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TREATED AND UNTREATED RICE STRAW FOR GROWING CATTLE

M Saadullah, M Haque & F Dolberg[1]

Department of General Animal Science, Bangladesh Agricultural University, Mymensingh, Bangladesh

Twenty eight calves of native, nondescript breed were divided into five groups: A, B, C, D and E. Each group was offered treated or untreated rice straw as follows: Group A untreated; Group B untreated; Group C 5% urea (ammonia) treated; Group D 4% lime treated and Group E 3% caustic soda and 1% lime treated. All the groups except Group A were made isonitrogenous by urea supplementation to a level corresponding to 1.3% N of DM. Feed intake, weight gain and digestibility were measured.

It took the animals approximately 50 days to adjust to the straw and reach peak intake. After that, the daily intake (g/kg $W^{0.75}$) was 86.6, 81.9, 91.6, 78.3 and 76.6 for Goups A, B, C, D and E respectively.

The dry matter digestibility increased significantly ($P < 0.01$) from 40% in Group A to 46, 51, 48 and 62% in Groups B, C, D and E respectively.

It is concluded that urea (ammonia) treatment of straw is the best method for Bangladesh as the method is uncomplicated and urea the cheapest of the chemicals. The study further suggests that the native cattle of Bangladesh have a high intake of untreated straw.

Key words: cattle, growth, straw, urea, alkali treatment

Chemical treatment of straw holds considerable promise for increasing ruminant production in developing countries such as Bangladesh with a high population density and little land to spare for fodder cultivation. The methods developed in the industrialised countries are too expensive and therefore are not applicable. They have been modified as described in Dolberg et al (1980) and Sayeed & Davis (1980). Judging by in vivo digestibility trials and in vivo dacron bag observations reported in the same studies, these methods are effective.

The studies reported here were aimed at evaluating the straw treatments in terms of animal production. At the same time to collect baseline data on native, nondescript Bangladeshi cattle fed diets of treated and untreated straws.

Materials and Methods

A feeding trial with 28 calves over 84 days was carried out in the Department of General Animal Science, Bangladesh Agricultural University.

Experimental animals: 28 calves (about 18 months old) of uniform weight were purchased from the local market. Calves were divided into 5 groups and assigned to diets at random. There was one female calf in each

[1] *IRDP/DANIDA Project, Noakhali District, Bangladesh*

group. In group D one calf had to be culled. Calves were allocated to the following treatments and adjusted to the housing conditions and experimental feed before starting the experiment. At the beginning and end of the experiment each animal was weighed on 2 consecutive days and the average was taken as liveweight.They were weighed at fortnightly intervals during the experimental period.

Ration: All calves were given 500 g green grass and 10 g bone meal and 10 g common salt per kg of straw supplied. $Na_2 SO_4$ was supplemented to all groups except A to make the N:S ratio 10:1. The treatments were as follows:

Group A - untreated straw
Group B - untreated straw plus urea (13 g N/kg)
Group C - 5% urea (ammonia) treated straw (13 g N/kg)
Group D - 4% slaked lime treated straw plus urea (13 g N/kg)
Group E - 3% NaOH with 1% lime treated straw plus urea (13 g N/kg)

Straw was fed ad libitum. Refusals were weighed and DM determined and feed dry matter intake calculated.

Method of straw treatment: a) Urea treatment: both the bamboo basket and earthern pit methods (Dolberg et al 1980) were used for the ammonification of straw using urea. The straw was sprayed with an equal weight of water and the urea solution was then sprayed over the straw in the basket and ensiled for 10 days. The pit was opened after 10 days, straw was taken out, sun dried, chopped to 20 - 25 cm lengths and fed to the calves.

b) Lime treatment: 400 g of lime (CaO) was dissolved in 10 l of H_2O and sprayed on 10 kg straw. This was then soaked in 90 l of water in a concrete tank for 48 hours. The straw was then removed and washed with water (5 l/kg of straw). The straw was dried in the sun, chopped and fed to the calves.

c) NaOH with lime treatment: 30 g NaOH and 10 g lime were dissolved as described in b) and added to 1 kg of straw which was then soaked in the tank for 24 hours.

