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A LABORATORY ASSESSMENT OF VARIOUS UREASE SOURCES ON THE CHEMICAL COMPOSITION OF UREA TREATED SUGARCANE BAGASSE

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An experiment was conducted to determine the best level of urease sources for complete hydrolysis of urea and nutritive value of urea treated bagasse. Sugarcane bagasse was treated with urea at 2.5% (DM) level. Four different urease sources; cattle manure, poultry manure, mungbean seed meal and urease enzyme were used. Cattle and poultry manure were added at three different levels; 5, 7.5 and 10%, mungbean seed meal at 5% and Urease at 0.1 and 0.2%. After treatment the samples were kept at room temperature for 3 and 6 weeks. Results indicated significant decrease ($P<0.05$) in neutral detergent fiber, hemicellulose and cellulose for urea treated sugarcane bagasse with all added urease sources. Crude protein contents of urea treated bagasse with urease source was significantly higher ($P<0.05$) than that treated with urea alone. Results suggested that additional source of urease is needed for the ammonification of urea when it is used to increase the nutritive value of bagasse.

INTRODUCTION

Land for production of forage to feed ruminants is limited especially in developing countries. Whether land can be spared for such use depends largely on population pressures and the need to produce food staples for human consumption. With increasing urbanization, the demand for and the value of animal products is increasing. This together with increasing crop yields increases pressure on land use and force the scientists to explore the possibilities of using non-conventional feedstuffs. In contrast to cereal straws, little work has been done on the utilization of sugarcane bagasse, which is due to its low nutritive value as feed for ruminants. Its low nutritive value is mainly due to the nature and extent of lingo-cellulosic bonding (Naseer et al., 1987).

Nutritive value of sugar cane bagasse can be improved by physical (Ibrahim et al. 1982; Naseer et al 1987) chemical (Prassad et al. 1986) and biological (Azim et al. 1987) treatments. Ammoniation of low quality roughages is the most extensively used method for upgrading the quality of crop residues (Sunstol et al. 1978). For urea treatment, Oji and Mowat (1977) suggested a reaction period of 20 d to achieve complete dissociation of urea into NH_3 when applied to corn stover in polyethylene bags at room temperature. Dissociation time of urea to NH_3 can be reduced from 20 d to 5 d by the addition of urease source. In addition, inclusion of urease source and (or) its source improve the dry matter digestibility of urea treated straw (Ibrahim et al. 1982) and bagasse (Torres et al. 1982).

The present paper reports a laboratory experiment carried out to determine the effects of urea treatment of bagasse with or with out the addition of different urease sources on the chemical composition of sugar cane bagasse.

MATERIALS AND METHOD

Batches of 1 kg sugarcane bagasse were treated with urea at 2.5% (DM) level. The moisture of bagasse was maintained at 40%. Four different urease sources; cattle manure, poultry manure, mungbean seed meal and urease (21-U Fisher Scientific Co.) enzyme were used. Cattle and poultry manure were added at three different levels; 5, 7.5 and 10% mungbean seed meal at 5% and Urease at 0.1 and 0.2%. Each treatment was carried out in six replicate, kept at room temperature and opened after 3 and 6 weeks. A control was prepared by treating bagasse with urea but with no added urease source and treatments were done at room temperature. The description of treatments is given in Table 1.

At the end of treatment, samples were taken, composited, and sub-sampled. Dry matter was determined by drying in duplicate, 200 g samples of each material in forced draft oven at a maximum of 60°C for 48 h. Following equilibration with atmospheric moisture, the duplicate dried samples were composited, ground to pass a 1 mm sieve and

subjected to analysis for DM, Ash, (AOAC, 1988), NDF (Van Soest and Wine, 1967), ADF, cellulose and lignin (Van Soest and Wine, 1968). Nitrogen was determined on wet feed samples and dry fecal samples (AOAC 1988).

Table 1. Description of Treatments.

