

## Comprehensive Research on Rice

Program: RM - 9

Project Number and Title: 70-26, The Value of Rice Straw as Animal Feed

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Objectives: The long range objective is to determine the potential value of natural and processed rice straw as a feed for ruminant animals.

Short term objectives have been:

1. An evaluation of processed rice straw with animal metabolism and feeding trials.
2. Laboratory investigations to extend and compliment the animal experiments.
3. An evaluation of natural rice straw as a component of a ration for growing-fattening cattle.

Work in Progress: (1) A feeding and digestion trial is underway with lambs, in which three promising procedures for processing rice straw are being evaluated. (2) A feeding trial is underway with beef calves comparing the value of rice straw fed in the form of cubes, pellets or ground by hammer mill. (3) A comparative feeding slaughter trial with growing-fattening steer calves is being conducted to determine the net energy value of rice straw. (4) Chemical analyses of the samples collected from the feeding and digestion trials.

Experiments Completed: Laboratory analyses of the samples obtained from previous reported digestion trials have been completed. The results indicate the increased digestibility of the NaOH or the NH<sub>3</sub> treated straw is related to an increased availability of the cellulose fraction. The magnitude of the increase in cellulose availability has been variable but ranges from 15 to 30%.

A comparative slaughter feeding trial with lambs has been completed. The trial compared untreated straw with straw processed with steam (400 psi for 90 and 20 seconds) 4% NaOH (at 100°C and at 400 psi steam pressure) and NH<sub>3</sub> treated straw. The results are summarized in table 1. Lambs receiving the rations containing NaOH or NH<sub>3</sub>, treated straw gained more weight and ate more feed than lambs eating the control ration (untreated rice straw). The straw processed by a steam pressure of 400 psi for 90 seconds was unpalatable to the lambs. Feed consumption on this ration was not enough for the lambs to maintain their weight. The straw processed by exposure to steam at 400 psi for 20 seconds did not result in improved performance of the lambs.

A feeding trial conducted on rice straw treated with NH<sub>3</sub> at a Richvale ranch gave results practically identical to those obtained with the straw treated with NH<sub>3</sub> at the U.S.D.A. laboratory in Albany. The results of this trial shown in table 2 also indicate an increased palatability of the NH<sub>3</sub> treated straw with a resulting increase in lamb performance.

These results along with those from current investigations will provide the necessary data to evaluate the practical economics of treated rice straw as a feed for ruminants.

In another trial untreated rice straw was successfully used in rations for wintering steer calves. The rations contained 70 to 83% rice straw and were fortified with protein, minerals and vitamin A supplements to correct the deficiencies present in the straw. The 500 lb. calves gained from .5 to .8 lb/day over a 98 day feeding period. Cubing the ration prevented sorting of the ingredients, but a binder was necessary to prepare a good quality cube.

Table 1. Response of lamb fed a 65% rice straw ration<sup>e</sup>

Measured variables	Rice straw treatment					
	Control	400 psi 90 seconds	400 psi 20 seconds	400 psi 4% NaOH	100° NaOH	NH <sub>3</sub>
Days fed	63	63	63	63	63	63
No. of lambs	10	10	10	10	10	10
Initial wt. lb.	57.8	57.8	56.3	58.4	57.5	57.7
Final wt. lb.	75.2 <sup>b</sup>	54.2 <sup>a</sup>	74.7 <sup>b</sup>	83.3 <sup>c</sup>	84.7 <sup>c</sup>	83.1 <sup>c</sup>
Daily gain, lb.	0.28 <sup>b</sup>	-.06 <sup>a</sup>	0.29 <sup>b</sup>	0.40 <sup>c</sup>	0.43 <sup>c</sup>	0.40 <sup>c</sup>
Feed intake <sup>d</sup> , lb.	4.15 <sup>b</sup>	2.87 <sup>a</sup>	4.49 <sup>b</sup>	4.76 <sup>c</sup>	5.01 <sup>c</sup>	4.83 <sup>c</sup>
Feed/gain ration	14.8 <sup>b</sup>	∞ <sup>a</sup>	15.5 <sup>b</sup>	11.9 <sup>c</sup>	11.6 <sup>c</sup>	12.1 <sup>c</sup>
Energy gain,						
kcal/day	500 <sup>b</sup>	100 <sup>a</sup>	510 <sup>b</sup>	780 <sup>c</sup>	720 <sup>c</sup>	770 <sup>c</sup>
Carcass fat, %	23.2 <sup>b</sup>	20.5 <sup>a</sup>	23.2 <sup>b</sup>	24.3 <sup>b</sup>	26.6 <sup>b</sup>	26.1 <sup>b</sup>
Net energy value						
Maintenance,						
mcal/lb.	0.47	0.26	0.42	0.52	0.52	0.52
Production,						
mcal/lb.	0.20	-	0.19	0.25	0.21	0.24

