TREATMENT OF RICE STRAW WITH LIME

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Eight male sheep were used to determine digestibility and voluntary intake of rice strew untreated and treated with slaked lime. The straw was soaked in water (1 kg straw in 10 l water) containing 40 g lime/kg straw for 48 hours in a concrete pit and then washed with water (5 1 water / kg straw) before sun drying. The lime used contained 60% CaO and 1.3% MgO

There was no change in the N-content of the straw due to the lime treatment, Digestibility of dry matter of straw increased significantly with lime treatment from 38 to 49%. When the treated straw was supplemented with 10% molasses and urea to give 2% N in the ration the digestibility of the total diet was 54%. This supplementation also brought about an increase in intake. Intake was 53.8, 47.6 and 71.3 g of dry matter/kg W0.75 for diets of untreated straw, lime treated straw and lime treated straw plus molasses/urea respectively. The increase due to supplementation was highly significant ($P< 0.01$) . Measured as percentage of body weight, feed dry mattes intake was 2.5, 2.2 and 3.8. Nitrogen retention (g/24 hours) was -2 94, -2.09 and + 4.74.

It is concluded that nitrogen is the first limiting nutrient in utilisation of treated straw. Also that all supplements can make contributions to a higher utilisation of a diet of course roughage.

Key words: Sheep, digestibility, straw, alkali treatment, molasses supplementation, intake

Methods of straw treatment to improve its utilisation in diets for ruminants should be developed with due consideration to the context in which they are going to be used. In Bangladesh, straw treatment has to be compatible with agricultural systems in which 67% of the people live on farms of 2 acres or less in a nation of 90 million people, The typical animal owner has only one or two head of cattle or goats. In this situation it is important to show the farmer appropriate means which are available on the farm to increase feed utilisation of ruminants through, for instance, treatment of straw with animal urine (Saadullah et al 1980). Treatment of straw can be applied immediately with some modifications (Dolberg et al 1980 and Davis and Sayeed 1980) in Bangladesh. This study is aimed at appropriate modifications.

Gharib et al (1975) had demonstrated lime (CaO) to be as efficient as NaOH in increasing the digestibility of poplar bark in vitro, when given 150 days for reaction. In addition a growth trial by Pacho et al(1977)with Zebu bulls on a diet of 60% rice straw and 40% concentrate has shown that growth is about 30% better (two trials), when the straw is soaked in lime water for 72 hours prior to feeding, It was the purpose of the present work to make a preliminary investigation into the feasibility of this method for Bangladesh, where a big deposit of limestone is available.

[1] *IDRP Project, Noakhali, Bangladesh (1975)*

Materials and Methods

Straw treatment: Rice straw purchased in the local market was used, 4% crude lime measured on dry straw weight was dissolved in 10 litres of water per 1 kg of straw. The straw was immersed in the solution for 48 hours in a concrete pit.

After soaking the straw was washed with 5 litres of water/1 kg of straw and then dried in the sun and fed ad libitum to the sheep.

Animal treatment: The diets were control (untreated straw), lime treated straw and lime treated straw supplemented with urea and molasses to give 2% and 10% molasses in the ration measured on dry matter basis. Sodium sulphate was added to the urea so that the N:S ratio was 10:1.

Digestibility trial: Two groups of male sheep were used for measurement of feed digestibility.

The trials on lime treated straw with and without supplement of urea and molasses were run at one time. The results for sheep on untreated and unsupplemented straw were obtained from earlier trials. This was necessary because of the restriction of facilities and animals. But the straw was from the same batch at the same time.

Each sheep was held in a digestibility crate; a 15 day preliminary feeding period was followed by a 7 day collection period. The sheep had been on the straw diets for eight months and were well adjusted to them.

Feed intake , faeces voided and urine volume were measured daily for seven days. A representative sample of feed and faeces were analysed to determine DM, crude protein (CP), crude fibre (CF) and ash. The urine was preserved with 6N HC1 and analysed for total nitrogen by the Kjeldahl method. Analysis of variance was used to determine the effects of treatment and Duncan's multiple range test for significance.

Results and Discussion

Composition of the rice straw: The percentage composition of the treated and untreated rice straw given to the animals was DM 89, 87; Crude protein 3.3, 3.3; Crude fibre 29, 25 and ash 12, 13 respectively.

Voluntary intake; digestibility and nitrogen retention: Table 1 gives the voluntary intake, digestibility of dry matter and crude fibre and retention time of nitrogen by the three groups of sheep.

From Table 1 it appears that lime treatments ($P < 0.05$) depressed straw intake by sheep. This is in line with the results of 0rskov and Grubb (1978), who made similar observations on barley straw treated with caustic soda. They also had a low level of digestibility, when the treated straw was unsupplemented. There is no trend in the study reported here where treatment with lime increased digestibility of dry matter from 38% to 49% and increased water intake by about 50%,

Supplementing the treated straw with 10% molasses and urea to ensure a nitrogen level of 2% in the diet causes a 50% increase in intake from 47.6 g to 71.3 g/kg $W^{0.75.}$ Only 16% of the increase in intake of digested dry matter is due to the increase in digestibility recorded which was from 49% to 54%. Assuming a digestibility of 100% in molasses, molasses intake explains 37% of the increase, leaving a balance of 47% to come from increased intake of straw. As both molasses and urea have been added, there are many factors involved and this complicates the explanation. As well as urea and highly digestible carbohydrate, molasses contains trace minerals and other macro-minerals such as sulphur which might be deficient in