Treatment No.	Urea Quantity (%)	Urease	
		Source	Quantity (%)
I	2.5	None	None
II	2.5	CM	5.00
III	2.5	CM	7.50
IV	2.5	CM	10.0
V	2.5	PM	5.00
VI	2.5	PM	7.50
VII	2.5	PM	10.0
VIII	2.5	MSM	5.00
IX	2.5	Urease	0.1
X	2.5	urease	0.2

CM (Cattle manure), PM (Poultry manure), MSM (Mungbean seed meal)

Statistical Analysis

The data was tested by analysis of variance using general linear model procedures of SAS (1982). Treatment, block, time, treatment*block *time interaction was included in model. Treatment was tested on treatment * block interaction and time was tested on treatment * time * block interaction. For treatment means the following contrasts were made; urea alone vs urease sources, cattle manure vs poultry manure, cattle manure vs urease, poultry manure vs urease, cattle manure and poultry manure vs mungbean seed meal and cattle manure and poultry manure vs urease.

RESULTS AND DISCUSSION

The effect of different urease sources on the cell wall constituents of sugarcane bagasse treated urea for 3 weeks showed decrease in the value of NDF, ADF, hemicellulose and cellulose, compared to bagasse treated with urea alone (Table 2). The decrease was found significant ($P<0.05$) for NDF, hemicellulose and cellulose content, whereas decreasing trend was observed for ADF values. Decrease in NDF and hemicellulose values are more pronounced when low quality roughages were treated with urea (Donelly et al. 1974 and Solaiman et al., 1979). Principle behind urea treatment involved "ammonification" of low quality roughages, therefore, hydrolysis of urea is compulsory to ensure the desirable effect (Cristina et al. 2006). Contrary to our findings Moore (1987) could not find any significant change in the fiber constituents when orchard grass hay was treated with aqueous ammonia. Apparently, better response in treatment having additional quantities of urease suggested that the amount of urease naturally present in sugar cane bagasse may have been insufficient to facilitate the breakdown of urea into ammonia for ammonification. A decreasing but no significant ($P>0.0\%$) trend was observed in ADF values fro the treatments with additional urease. However, for all the treatments the values of ADL remained unchanged.

Table 2. Effect of urease sources on the cell wall composition of urea treated sugarcane bagasse after 3 weeks.

Treatments	NDF	ADF	HCHO*	CHO*	ADL
I	79.28	52.29	26.11	42.50	12.55
II	73.57	49.99	23.71	39.99	10.11
III	72.36	48.87	23.08	39.05	10.07
IV	69.51	48.13	22.50	43.81	11.06
V	74.33	53.03	20.36	41.98	11.96
VI	71.78	48.83	23.18	43.86	11.47
VII	71.55	48.86	22.16	37.88	11.54
VIII	70.60	48.20	22.80	36.79	11.05
IX	69.43	49.33	20.43	37.09	11.93
X	72.16	50.67	22.18	39.57	10.53

*Significantly ($P<0.05$) different for all the contrasts.
NDF (Neutral detergent fiber), ADF (Acid detergent fiber), HCHO
(Hemicellulose), CHO (Cellulose) ADL (Acid detergent fiber).

Similar results were found for cell wall components of sugarcane bagasse treated with urea alone or in combination with urease for 6 weeks (Table 3). Williams and Innes (1983) and Ibbotson (1983) proposed that rate and extent of urea hydrolysis and ammonification of straw were influenced by the moisture content of straw, treatment temperature and duration of treatment. In our experiment non differential response to time (3vs6 weeks) indicated that a period of 3 weeks was sufficient for the hydrolysis and consequently for the improvement of nutritive value of urea treated sugarcane bagasse with or without the addition of urease source. Ibrahim et al (1983) reported that the treatment time could be reduced with the addition of 8.5% soybean as urease source.

Table 3. Effect of urease sources on the cell wall composition of urea treated sugarcane bagasse after 6 weeks.

Treatments	NDF*	ADF	HCHO*	CHO*	ADL
I	79.96	55.06	24.55	42.50	11.18
II	78.63	54.63	24.56	45.31	9.62
III	78.52	55.51	23.12	43.27	11.74
IV	79.55	55.66	23.75	43.32	11.10
V	76.39	53.55	22.90	41.33	10.42
VI	75.08	53.64	21.42	41.65	9.48
VII	75.52	56.76	22.58	41.55	11.07
VIII	76.22	52.38	23.64	39.61	9.84
IX	76.30	54.22	24.05	43.62	10.39
X	78.70	49.40	23.90	41.33	10.03

*Significantly (P<0.05) different for all the contrasts.
NDF (Neutral detergent fiber), ADF (acid detergent fiber), HCHO (hemicellulose), CHO (Cellulose) ADL (acid detergent fiber).

