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Influence of feeding urea ammoniated sugarcane bagasse pith on growth performance and nutrient utilization in crossbred bulls

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ABSTRACT

Adult 12 crossbred bulls of about 17–18 months of age and 242.0 ± 5.25 kg mean body wt. were randomly divided into 2 groups of 6 each following RBD. In group 1 animals were fed a complete ration consisting of 50% wheat straw and 50% concentrate feed were formulated. In group 2 wheat straw was completely replaced by urea ammoniated sugarcane bagasse pith. Both complete feeds were iso-nitrogenous. Experimental feeding was continued for 120 days including a 6-day metabolic trial. Dry matter (DM) and organic matter (OM) intake was similar in both groups, while digestibility of DM and OM was significantly higher in group 1 as compared to group 2. Intake of crude protein was also similar in groups 1 and 2. Total nitrogen intake and balances was similar in groups 1 and 2. Ca intake (g/day) was higher in group 1 as compared to group 2, balance of Ca was found positive and significantly similar in group 1 and 2, respectively. Intake of DCP and TDN was comparable in groups 1 and 2, respectively. Total dry matter intake (kg) during the entire experimental period of 120 days showed significantly different between 2 groups. Average daily gain (g) was significantly higher in group 1 as compared to group 2. It is concluded that wheat straw can be replaced by urea ammoniated sugarcane bagasse pith in the complete diet of crossbred bulls as source of dry roughage.

Key words: Bagasse pith, Crossbred bull, Growth performance, Nutrient utilization

Shortage of feeds and fodders for the feeding of animals in India is well known. With the production of about 491 million tonnes of green roughages as against an estimated requirement of nearly 648 million tonnes, there is more than 27% deficit in green roughage. Also, there is a 35% and 28% shortfall in availability of concentrates and dry roughages, respectively in the country (GOI 2007). This gap can be largely filled by using unutilized and under-utilized agro-industrial by-products, agro-forestry by-products, crop residues etc. The major crops produced in our country are wheat, rice and sugarcane. At present crop residues of wheat and rice are extensively used as source of roughage in livestock feeding. The next most important crop in our country is the sugarcane and India is the second largest sugarcane producing country in the world with an annual production of 340 million tonnes (SBI 2012) in crushing year 2011–12. Sugarcane and its by-products are of special importance for tropical countries, particularly those faring a shortage of cereals and other green fodders. Even whole sugarcane feeding of livestock has been tried in many countries. Sugarcane crop residues are also available in large quantities. The main crop residues available from sugarcane farming/industry are sugarcane tops, trash, bagasse, bagasse pith, molasses and press mud. Thus sugarcane plays a special role in the 3 F Chains - food, fodder and fuel. Most of the bagasse is being diverted to the paper and particle board industries, where long fibers are separated and used as their raw material leaving a large amount of the small fiber residue called pith. On an average, it is about 30% of the bagasse. Pith is made up of the soft, thin walled, irregularly shaped parenchymatous cells of the inner stalk tissue. This product (pith) is available in large quantities as a by-product of the paper mills. A part of pith is again used as fuel by the paper mills. Still, a large portion of it remains unutilized and goes waste. This product, bagasse pith, too has a big potential to be used as animal feed. Therefore, present study was conducted to assess the performance of crossbred bulls fed on complete rations containing 50% of either wheat straw or urea ammoniated bagasse pith.

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MATERIALS AND METHODS

Healthy male crossbred bulls (12) of about 17–18 months of age and 242.0±5.25kg mean body weights were divided into 2 equal groups following randomized block design (RBD). All the animals were housed in a well-ventilated cement floored shed having individual feeding arrangements and maintained under standard managemental and hygienic conditions. All the animals were vaccinated against common epidemic diseases and dewormed before the start of the experiment and subsequently at regular intervals. Sugarcane bagasse pith, obtained from a paper mill, was sun dried to reduce the moisture from about 50 to 11–12% and stored for further use. Bagasse pith was urea ammoniated with 4% fertilizer grade urea at 40% moisture level and incubated under airtight condition using a good quality polythene cover for 21 days. Before feeding to the animals required amount of ammoniated bagasse pith was aerated every day spread on the floor for at least 24 h to facilitate the escape of free ammonia. Two isonitrogenous (NRC 1989) complete feeds containing 50% roughage and 50% concentrate feed ingredients were formulated. The detailed physical and chemical composition of these complete feeds are presented in Table 1. These complete feeds were prepared in mash form and randomly allotted to the 2 groups. Animals were offered their respective diets *ad lib.* after mixing with minimum amount of water daily to keep the feed uniformly mixed. About 1 kg green fodder/head/day was offered to fulfill vitamin A requirements throughout the experimental period, except during metabolic trial.

