Effect of Feeding Urea Treated Rice and Wheat Straw on Intake and Milk Yield of Lactating Buffaloes under Farmers Conditions

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ABSTRACT : Two experiments were conducted to study the effect of urea treatment of rice and wheat straw on feed intake, dry matter (DM) digestibility and milk yield of lactating buffaloes in their late lactation under farmers' management conditions in the western hills of Nepal during 1995 and 1997. Dry matter intake (DMI) from urea treated rice and wheat straw was not improved significantly ($p>0.05$) nor the total DMI of the lactating buffaloes was improved significantly. However, feeding urea treated rice straw increased straw DMI by 14.2% and total DMI by 10.63% units over the untreated rice straw. Similarly, the increase in straw and total DMI were 20.18 and 17.40% units over the untreated wheat straw fed animals. Although there was no significant effect of urea treatment of both straw on DM digestibility, it was higher for treated than untreated straw at all locations. An overall increment of 18.1% units for rice straw and 13.3% units for wheat straw was observed. There was a significant effect ($p<0.01$) of feeding urea treated rice and wheat straw on the milk yield of lactating buffaloes during late lactation under farmers conditions. Post experiment milk yield was also significantly ($p<0.05$) higher for the animals fed treated straw in both the experiments. Buffalo milk yield was also significantly affected by breed ($p<0.01$), location ($p<0.01$) and parity ($p<0.01$) of the animals. General response of the farmers about the technology and their observed effect on animal performance was also very positive. (*Asian-Aus. J. Anim. Sci. 1999. Vol. 12, No. 8 : 1200-1204*)

Key Words : Urea Treatment, Rice and Wheat Straw, Lactating Buffaloes, Farmers' Management

INTRODUCTION

Fibrous crop residues (FCR) play an important role in the supply of ruminant feeds, particularly for large ruminants, in the complex and integrated crop-livestock farming system of Nepal. Rice and wheat straw are two main FCR available to the farmers. Both these straws occupy a major portion of ruminant diets in the western hills of this mountainous country. Large ruminants in this part of the country survive on straw based diets for seven months or more, from November to May/June (Poudel et al., 1997). However, low nutrient content and poor feeding value are the main constraints in their efficient utilization as ruminant feed. Efforts have been going on in various parts of the tropical and sub-tropical world for improving the nutrient content, voluntary intake, digestibility and utilization by the animal. Special emphasis has been given to generate simple and economically viable technologies that suit the varied conditions of subsistence farmers of the developing countries. Although various technologies have been reported for improving their feeding value and nutrient content (Ibrahim, 1983; Reddy et al., 1993; Jayasuria, 1985; Leng and Preston, 1985), most of them involve a great deal of technical know-how and therefore have not been easily adapted by the common farmers for whom they were intended.

Urea treatment of straw is one of the technologies that has been tried in most of the tropical countries and found effective in improving nutrient content and feeding value of various types of straw. It has been reported that urea treatment increases digestibility, palatability and nutrient content of the straw (Dahiya et al., 1992). Dhaubhadel and Tiwari (1991) have found that feeding urea treated straw to lactating buffaloes increased milk yield. It is one of those few technologies that have been relatively adapted by the farmers in many countries. Verification of this technology and its proper modification to suit the hill farming system and maintaining its level of effectiveness at the same time is an important aspect for proper and efficient utilization of FCR in Nepal.

Two experiments were conducted to study the effect of feeding urea treated rice and wheat straw on the total and straw DMI, digestibility and milk yield of lactating buffaloes under farmers conditions in Lumle Agricultural Research Centre's (LARC) Research Command Areas (RCA).

MATERIALS AND METHODS

Selection of sites and experimental buffaloes

First experiment to study the effect of feeding urea treated rice straw to lactating buffaloes was conducted during 1995 at 3 different out-reach sites, Wakhet, Pakuwa and Shishuwa (Myagdi, Parbat and Kaski districts respectively) of LARC's RCA. Second experiment on the effect feeding urea treated wheat straw to lactating buffaloes was conducted at 4 different out-reach sites, Barabise, Atrauli, Chhebetar,

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Table 1. Daily DMI (kg) from urea treated and untreated rice straw, other forages *kundo* and total DMI by lactating buffaloes under farmers conditions

Treatments	Rice straw	*Kundo*	Other forages		Total DMI
			Green	Dry	
Urea treated	7.80±1.01	1.13±0.21	2.12±0.28	2.34±0.29	13.42±1.47
Urea untreated	6.83±0.93	1.05±0.20	2.20±0.31	2.07±0.23	12.13±1.33

and Pakuwa (Syangja, Tanahun, Gorkha and Parbat districts respectively) in 1997. These sites were selected such that they represented different agro-ecological zones of the western hills of Nepal. Four buffaloes in their late lactation were selected for each treatment in each site from the farmers field and allotted at random to urea treated and untreated rice or wheat straw feeding group in each out-reach site. These buffaloes were selected such that their milk yield was very close to each other. This was 3.49 and 3.51 kg/day respectively for urea treated and untreated rice straw fed group and 3.02 and 3.09 kg/day respectively for urea treated and untreated wheat straw fed group.