Digestibility trials: At the end of the 84 day feeding experiment, 4 calves from each group were used to examine the digestibility of the feed. The trial consisted of 10 days preliminary period and 7 days collection period. Faeces were collected daily and a 10% sample taken and stored after sun drying. A representative sample of the feed and faeces were analysed for dry matter, crude protein (Nx6.25), crude fibre and ash.

Analysis of variance was used to determine the effect of straw treatment on feed intake and growth. Duncan's Multiple Range Test was used to test for significance (Kramer 1956).

Results and Discussion

Chemical composition: The effect of treatment on the chemical composition of rice straw has been reported earlier (Saadullah et al 1981 a,b) and the results of this trial did not vary from the earlier findings in any significant way.

Feed intake: Table 1 shows the intake of dry matter and organic matter and digestibility of rations by calves in different groups after 50 days on the experiment. The dry matter intake in kg/day varied from 1.8 in un-

Table 1:

Daily intake of dry matter, organic matter and nitrogen by calves fed with differently treated rice straw after 50 days on experiment

Straw treatment	A	B	C	D	E
No. of animals	4	6	6	5	6
Dry matter intake (kg/d)					
Straw	1.7	1.7	1.9	1.6	1.6
Green grass	0.1	0.1	0.1	0.1	0.1
Total DMI	1.8	1.8	2.0	1.7	1.7
Organic matter intake	1.6	1.6	1.8	1.5	1.5
Consumption index*	3.2	2.9	3.3	2.8	2.8
Nitrogen intake (g/d)	9.3	13.3	25.7	23.3	23.1

*Kg DM/100 kg liveweight

treated straw to 1.8, 2.0, 1.7 and 1.7 in rice straw fed with urea during feeding, 5% urea treated straw, 4% lime treated straw and 3% NaOH with 1% lime treated straw groups, respectively.

The animals reached maximum feed intake after 50 days. Verma (1981) observed a similar trend in crossbred heifers on alkali treated wheat straw supplemented with urea to make the diets isonitrogenous. A minimum period of 50 days may therefore be needed by the animals for proper adjustment to treated/untreated straw when no supplement of concentrate is given, and the green forage supplement is small.

Digestibility trial: The dry matter digestibility (Table 2) increased significantly ($P < 0.01$) from 40% in untreated straw to 46% when urea was supplemented at the time of feeding and to 51% for urea (ammonia) treated

Table 2:

Mean liveweight change, feed conversion and ration digestibility by calves fed with differently treated rice straw ($\bar{x} \pm SE_{\bar{x}}$)

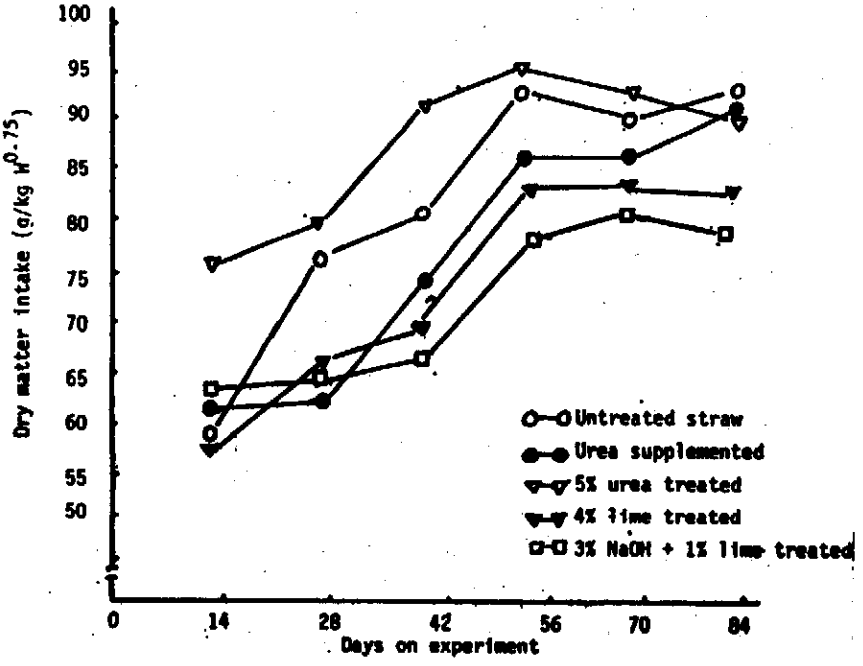
Straw treatment	A	B	C	D	E
Initial liveweight (kg)	54 ± 1.8	58 ± 4.2	58 ± 2.5	57 ± 1.9	56 ± 1.0
Final liveweight (kg)	57 ± 1.5	65 ± 4.5	67 ± 1.8	65 ± 1.8	66 ± 1.1
Daily gain g/d	35^{a}	75^{b}	110^{cd}	99^{c}	120^{d}
Days to gain 100 kg	2844	1336	902	1014	834
Conversion (kg DM/kg gain)	50	24	18	17	14
Apparent digestibility (%)					
Dry matter	40^{a}	46^{b}	51^{c}	48^{bc}	62^{d}
Crude protein		54^{a}	58^{b}	50^{a}	65^{c}
Crude fibre	58^{a}	63^{b}	65^{b}	65^{b}	74^{c}