Table 1:
Sheep intake and digestibility characteristics of untreated and lime treated rice straws

	Untreated	4% lime treated	4% lime treated and supplemented with urea and molasses	SE	Level of significance
Average weight of sheep (kg)	21.5	19.8	12.7		
Consumption index[1]	2.5	2.2	3.8		
DMI g/Kg $W^{0.75}$/d	53.8[a]	47.6[b]	71.3[c]	± 1.35	a to b* / a and b to c**
Digestibility of dry matter,%	38.0[a]	49.0[b]	54.0[c]	± 0.38	*
Digestibility of crude fibre,%	55.0[a]	59.0[b]	63.0[c]	± 0.93	a to b* / b to c* / a to c**
Intake of DDM g/kg	20.4	23.3	38.3		
$W^{0.75}$ relative intake of DDM g/Kg $W^{0.75}$	100	114	187		
N retention g/24h	-2.94	-2.09	+4.74		

[1] kg DM per 100 kg bodyweight

[2] different superscripts indicates statistically significant differences: * $P < 0.05$, ** $P < 0.01$

this diet. When Saadullah et al (1981) added 10% molasses to ammonia treated straw, they recorded increased intakes of the same order as observed here, the increase in intake of digested nutrients was then only 4% to 10%, hardly compensating for the added molasses. El Shazly et al (1961) have shown that in the presence of both starch and cellulose in purified forms, cellulose digestion was depressed when urea in molasses was utilized as a source of nitrogen and readily digestible carbohydrate. As the sugars in molasses are more quickly fermented than starch, which is more rapidly fermented then cell wall carbohydrates (Johnson 1976), the problem facing researchers is to find the point, where inclusion of some source of readily fermentable carbohydrate does not depress cellulytic bacteria. In vitro studies of carbohydrate fermenting i.e. (Rouf (1976) using rice gruel, Saadullah (1978) with molasses and Rashiq (1980) with barley) have demonstrated this level to be at 10% to 20% inclusion in the diet.

Because the experiments above have been conducted with sufficient nitrogen to meet the requirements for microbial protein synthesis in the rumen the logical conclusion is that inclusion of molasses or any other source of readily fermentable carbohydrate in a coarse roughage, low nitrogen diet would depress digestibility of the roughage, as the fermentation of molasses would require the available nitrogen (Saadullah 1978 in vitro) and possibly also, decrease the rate of passage and thus intake, The reverse should be the case, when a nitrogen supplement is given to such a diet and the difference should be particularly distinct between treated and untreated straw, as treatment makes more energy available to the rumen microbes, For utilization of treated straw, urea then becomes more important than molasses.

This is seen in the work of Kategile (1979), where digestibility of dry matter went up from 38.3% to 64.3% and of cell wall constituents from 18.3% to 56.5%, when the level of urea was increased from 0 to 1.5% in a NaOH treated maize cobs diet. There was no effect on intake. 0rskov and Grubb (1978) compared effect of urea supplementation on intake and digestibility of straw with and without treatment with NaOH. On the untreated straw, they found no increase in intake, but a small increase in digestibility. Altogether the intake of digestible organic matter was increased from 180 g/day to 211 g/day as the level of urea increased from 0 g/kg to 18 g/kg. With sheep on the treated straw, there was increase in intake as well as digestibility, and intake of digestible organic matter went up from 134 g/day to 301 g/day - more than doubled. From this discussion it is concluded that while the inclusion of molasses in the present study has had an additive effect on intake, it is nitrogen that is the first limiting nutrient in a treated straw diet.

That lime treatment increases digestibility is in agreement with Gharib et al (1975), Dumlao and Perez (1976), Selvendran et al (1977) and Devendra (1979).

Method of treatment : Compared to caustic soda, lime added to dry straw takes a longer reaction time to increase the straws digestibility. Long treatment periods are, however, very difficult under village conditions in Bangladesh, where heavy rainfall washes away soil and spoils plastic during the process as has been experienced by the present authors and the short soaking period is much more preferable. However, the treated straw, has to be washed very carefully, otherwise the animals refuse to eat.

Both Selvendran et al (1977) and Devendra (1979) had a straw to water ratio of only 1:1, when they treated with lime, which is the same as the ratio, used by Saadullah et al (1981), when treating straw with urea as a source of ammonia. Dumlao and Perez (1976) showed that 1% lime significantly increased digestibility of straw. Due to the high content of oxalates in rice straw (Jackson 1977) 1% of lime is recommended as a mineral supplement when rice straw is a major proportion of the diet. This opens up some possibilities of combinations of urea as source of ammonia, where both lime and urea (through ammoniation) contribute to the increase in digestibility. It is of interest to note that while ammonia primarily acts to increase hemicellulose digestibility (Rashiq 1980), lime appears to also increase acid detergent fibre and cellulose digestibility (Gharib et al 1975). Using ammonia and sodium chlorite ($NaClO_2$) Terashima et al (1980) have demonstrated that the effect of two chemicals can be additive. Work on these lines is in progress.

Conclusion

Lime is available in Bangladesh and the results of this study indicates that it can be used to increase the digestibility of rice straw. While nitrogen is considered to be the first limiting nutrient in treated straw, the role of supplements such as molasses to maximise intake and digestibility of course roughages requires further investigation.

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