Urea treatment of rice and wheat straw

Rice and wheat straw were treated with 4% urea (DM basis) dissolved in water and the solution was sprinkled over the straw in 1:1 ratio (w/v). Urea dissolved water was sprinkled uniformly over the straw and mixed thoroughly. The treated straw was then filled in a pit (depth - 1.5 m and diameter - 1 m) where polythene sheet was spread for ensiling and pressed manually by trampling. The pit was sealed by a polythene sheet, plastered with soil for making the pit air tight and ensiled for 3 weeks.

Feeding of rice and wheat straw

After 3 weeks of ensiling, treated straw was taken out from the pit as per the daily requirement of the animals. Animals were fed with treated rice and wheat straw after exposing the ensiled material for 2 hours to avoid the inhalation of ammonia by the animals. Untreated rice and wheat straw was fed immediately after taking out from the barn. All animals were given an initial adaptation period of 10 days, and milk yield and feed intake was monitored for successive 21 days. Introduction of urea treated straw was gradual. All animals were also given *kundo* (a kind of cooked home made concentrate prepared from rice bran, maize grain/flour, oil cakes and other household wastes) and other forages as per the farmers practice. Water was made available twice daily. They were kept completely under stall feeding conditions. All other management practices were similar as far as possible. However, due to the differences in farmers practice, there might have been slight variations in some management aspects which is extremely difficult to control under field conditions existing in the western hills when 3 or 4 sites lying at a distance of 50 km from each other are managed at the same time.

Observation and recording

Data were recorded for the feeds offered and left, daily intakes of urea treated and untreated rice and wheat straw, *kundo*, other forages and total DMI for the experimental period.

Dry matter content of the individual feed offered was also determined (AOAC, 1980). Faeces were also collected at the end of the experiment for 7 days and their DM content determined for estimating apparent digestibility. Milk yield of all lactating buffaloes was recorded daily by the farmers for 21 days during the experiment and 10 days post-experiment.

Data analysis

Data obtained on milk yield and feed intake were analyzed using general linear model. Breed of the buffaloes, location and parity of the animal were also considered while analyzing the data obtained on milk yield. However, these parameters were not taken into account for analyzing the data on post-experiment milk yield. Digestibility was determined for both rice and wheat straw, and the locations were pooled for comparison between the two.

RESULTS AND DISCUSSION

Dry matter intake

Table 1 shows the daily DM intake from urea treated and untreated rice straw, other forages, *kundo* and total DMI by lactating buffaloes under farmers' management conditions. There was no significant effect on the DMI from any of the feeds studied nor was it on the total DMI. However, there was a trend that urea treatment increased rice straw intake and total DMI by the lactating buffaloes. The increase in rice straw intake was 14.2% and that in total DMI was 10.63%. Although a fixed amount of *kundo* and other forages were offered to the experimental buffaloes in both the groups in both experiments, intake of these items was different (not significant) which may be due to feeding of treated straw. Increased straw and total DMI have been shown in a review by Khajarern and

Table 2. Daily intake (kg) of urea treated and untreated wheat straw, *kundo*, other forages and total DMI by lactating buffaloes under farmers conditions

Treatments	Wheat straw	*Kundo*	Other forages		Total DMI
			Green	Dry	
Urea treated	3.93±0.57	1.02±0.20	4.89±0.52	3.23±0.51	13.09±1.23
Urea untreated	3.27±0.33	0.92±0.17	4.76±0.43	2.65±0.29	11.15±1.19

Table 3. Total DM digestibility (%) of urea treated and untreated rice and wheat straw by lactating buffaloes under farmers conditions in the western hills of Nepal

Treatments	Rice straw			Pooled	Wheat straw				Pooled
	Pakuwa	Shisuwa	Wakhet		Pakuwa	Atrauli	Barabise	Chhebetar	
Urea treated	53.6±3.7	52.7±3.8	56.1±4.8	54.2±4.0	56.6±4.0	57.8±4.2	55.9±4.6	59.2±4.6	56.9±4.3
Urea untreated	46.3±3.2	47.4±3.7	43.9±3.0	45.9±3.3	50.7±4.0	49.2±4.1	48.5±4.2	51.9±5.1	50.2±4.3

Khajarern (1985) in various species of ruminants. However, Ibrahim (1983) reported a reduced intake in ruminants, when urea ensiled straw was fed to them.