abcd Values on the same row having different superscripts are significantly different ($P < 0.01$)

straw. Digestibility increased to 48% in lime treated and to 62% in straw treated with 3% caustic soda and 1% lime, respectively. Improvements in the digestibilities of crude fibre and protein were also observed. These findings are in agreement with Saadullah et al (1981 a,b) and Tubei and Said (1981).

The trend in feed intake is shown in Figure 1. It is uniform for all groups, but a particularly distinct adjustment from the 14th to the 28th day is seen in the group on untreated, unsupplemented straw. Treatment of straw has often caused not only increased digestibility, but also increased intake (Khan and Davis 1981; Ørskov 1981b). No such trend occurred in this study, but the level of intake of untreated straw at 86.6 g/kg $W^{0.75}$

Figure 1:
Treated and untreated rice straw for growing cattle



is high, and similar to that reported earlier in village cattle in Bangladesh (Dolberg et al 1981). Straw treatment is a recommended way of making more energy available to the animal, but the high intake in these studies suggests that correct supplementation, without treatment may also be potentially profitable.

There are anonymous reports (1934-35) of studies in which weight loss in bullocks occurred on untreated rice straw alone, but gains, when 255 g of linseed cake was supplemented. More recently, Davis and Khan (1980) found local Bangladeshi cows gained at a modest rate of 23 g/day and yielded 1 kg of milk/day when they were fed rice straw ad libitum and supplemented daily with 160 g urea, 100 g minerals and 500 g sesame oil cake. Saadullah et al (unpublished data) have recorded a daily gain of 173 g, when the supplement was 300 g oil cake, 300 g rice bran, minerals and 1 kg green forage. Untreated straw was fed ad libitum and intake of straw DM around 95 g/kg $W^{0.75}$.

However, alternatively, considerable amounts of straw could be saved , if treated, if the objective was to feed maintenance rations to carry draft animals over from one cultivation season to the next.

Though a small gain of 35 g/d was observed in the animals on untreated, unsupplemented straw, the diet would not be a realistic one over extended periods of time. The animals became pot bellied and progressively weakened. The daily supplement of urea at the time of feeding of untreated straw doubled the rate of gain, and this diet could form a maintenance ration in areas where straw is plentiful and the animals have the same capacity for high intake of straw as observed in this study. On a similar diet, but with Friesian heifers and barley straw, in Scotland, Ørskov (1981b) found a daily weight loss of 447g. Cattle in Bangladesh have had straw as the major item of their diet for generations, and it is tempting to speculate that a natural selection has taken place for high intakes of straw, but there may also be differences of importance between rice and barley straw. Of the diets of treated straw, the one treated with 3% caustic soda and 1% lime was significantly better than the one treated with lime, while the diet treated with ammonia (through urea) was intermediate.

The comparatively poor result with lime could be due to too great a dilution of the lime in the solution, as there was only 0.4% commercial lime in the soaking solution. The 48 hours of soaking might also be too short a time.

Verma (1981) comparing different levels of limes and times of treatment found a solution of 1.3% lime and a soaking time of 3 days, and a solution of 1.9% lime and a soaking time of 2 days, to be comparable to a solution with caustic soda. He used 12 litres of water against 10 in the present study per kg of straw.

