TREATING RICE STRAW WITH ANIMAL URINE

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Eight male crossbred sheep with four in each group were used to determine the effect of treating straw with animal urine. One litre of urine was added per kg of straw. the straw was treated for 20 days in a stack above ground, covered with bamboo mats which were plastered with a mixture of cow dung and mud. Due to treatment with urine, the crude protein content of the straw was improved from 3.3% to 5.6%. The nitrogen balance for 24 hours was improved from -2.94 g to -1.15 g. Dry matter, organic matter and crude fibre digestibilities went up from 38%, 45% and 56% to 51%, 551 and 62% respectively. The intake of digestible dry matter went up by more than 70%.

It is concluded that animal urine can be as efficient as urea as source of urea for treatment of straw, but further work is needed to determine the health aspects, collection and storage methods of urine and production response in animals to a diet of urine treated straw.

Key words: Treatment of rice straw, sheep, urine, digestibility

Based on our own results and comparisons with other reports, Saadullaha et al (1980) concluded that treatment of rice straw with ammonia through urea is as efficient as anhydrous ammonia, the method in use in a number of industrialised countries. As treatment of straw with urea can be done under very simple storage conditions (Dolberg et al 1980),and since urea is cheap, easy to handle, divide and carry, the efficiency of urea in straw treatment has made the method potentially available to many more small farmers living in remote villages with poor or no access to roads. Still, from a poor farmer's point of view, the method suffers from shortcomings as it does involve expenditure of money and dependence on an outside agent for supply.

Farmers in the NIRDP/DANIDA Project area collect the dung from their cattle by digging pits in the ground - often right behind the cattle shelter. No particular cover is provided and the pit is open to sun and rain. Urine is only collected when the pit is right behind the animals and the slope is such that the urine runs, by itself into the manure pit, where it is absorbed into the compost. If the pit is at a distance from the shelter the urine is generally left uncollected. In either case, very little of the ammonia in the urine will become of use to the farmer.

Coxworth and Kullman (1978) under laboratory conditions have demonstrated cattle urine to be as efficient as other sources of ammonia for straw treatment. It was the purpose of this study to investigate the possibility of using animal urine to treat straw, and the acceptance of such straw by sheep. In order to predict the level of self sufficiency that can be expected, the quantity of urine excreted was also measured.

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Materials and Methods

Collection of urine: Using ordinary collection bags as used for in vivo digestibility trials, urine was collected at the rate of about 500 g per sheep per day from four sheep for a period of 15 days. The collected urine was kept in airtight plastic bottles.

Treatment of straw: Rice straw was bought through a contractor and a portion of it was treated with the sheep urine at the rate of one litre per one kg of straw. The straw was stacked and covered with bamboo mats, which were plastered with a mixture of cow dung and mud. Treatment time was 20 days. After treatment the stack was pulled down and the straw was allowed to dry. Some fungi had developed on the outer parts of the stack. but all straw was kept and used for the experiment. Both untreated and treated straw were analysed for dry matter (DM), crude fibre (CF), crude protein (CP) and ash.

Digestion trial: Eight male crossbred sheep were allocated to two groups with four in each group. Each sheep was placed in a specially designed digestibility crate to facilitate the collection of faeces and urine. The straw was fed ad libitum and intake measured daily. The same sheep had been on a basic straw diet for the preceding nine months and were thus well adjusted to straw. One group received plain untreated straw, while the other had urine treated. Faeces and urine were collected daily for a period of seven days after a preliminary period of fifteen days. Representative urine and faeces samples from each sheep were preserved with 6N HCl and analysed for total nitrogen by Kjeldahl method. Analysis of variance was used to determine the effect of treatment and Duncan's Multiple Range test for significance.

Results and Discussion

Chemical Composition: The chemical composition of the treated and untreated straw is shown in Table 1. It can be observed that treatment of straw caused a lower dry matter.

Table 1:
Chemical composition of Rice Straw (g/100 g of dry matter)

	Dry matter	Crude protein	Crude fibre	Ash
Untreated straw	89	3.3	29	12
Straw 1: urine 1	85	5.6	24	13

The increase in crude protein is in agreement with Coxworth and Kullman (1978), when with the same ration of wheat straw and cattle urine, they reported an increase from 3.3% to 6.7% or 103%. This gives a marginal utility of the first one litre of urine ranging from 2.3% to 3.4% units of crude protein. Adding another two litres of urine to obtain a proportion of one to three, increased the crude protein content by only another 2% units from 6.7% to 8.7%. This gave as low a marginal utility per litre of the last two added as of only 1.0% units crude protein per extra litre of urine. The increase in crude protein in the straw is in agreement with results reported where other sources of ammonia were used (Sundstol et al 1978; Saadullah et al 1980).