Table 2 shows the daily DM intake from urea treated and untreated wheat straw, other forages, *kundo* and total DMI of the lactating buffaloes under farmers conditions. Although the increment of straw and total DMI was statistically non-significant, intake was increased by 20.18 and 17.40 percentage units in straw and total DMI, respectively. The trend in feeding rice and wheat straw was similar in both the cases. Intake of both untreated and urea treated rice straw was higher than that of wheat straw while the percentage unit increase of feed intake was high for urea treated wheat than for urea treated rice straw. This may be due to the habit of feeding rice straw to buffaloes for quite a long time as against to wheat straw feeding which is not very common among the farmers.

Digestibility

Although there was no significant effect of urea treatment on the apparent DM digestibility by the lactating buffaloes under farmers management conditions in the western hills of Nepal (table 3), an overall increment in the apparent digestibility could be clearly observed at all locations. It was 18.1% units for rice straw and 13.3% units for wheat straw. This could be due to the better rumen environment created by the increased concentration of ammonia upon the degradation of urea by the rumen microbes. Because provision of NPN increases ammonia level in the rumen and increases microbial population (Orskov, 1986) which then act upon the feed material available in the system. Better digestibility of DM could be the reason for some improvement in the total DMI by the animals (tables 1 and 2).

Milk yield

Least square means and standard errors of milk yield of lactating buffaloes fed urea treated and untreated rice and wheat straw under farmers management conditions in the western hills are given in table 4. There was a significant increase ($p<0.05$) in the milk yield of lactating buffaloes in their late lactation when these buffaloes were fed with 4% urea treated rice and wheat straw. This may be due to increased nutrient content in the treated straw and higher (but non-significant) intake and digestibility of both the treated straws. Because urea treatment increases crude protein through added non-protein nitrogen (NPN) and enhances digestibility through delignification.

Urea treatment increases microbial protein synthetic activity (Garg, 1998) in the rumen making more microbial protein yield available in the lower gut for higher milk production. Increased milk yield might also be due to increased total DMI (tables 1 and 2) when urea treated straw was fed to the experimental animals. Besides, urea treatment might have changed the intrinsic properties of rice and wheat straw for higher energy yields (Moss et al., 1994) and reduced methane emission from it (Leng, 1991). This energy might have been utilised for increased milk production. Since initial milk yield (3.49 and 3.51 in the first experiment and 3.02 and 3.09 kg/day in second experiment respectively in treated and untreated rice and wheat straw fed group) of the animals was similar in both the groups in both experiments, this might be due to the effect of feeding treated straw. Increased milk yield due to urea treated straw feeding to lactating buffaloes has been reported by Doyle et al. (1986) and Dhaubhadel and Tiwari (1991).

Effect of breed, location and parity on the milk

yield of buffaloes is also given in table 4. Breed and location had a highly significant effect ($p<0.01$) whereas that of parity had a significant effect ($p<0.05$) on the milk yield of lactating buffaloes. Murrah crosses gave higher yield than that of local ones, and 3rd and 4th lactation animals gave higher yields than 2nd lactation animals both of which are normal. Significant effect of location may be because some locations might be better than the others due to micro-climatic conditions prevailing in those specific areas.

Post experiment milk yield of animals given treated rice and wheat straw was also significantly ($p<0.05$) higher than those given untreated rice or wheat straw. It indicated that there was some effect of urea treatment on milk yield even after withdrawal of feeding treated straw. This may be due to the improved body condition of the buffaloes in treated group (farmers' response).

Farmers' response

Farmers' perception and response to urea treatment of rice and wheat straw was also collected at the end of the experiment. In general all farmers liked the urea treatment technology because it improved milk production, animals liked it and consumed more. Farmers believed that body condition was improved upon feeding of treated straw. They were more attracted by the persistence of milk yield even after the withdrawal of feeding treated straw to the experimental animals. They said that rice straw is the major roughage and wheat straw is not fed generally to their ruminants and is wasted. This technology provides an opportunity to utilize these residues more efficiently. This can improve the feed situation during February - May when the farmers are running with great difficulty due to the scarcity of feed and fodder. However, they expressed their reservation about the unavailability of urea in the villages and consider it as a major constraint of this technology. Farmers were a bit sceptical to the technology since increment in DM intake meant more straw required for the same animals which these small farmers were constrained by the limited availability of rice or wheat straw.