a,b,c, - Means with unlike superscripts are significantly different (P<.05).

b - Dry matter per day.

e - Rice straw, 65%; Barley, 12%; Cottonseed meal, 12%; Molasses, 9.5%; Urea, 0.5%; Dicalcium phosphate, 0.5%; Trace mineral salt, 0.5%; Vitamin A, 1200 I.U./lb.

Table 2. Response of lambs fed a rice straw ration<sup>c</sup> treated with ammonia at Richvale.

Measured variable	Richvale straw	
	Control	NH <sub>3</sub> treated
Days fed	57	57
No. of lambs	10	10
Initial wt. lb.	58.4	57.7
Final wt. lb.	72.7	78.9 <sup>a</sup>
Daily gain, lb.	0.25	0.37 <sup>a</sup>
Feed intake <sup>b</sup> , lb.	4.16	4.62 <sup>a</sup>
Feed/gain ratio	16.6	12.5 <sup>a</sup>
Energy gain, kcal/day	530	700 <sup>a</sup>
Carcass fat, %	24.5	24.8
Net energy value		
Maintenance, mcal/lb.	0.48	0.52
Production, mcal/lb.	0.21	0.23

a - Means with unlike superscripts are significantly different (P<.05)

b - Dry matter per day.

c - See footnote e of table 1.

Major Accomplishments: The feeding value of rice straw has been improved by treatment with NaOH or NH<sub>3</sub>. The major difference between the treated and untreated straw is an increased utilization of the cellulose and an improved palatability of the treated straw.

Work Planned: This project is being terminated due to the reluctance of the Rice Board to supply additional funds for research in this area.

Immediately Applicable Research Results: We now have considerable confidence in our knowledge concerning the feeding value of natural rice straw and are obtaining the data which will give us the information necessary to extend this confidence to the treated straws. The data now available will permit some reasonable projections concerning the value of rice straw to the animal industry.

Evaluation of the Project: This project has the advantage of being a cooperative venture in that additional funds have been available from the U.S.D.A. for assistance in the animal phase of these investigations. The U.S.D.A. has also been responsible for development of the straw treatment procedures and has supplied all the treated straws used in these cooperative trials. Thru our cooperative efforts, but due primarily to the input of man power and funds from the U.S.D.A., this project has supplied animal nutritionists with the information which can be used to more effectively assess the possible uses of rice straw in ruminant diets. Completion of the experiments now in progress should provide the additional information necessary for a reasonable economic appraisal of the role that rice straw might have in the animal industry.

Publication of Reports:

Dobie, J. B. and W. N. Garrett. 1972. Utilization of rice straw for livestock feed. American Society of Agricultural Engineers, SP - 01 - 72.

Waiss, H. G. Jr., J. Guggolz, G. O. Kohler, H. G. Walker, Jr., and W. N. Garrett. Improving digestibility of straws for ruminant feed by aqueous ammonia. J. Animal Science 35:109.

Hull, R. L., J. B. Dobie and J. G. Morris. 1972. Steer Calves Can Be Wintered On Rations High In Rice Straw. California Agriculture, November.