The importance of the nitrogen supplement is very clear, when the 50 kg DM/kg gain for the untreated, unsupplemented group is compared to the 24 kg DM/kg gain for the untreated, but urea supplemented group. According to Ørskov (1978 and 1981a), the microbial protein produced in the rumen on the basis of urea nitrogen is, however, insufficient for full realization of the growth potential of young ruminants. Growth responses should be expected to supplements of proteins relatively undegraded in the rumen. It is therefore not likely that the full potential for growth on a straw diet (treated or untreated) has been realised in the present study.

Based on preliminary observations with a small supplement of fish meal to untreated, unsupplemented rice straw (Saadullah et al unpublished data), it is hypothesised that the question of bypass protein together with fermentable nitrogen and other supplements may well be as important as treat -

ment of straw in a situation where the level of intake is already high.

The pattern of gain largely followed the pattern of intake (Figure 1) with a lag time of approximately two weeks, and with the exception of the group on lime treated straw.

Conclusion

In relation to the objectives of the study, it is concluded that although the efficiency of the urea (ammonia) treated straw was only intermediate, this is the most feasible method for Bangladesh. The method is uncomplicated and urea is the cheapest of the chemicals. But the method of lime treatment should be investigated further, both with regard to level of lime in the solution and time of treatment.

The study further suggests that the native cattle of Bangladesh have a high capacity for intake of untreated straw.

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References

Anonymous 1934-1935 Report on animal nutrition work in Bengal

Davis C H & Khan Nuruzzamal K M 1980 Effect of soaking or spraying deep water aman paddy straw with sodium hydroxide solution on the performance of lactating indigenous Bangladeshi cows Paper presented at First Annual Seminar on Maximum Livestock Production from Minimum land Bangladesh 1980

Dolberg F, Saadullah M, Haque M, Ahmend R & Haque R 1980 Different ways of keeping straw during treatment with urea as a source of ammonia using indigenous material for storage - including some observations of temperature and treatment time Paper presented at the First Asian Australasian Animal Science Congress Malaysia 1980

Dolberg F, Saadullah M, Haque M & Haque R 1981 Straw treatment in a village in the Noakhali District Bangladesh Paper presented at the Second Annual Seminar on Maximum Livestock Production from Minimum land Bangladesh 1981

Kahn Nurâzzamal A K M & Davis C H 1981 Chemical treatment of straw- effect of treating amon paddy straw with ammonia (generated from urea) on the performance of Bangladesh local and crossbred (local x Tuarus) lactating cows Paper presented at the Second Annual Seminar on Maximum Livestock Production from Minimum Land Bangladesh 1981

Kramer C Y 1956 Extension of multiple range tests to group means with unequal numbers of replication Biometrics 12:307-310

Ørskov E R 1978 Relative importance of ruminal and postruminal digestion with respect to protein and energy nutrition in ruminants Tropical Animal Production 3:91-103

Ørskov E R 1981a Evaluation of poor quality forages Paper presented at the Second Annual Seminar on Maximum Livestock Production from Minimum Land Bangladesh 1981

Ørskov E R 1981b Evaluation of poor quality forages Paper presented at the Second Annual Seminar on Maximum Livestock Production from Minimum Land Bangladesh 1981

Saadullah M, Haque M & Dolberg F 1981a Effectiveness of ammonification through urea in improving the feeding value of rice straw in ruminants Tropical Animal Production 6:32-36

Saadullah M, Haque M & Dolberg F 1981b Lime treatment of rice straw Tropical Animal Production 6:116-120

Sayeed A & Davis C H 1980 A simple method for treating crop residues in the village by soaking in a chemical solution, draining and washing Paper presented at the First Annual Seminar on Maximum Livestock Production from Minimum Land Bangladesh 1980

Tubei S K & Said A N 1981 The utilization of ammoniated maize cobs and maize stover Paper presented at the "Workshop on the utilization of coarse roughage in Africa" Tanzania January 1981

Verma M L 1981 Chemical treatment of straw Paper presented at Second Annual Seminar on Maximum Livestock Production from Minimum Land Bangladesh 1981

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