India for use as mineral supplements for livestock. *Animal Feed Science and Technology*,**23**: 343-348.
- Mahto, B., Prasad, N., Singh, S.K., Mahto, D., Kumar, S. and Kumar, U. (2007). Effect of tamarind seed on nutrient utilization in pigs.*Indian Journal of Animal Nutrition*,**24**: 147-149.
- Malapure, C.D., Saha, S.K. and Patel, B.H.M. (2015).Effect of feeding sugarcane press mud on body weight changes and average daily gain of crossbred calves in pre-ruminant stages. In: *Proceedings of 9th Biennial Animal Nutrition Association Conference*, 22<sup>nd</sup> - 24<sup>th</sup> January, Guwahati, India, p. 34.
- Moeini, M.M., Veyskarami, S. and Hozhabri, F. (2014). Effect of molasses distillers condensed soluble on nutrients digestibility, performance and some blood biological parameters in lambs. *Annual Research and Review in Biology*,**4**: 443-450.
- Mohamed, A.H. and El-Saidy, B.E. (2003). Effect of including filter cake blocks in lactating goats rations on digestibility and productive performance. *Egyptian Journal of Nutrition Feeds*,**6**: 59-67.
- Morrison, F.B. (1961). Feeds and Feeding, Abridged. 9<sup>th</sup>edn.Morrison Publ. Co., Clinton, IA, USA.

- Reitman, S. and Frankel, S. (1957). Calorimetric method for the determination of serum Glutamic-Oxaloacetic and Glutamic-Pyruvate Transaminase. *Analytical Journal of Clinical Pathology*, **28**:56.
- Resines J.A., Arin, M.J. and Diez, M.T. (1992). Determination of creatinine and purine derivatives in ruminant's urine by reversed-phase high-performance liquid chromatography. *Journal of Analytical Chromatography*, **607**: 199-202.
- Roscoe, M.H. (1953). The Estimation of Creatinine in Serum. *Journal of Clinical Pathology*, **6**:201.
- Sacks, D.B. (1999). Carbohydrate. Tietz Textbook of Clinical Chemistry, 3<sup>rd</sup>edn, pp. 750-804. (Eds) Burtis C.A. and Ashwood E.R.W.B. Saunders Company, Philadelphia.
- Sahu, S., Patel, B.H.M., Archana Sarangi., Dinesh Kumar., Mahesh, M.S., Deepak Upadhyay and Triveni Dutt. (2021). Sun-Dried Sugarcane Press Mud Could be a Prospective Feedstuff for Swine Production. *Sugar Technology*, **23**:10-14.
- Sahu, S., Patel, B.H.M., Dutta, T. and Verma, A.K., (2014). Effect of graded levels of sugarcane press mud in ration on carcass characteristics of crossbred (Landrace × Desi) pigs. *Indian Journal of Animal Sciences*, **84**: 1109-1112.
- Sahu, S., Patel, B.H.M., Malapure, C.D., Singh, A.M., Verma, A.K., Singh, G. and Bhusain, B. (2016). Screening of sugarcane press mud as a potential alternative feed for livestock. *Indian Journal of Animal Research*, **50**: 207-210.
- SAS, 2012. Statistical Analytical System, User's Guide, Statistical Version 9.1<sup>th</sup>edn. SAS. Inst.Inc.Cary. N.C. USA.
- Sharma, V.C., Mahesh, M.S., Mohini, M., Datt, C. and Nampoothiri, V.M. (2014). Nutrient utilisation and methane emissions in Sahiwal calves differing in residual feed intake. *Archives of Animal Nutrition*, **68**: 345-357.
- Solomon, S. (2011). Sugarcane by-products based industries in India. *Sugar Technology*, **13**: 408-416.
- Suma, N., Reddy, B.S.V., Gloridoss, R.G., Rao, R., Singh, K.C., Rekha, M.T. and Gomes, A.R. (2007). Egg quality traits of layers influenced by supplementation of different levels of sugarcane press residue. *International Journal of Poultry Science*, **6**: 102-106.
- Suresh B.N., Reddy B.S.V., Bolka P.C. and Umashankar B.C. (2010). Effect of sugarcane press residue on calcium and phosphorus status of layers. *Indian Journal of Poultry Science*, **45**:364-367.
- Suresh, B.N. and Reddy, B.S.V. (2011). Dried sugarcane press residue as a potential feed ingredient source of nutrients for poultry. *Asian-Australasian Journal of Animal Sciences*, **24**:1595-1600.

- Suresh, B.N., Reddy, B.S.V., Prabhu, T.M., Gloridoss, R.G. and Jagadish, B. (2006). Nutritional evaluation of sugarcane press mud in lambs. *Indian Journal of Animal Nutrition*, **23**: 47-49.
- Talapatra, S.K., Roy, S.C. and Sen, K.C. (1940). The analysis of mineral constituents in biological materials. Estimation of phosphorus, chlorine, calcium, manganese, sodium and potassium in foodstuffs. *Indian Journal Veterinary Science and Animal Husbandry*, **10**: 243.
- Tietz, N.W. (1998). Fundamentals of Clinical Biochemistry. 3<sup>rd</sup>edn. W. B. Saunders Company, U.S.A. p.179-183.
- Tran, G. (2015). Sugarcane press mud. *Feedipedia*. Programme by INRA, CIRAD, AFZ and FAO. <http://www.feedipedia.org/node/563>.
- Van Niekerk, B.D.H., Bensadoun, A., Paladines, O.L. and Reid, J.T. (1963). A Study of Some of the Conditions Affecting the Rate of Excretion and Stability of Creatinine in Sheep Urine. *The Journal of Nutrition*, **79**: 373-380.
- Van Soest, P. J., Robertson, J. B. and Lewis, B. A. (1991). Methods for dietary fiber, neutral detergent fiber and non-starch polysaccharides in relation to animal nutrition. Symposium on carbohydrate methodology, metabolism and nutritional implications in dairy cattle. *Journal of Dairy Science*, **74**: 3563-3597.
- Venkata, S.B., Pakala, R., Prasanna Kumar, M., Sahitya Rani and Raghava Rao, E. (2018). Utilization of Sugarcane By-Products as Complete Rations for Milk Production in Buffaloes. *International Journal of Current Microbiological Applied Science*, **7**: 3111-3117.