The experimental feeding was continued for 120 days including a 6 days metabolic trial. In order to find out the daily feed intake, amount of complete feed offered and residues left by each animal were recorded daily and sampled for the estimation of DM. To study the growth pattern, average daily gain and feed conversion efficiency (FCE) in different groups, all the animals were weighed fortnightly for 2 consecutive days in the morning, before offering any feed and water, throughout the experimental period.

One metabolism trial of 6 days duration (excluding 2–3 days of adaptation period) was conducted after 3 months of feeding. The representative samples of the feeds offered (2 complete feeds) and residue left during metabolism trial were daily brought to the laboratory for the determination of DM and dried samples were pooled for further analysis. Representative sample of the faeces and urine from each animal was collected daily after thorough mixing. Suitable aliquots were taken for further analysis.

Proximate principles were analyzed as per AOAC (2005). The fibre fractions were determined as per Van Soest *et al.* (1991).The data were analyzed statistically as per Snedecor and Cochran (1968).

RESULTS AND DISCUSSION

Chemical composition of feeds: Chemical composition of the 2 complete feeds used in the present study is presented in Table 1. Contents of OM, CP, TA, EE, ADF and cellulose were almost similar in 2 complete feeds, however, decline in cell wall fractions, viz. NDF, ADF, HC and cellulose in complete feed 2 was probably due to the urea ammonization of bagasse pith which was the roughage source in diet 2. The CP content was really increased by urea treatment because urea is a good source of nitrogen. These results are in accordance with those obtained by Mohamed (1998). Alkali treatment also increased CP than that of the control, because treatment increased DM content (El-Sayed *et al.* 2001).Similar observations were reported by Dass *et al.* (1993) in the ammoniated wheat straw. The decreasing trend in cell wall fractions might be on account of the solubilization of cell wall constituents (Yadav and Virk 1994 a). Almost similar content of Ca and P in wheat straw and bagasse pith (Dey 2001) reflected similar content of these minerals in CF-1 and 2. Salman *et al.* (2011) have also reported almost same proximate value of bagasse pith treated with 3% urea.

Table 1. Physical and chemical composition of different complete feeds

Feed ingredients (% fresh wt. basis)	CF-1	CF–2
Wheat straw	50	0
Ammoniated sugarcane bagasse pith (ASCBP)	0	50
Wheat bran	13.5	21.0
Crushed maize	10.0	10.0
Deoiled Soybean cake	15.0	7.5
Molasses	10.0	10.0
Mineral mixture	1.0	1.0
Common salt	0.5	0.5
Chemical composition (% DM basis)		
Organic matter	88.65	89.80
Crude protein	14.01	14.96
Ether extract	1.44	1.21
Total ash	11.35	10.20
Acid insoluble ash	4.51	4.89
Neutral detergent fiber	70.54	61.80
Acid detergent fiber	35.06	33.83
Hemi-cellulose	35.48	27.97
Acid detergent lignin	5.46	6.27
Cellulose	29.60	27.56
Ca	0.91	0.76
P	0.39	0.39

Intake, digestibility coefficient of different nutrients and plane of nutrition: Intake, digestibility coefficient of different nutrients and plane of nutrition are given in Table 2. Dry matter intake (g/d) had no significant difference between the 2 groups in all terms. However, digestibility of dry matter was significantly ($P<0.05$) higher in group 1 compared to group 2. It suggested that wheat straw can be completely replaced with ammoniated bagasse pith in the diet of adult cattle without any adverse effect so far as DM intake is concerned. It also suggested that ammoniated bagasse pith can be included up to 50% in the diet of adult cattle and such diets are as palatable as 50% wheat straw based complete diets. Dey (2001) also reported that inclusion of bagasse pith

Table 2. Nutrients intake, digestibility and plane of nutrition in different groups