Treatment of sugarcane bagasse in the presence of various urease sources (cattle and poultry manure and mungbean seed meal) showed increase (P<0.0%) in the values of crude protein, compared to sugarcane bagasse treated with urea alone or in the presence of pure urease enzyme (Table 4). The higher level of CP in these treatments was due to additional N provided by manure and mungbean seed meal. Sugarcane bagasse treated with urea in the presence of mungbean seed meal exhibited the highest crude protein contents compared to other urease sources. The low increment of nitrogen was due to the fact that the nitrogen detected was only the fraction of nitrogen which was chemically fixed to the cells of the straw and insoluble in water. On the other hand, the nitrogen fixation ratio usually falls with the increase in the urea level because large amounts of free ammonia (not fixed yet) built up within the straw matter may stop or hinder hydrolysis of the urea (Chenost and Kayouli 1997). After three weeks, sugarcane bagasse treated with urea and urease had decreased (P<0.05) CP content than that treated with urea alone. This was due to the catalytic effect of urease which stimulated the hydrolysis of urea into ammonia and partial loss of NPN into environment. These results are in agreement earlier reports (Ali and Naseer, 1985) when wheat straw was treated with urea with or without urease source. Differences among treatments with various ureases were not encountered for crude protein.

Table 4. Effect of urease sources on NH_3 content of urea treated sugarcane bagasse after 3 and 6 weeks.

Treatment	NH_3-N [abc]	NH_3-N
	3 weeks	6 weeks
I	0.694	0.774
II	0.829	0.730
III	0.802	0.670
IV	0.657	0.670
V	0.873	0.800
VI	0.808	0.690
VII	0.752	0.680
VIII	0.788	0.760
IX	0.710	0.690
X	0.688	0.770

Untreated bagasse has 0.363 %N and 0.05% NH_3-N.
[a]CM vs urease differ (P<0.05).
[b]PM vs urease differ (P<0.05).
[c]CM and PM vs urease differ (P<0.05).

Sugarcane bagasse treated with urea in combination with urease showed numerical but not significant increase in NH_3-N contents over sugarcane bagasse treated with urea alone (Table 5). For different treatments, no consistent change was found in the values of NH_3-N. However, treatments kept for six weeks showed comparatively lower values of NH_3-N than treatments kept for three weeks. Our data indicated that approximately 70% of retained N was tested as free NH_3-N, a value quite high than the values reported by Dias-de-Silva and Sunstol (1986).

Table 5. Effect of urease sources on the crude protein contents of urea treated sugarcane bagasse after 3 and 6 weeks.

Treatments	Weeks		
	0[abcd]	3[ceg]	6[c]
	%		
I	8.10	8.16	8.00
II	11.31	8.06	8.16
III	10.25	8.81	8.99
IV	10.88	9.40	8.99
V	11.02	8.21	8.12
VI	10.45	8.37	8.02
VII	10.85	8.37	8.02
VIII	13.43	10.45	9.99
IX	8.18	8.32	7.50
X	8.45	8.08	7.71

Untreated bagasse has 2.27 CP
[a]CM vs MBSM differ (P<0.05).
[b]CM vs urease differ (P<0.05).
[c]PM vs MBSM differ (P<0.05).
[e]PM vs urease differ (P<0.05).
[f]PM + CM vs MBSM + urease differ (P<0.05).
[g]MBSM vs urease differ (P<0.05).

Cell wall constituents of bagasse were reduced after urea treatment with the inclusion of urease source. The amount of the nitrogen which was fixed to the straw structure increased significantly with urea but additional source of urease is necessary for complete hydrolysis of urea to ammonia in urea treated bagasse. Chemical analyses alone are not enough to evaluate the improved feeding value of sugarcane bagasse. Other methods of evaluation like *in vitro and in situ* are needed to define set of conditions for urea-ammoniation treatment of sugar cane bagasse.

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