The crude fibre fraction was reduced from 29% to 24%. The same trend was reported by Saadullah et al (1980), when urea was used as a source of ammonia.

Digestibility and N-retention: Digestibility of dry matter, organic matter and crude fibre is shown in Table 2 together with nitrogen retention. There was a highly significant ($P < 0.01$) increase in dry matter digestibility and also in crude fibre digestibility. Table 2 also demonstrates an improvement in the nitrogen balance from -2.94 to -1.15 g N/24 hours.

Table 2:
Apparent digestibility (%) and nitrogen retention rice ammoniated through urine

	Untreated	Treated
Dry matter	38	51
Organic matter	45	55
Crude fibre	56	61
N-retention (g/24 hours)	-2.94	-1.15

The effect of adding one litre of urine to one kg of straw on digestibility is greater in this study than compared to that of Coxworth and Kullman (1976). It is also better than the effect of 3% urea treatment on improvement of dry matter and organic matter digestibility and nitrogen retention, but less than 5% urea as reported by Saadullah et al (1980).

Food intake: When the intake of straw in Table 3 is compared on a percentage of bodyweight basis, there is an increase in intake of 28%, due to treatment with urine.

*Table 3: **
Voluntary intake of rice straw ammoniated through urine

	Untreated	Treated
Dry matter g/day	538	369
Organic matter g/day	479	323
Average weight of sheep kg	21.5	11.5
DM consumption as % of bodyweight	2.5	3.2

Compared to increases ranging from 112 to 23% measured, when 5% urea was used for straw treatment (Saadullah et al 1980) the present increase compares well and indicates that urine treated straw is palatable. Combined with the increased digestibility reported in Table 2 this allows a higher intake of digestible dry matter of 71%.

* Editors note: The Editors would like to draw attention to the large weight difference between groups and the possible effects of this on intake and digestibility. However the editors accepted this paper in view of current interest in this subject.

It has recently been demonstrated in a trial on Holstein Friesian heifers at the Rowett Research Institute in Scotland (Ørskov 1980 personal communication) that this double effect of ammonia treatment on intake and digestibility is of considerable practical significance. Heifers fed only NH_3 treated straw gained 350 - 400 g/day, while there was a similar loss of weight on untreated straw, where urea was added at the time of feeding. Intake increased by about 50% and digestibility from 48% to 58%.

Level of urea excreted: To gather some information about the quantity of urea excreted and the degree of self sufficiency that can be expected, Table 4 compares straw and water intake to urine excreted. Data from the control group and an earlier group on 3% urea treated straw are also given.

Table 4:
Comparison of straw and water intake to urine excretion

	Straw only	Urine treated	3% urea treated
Straw consumption g/day	604	434	684
Daily urine excretion ml	359	478	506
Water intake daily ml	1880	1175	1218
Liveweight kg	21.5	11.5	20.1

Urine excretion and water intake may vary for a number of reasons some of the more obvious of which are climate and dry matter percentage in the feed. However, the important comparison here, is that between straw intake and urine excreted. The figures reveal that on a diet of ammonia treated straw as reported, where the animals at the same time had free access to water, the urine excretion will not permit a proportion of urine to straw higher than 1:1. As the nitrogen balance was negative, a supplement rich in protein will have to be added. Because of scarcity of land, combinations with tree legumes or water plants would be particularly interesting. Given a crude protein content of above 25% of DM, a combination of three to four parts of urine treated straw on a DM basis to one part of Leucaena leucocephala DM would give a satisfactory protein level in the total ration. This would also keep Leucaena leucocephala at a level where there should be no problems with the health of the animals due to mimosine. (National Academy of Sciences 1977).

Conclusion

It is concluded that animal urine appears to be as efficient as any other source of ammonia in the treatment of straw. One litre of urine replaces at least 30 g of urea. The figures for urine excretion suggest that a ratio of urine and straw of greater than 1:1 is not feasible. The integration of urine treated straw with a supplement from a tree legume or water plants should be attempted. But further work is needed to determine health aspects, collection and storage methods of urine under village conditions, and production responses in ruminants fed a diet based on straw treated with their own urine.

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