Attribute	Group 1	Group 2	SEM±
No. of animals	6	6	
Mean body wt. (kg)	314.9±5.01	288.9±4.24	2.36NS
Dry matter intake			
g/day	6285±252.0	6186±211.4	157.5NS
kg/100kg bwt.	2.00±0.10	2.14±0.06	0.06NS
g/kg$W^{0.75}$	84.23±3.98	88.24±2.65	2.4NS
Organic Matter intake			
g/day	5622±217.7	5761±108.3	117.8NS
g/kg$W^{0.75}$	75.34±3.46	82.32±2.26	2.2NS
Crude intake			
g/day	927.3±30.5	973.6±16.8	18.0NS
g/kg$W^{0.75}$	12.42±0.50	13.91±0.36	0.43NS
Digestibility (%)			
DM	58.97±1.43	51.66±1.57	1.50*
OM	63.93±1.51	57.95±1.84	1.45*
Crude protein	70.76±5.08	63.89±3.89	3.22 NS
EE	69.40±3.86	68.46±2.55	2.21 NS
NDF	66.11±1.14	52.80±2.07	2.30*
ADF	61.48±0.88	44.16±2.41	2.88*
Hemicellulose	70.84±1.59	62.64±2.91	2.01*
Cellulose	66.99±1.15	53.26±2.31	2.41*
Plane of nutrition			
DDM intake (g/kg$W^{0.75}$)	49.68±2.75	45.58±1.83	1.69NS
DOM intake (g/kg$W^{0.75}$)	48.08±2.14	47.73±2.21	1.47NS
DCP intake (g/kg$W^{0.75}$)	8.790.37	8.89±0.58	0.41NS
TDN intake (g/kg$W^{0.75}$)	49.15±2.21	48.67±2.24	1.50NS

NS, Differences were not significant (P>0.05). * Differences were significant (P<0.05).

Table 3. Metabolism of nitrogen, calcium and phosphorus in the 2 groups

Attributes	Group 1	Group 2	SEM±
N metabolism (g/d)			
Intake	148.3±4.88	155.7±2.69	2.88NS
Voided in faeces	44.5±9.25	56.3±6.24	5.61NS
Excreted in urine	62.5±4.34	66.9±5.44	3.39NS
Balance	41.3±8.29	32.5±9.98	6.32NS
Ca metabolism (g/d)			
Intake	60.64±1.95	49.0±0.84	1.94**
Voided in faeces	46.44±3.44	36.9±0.99	2.23*
Excreted in urine	0.84±0.11	1.06±0.21	0.11NS
Balance	13.36±2.49	11.78±1.56	1.42NS
P metabolism (g/d)			
Intake	24.59±1.09	24.12±0.70	0.91NS
Voided in faeces	22.01±1.34	20.39±1.73	1.07NS
Excreted in urine	1.05±0.23	1.04±0.15	0.13NS
Balance	1.53±0.63	2.69±0.85	0.55NS

NS- Differences were not significant (P>0.05). Difference were significant* (P<0.05) and ** (P<0.01).

up to 50% in the diet of growing cattle had no adverse effect. He also observed that inclusion of bagasse up to 25% level in the diet had no adverse effect on the DM intake of the animals its inclusion at 50% level did significantly reduced the DM intake. It suggested that pith is probably a better substitute of wheat straw as compared to sugarcane bagasse so far as palatability is concerned. Higher palatability of bagasse pith as compared to sole bagasse may be due to its finer particle size. Molina *et al*. (1991) also reported 93.0 g/kg $W^{0.75}$ DM intake in crossbred steers fed 42% bagasse pith supplemented with 36% milled maize and 22% yeast cream, which is comparable with the present study. In another study Ravi and Natanam (1998b) also who observed that urea treated bagasse pith can replace 40% sorghum straw in the diet of ram without affecting DM intake. Intake of OM and CP was similar (P>0.05) in both groups. OM digestibility (%) was significantly (P<0.05) higher in group 1 as compared to group 2. However digestibility of CP was similar (P>0.05) in both groups.

Digestibility of DM, OM, NDF, ADF, hemi-cellulose and cellulose were significantly (P<0.05) reduced in group 1, indicating that inclusion of ammoniated bagasse pith at 50% level in the diet of adult cattle had an adverse effect on DM, OM, NDF, ADF, hemi-cellulose and cellulose digestibility. However, EE and CP digestibility were similar in both the groups. Amjed *et al*. (1992) compared the *in vitro* DM digestibility of wheat straw with bagasse pith and found that the value was almost 3-times higher in wheat straw (53.1%) as compared to pith (18.9%), indicating very poor digestibility of cell wall monosaccarides in pith as compared to wheat straw and probably for this reason significant reduction in the digestibility of nutrients in the animals fed bagasse pith as sole roughage was observed. Ravi and Natanam (1997) have also reported very poor *in vitro* DM and OM digestibility of bagasse pith, which were 22.60 and 23.36%, respectively.

Poor digestibility of ammoniated bagasse pith based complete diet may be attributed to (i) physical structure of the bagasse pith particles, which prevents adequate microbial growth (Molina *et al*. 1983), (ii) chemical nature of the cell wall-monosaccharides of sugarcane residues which are less digestible than those of wheat straw (Amjed *et al*. 1992), (iii) (a) nature of lignin which acts as a physical barrier between cellulose and rumen bacteria and (b) have a negative correlation between forage lignin and/or cellulose and DM digestibility (Van Soest 1964).

Plane of nutrition: Similar to dry matter intake, the intake of digestible dry matter (g/kg$W^{0.75}$) was also similar (P>0.05) in the 2 groups. In comparison to NRC (1989) recommendation for 500 g growth also the intake of DM and CP was higher and TDN intake was almost at par in the present experiment. The digestible organic matter intake (g/kg$W^{0.75}$) of also showed no significant difference between the 2 groups. The DCP and TDN intake (g/kg$W^{0.75}$) was also similar (P>0.05) in both groups. Rao *et al*. (1997) have reported a significant reduction in the TDN intake in the

Table 4. Growth rate and feed conversion efficiency in the 2 groups

Parameter	Group 1	Group 2	Mean±SEM
Initial body wt. (kg)	253.0±8.22	248.5±5.58	250.75±4.78
Final body wt. (kg)**	328.2±4.35	302.5±4.51	315.33±4.89
Total gain (kg)*	75.2±6.58	54.0±3.46	64.58±4.77
Average daily gain (g)*	626.3±54.83	450.0±28.87	538.19±39.75
Total DMI (kg)	837.8±3.31	769.7±36.67	803.79±20.31 NS
Feed : gain	11.61±1.08	14.54±1.18	13.07±0.88 NS

Differences were significant * (P<0.05) and ** (P<0.01).

animals fed either steam treated or untreated bagasse as compared to the animals fed paddy straw based complete feeds. Allam *et al*. (2006) reported that the biologically treated sugar beet pulp was to replace 0, 60, 75 or 100% of corn grains for growing lamb groups, indicating that the feed cost /kg gain decreased with increasing replacing level.

Balances of N, Ca and P: The data on intake, excretion and balance of N, Ca and P are given in Table 3. The balances of N, Ca and P were positive and similar in both groups. Rao *et al*. (1997) also observed positive N balance (6.14g/d) in crossbred calves fed complete diet having 60% steam treated bagasse, 10% GNC, 23.5% wheat bran, 5% molasses, 1% mineral mixture and 0.5% salt. However, a poor retention of N was reported in bagasse fed animals by Horton *et al*. (1991). Ca intake (g/d) and excretion through feaces differed significantly (P<0.05) between the 2 groups. However, excretion of Ca through urine did not differ. Similar results were obtained by El-Kamisi (2008).

The results with respect to calcium and phosphorus balance collaborated well with the findings of Vaidya *et al.* (1981) who found positive balances of calcium and phosphorus at 16.2 and 11.19g/d, respectively, in crossbred cattle fed 50% bagasse along with 2% urea 20% molasses and 2 kg concentrate mixture. Similarly, Reddy *et al.* (2001) and Dey (2001) observed positive calcium and phosphorus balances in animals fed bagasse plus concentrate mixture.

Growth and feed conversion efficiency: The average daily gain, total dry matter intake during the period of experimental feeding and feed: gain ratio in the 2 groups are given in Table 4. The average daily gain (g) was significantly (P<0.05) higher in group 1 as compared to group 2. However, total dry matter intake (kg) and mean feed: gain ratios were similar (P>0.05). Studies on the effect of feeding bagasse pith on the growth performance of the animals appear to be very scarce. In one of the studies, Molina *et al*. (1991) fed 44% bagasse pith and recorded a daily gain of 587g/d. But in this case also, the bagasse pith was fed with more nutritious feed like yeast cream and the animals used were also Hereford × Zebu (229.5kg mean body weight). The results of the present study are supported by the work of Martin (1981), who observed an average daily gain of 433g/d in the animals fed bagasse pith with concentrate supplementation. Hanke and Martin (1983) observed slightly better FCE in cattle in comparison to the present study.

Ammoniated bagasse pith can be used up to 50% in the complete diet of growing cattle bulls without any adverse on their performance.

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