CONCLUSION

These two experiments conducted under farmers' conditions indicated that urea treatment of rice and wheat straw increases milk yield of buffaloes in their late lactation. An increment trend on straw and total DMI was also observed in the buffaloes. Persistency in the milk yield even after withdrawal of feeding urea treated straw was liked very much by the farmers. Since the experiments were conducted by the farmers themselves, its relevance to and adaptability by the farmers is relatively high. It can help in addressing the winter feed scarcity. Farmers' response to the overall technology was also very positive.

Table 4. Least square means of milk yield (kg/day) of lactating buffaloes fed urea treated and untreated rice and wheat straw under farmers conditions

Factors	Rice straw	Wheat straw
Treatment	p=0.05	p=0.05
i. During experiment :		
Urea treated	4.26±0.32	3.64±0.31
Urea untreated	3.11±0.30	2.52±0.25
ii. Post experiment :		
Urea treated	4.11±0.31	3.52±0.30
Urea untreated	2.86±0.28	2.21±0.25
Breed	p=0.001	p=0.0001
Murrah cross	4.42±0.39	4.38±0.30
Loca	2.89±0.29	2.56±0.15
Location	p=0.01	p=0.01
Shishuwa	4.37±0.41	-
Wakhet	4.48±0.37	-
Pakuwa	3.68±0.35	3.70±0.46
Atrauli	-	2.63±0.27
Barabise	-	2.76±0.22
Chhebetar	-	3.35±0.40
Parity	p=0.05	p=0.05
2	3.13±0.38	2.86±0.36
3	4.23±0.43	3.54±0.37
4	4.04±0.37	-

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REFERENCES

AOAC. 1980. Official Methods of Analysis, 13th Ed., Assoc. Off. Anal. Chem. Washington DC, USA.

Dahiya, S. S., S. J. Sengar, P. Sikka and V. D. Mudgal. 1992. Feed intake nutrient utilization, and milk production in buffaloes maintained on urea-treated wheat straw based ration. Buffalo Bulletin, 11(2).

Dhaubhadel, T. S. and B. N. Tiwari. 1991. Problems and prospects of crop by-product utilization as an animal feed in the hills of Nepal: experiences of Lumle Regional Agricultural Research Centre, Nepal. LARC Seminar Paper No. 28/91. Lumle, Kaski. Lumle Agricultural Research Centre.

Doyle, P. T., C. Devendra. and G. R. Pearce. 1986. Rice Straw as Feed for Ruminants. IDP, Canberra, Australia.

Garg, M. R. 1998. Role of bypass protein in feeding ruminants on crop residue based diet. Asian-Aus. J. Anim. Sci. 11(2):107-116.

Ibrahim, M. N. M. 1983. Physical, chemical, physico-chemical and biological treatment of crop residues. In: G. R. Pearce (Ed.) The Utilization of Fibrous Agricultural Residues. Australian Government Publishing Service, Canberra.

Jayasuria, M. C. N. 1985. Potential for the better utilisation of crop residues and agro-industrial by-products in animal feeding in the Indian sub-continent. In: FAO Animal Production and Health Paper 50, FAO, Rome. 37-39.

Khajarern, S. and J. Khajarern. 1985. Potential for the utilization of crop residues and agro-industrial by-products in animal feeding in Southeast Asia, with special reference to methodology, equipment, facilities, and personnel involved as well as outline of research priorities of the region. In: Better Utilization of Crop Residues and By-products in Animal Feeding: Research Guidelines. 1. State of Knowledge. FAO Animal Production and Health Paper No. 50, 1985. FAO, Rome.

Leng, R. A. 1991. Improving ruminant production and reducing methane emissions from ruminants by strategic supplementation. EPA/400/1-91/004, US Environmental Protection Agency, Washington DC.

Leng, R. A. and T. R. Preston. 1985. Constraints to the efficient utilization of sugar cane and its by-products for production of large ruminants. In: R. M. Dixon (Ed.) Ruminant Feeding Systems Utilizing Fibrous Agricultural Residues. IDP, Canberra, Australia.

Moss, A. R., D. I. Givens and P. C. Garnsworthy. 1994. The effect of alkali treatment of cereal straws on digestibility and methane production by sheep. Animal Feed Science and Technology. 49:245-259.

Ørskov, E. R. 1986. Factors affecting utilization of poor quality roughages. In: M. N. M. Ibrahim and J. B. Schiere (Ed.) Straw and Related Feeds in Ruminant Rations, Straw Utilization Project, Publication No. 2, Kandy, Sri Lanka.

Paudel, K. C., I. K. Aryal., N. P. Osti., R. P. Bari, T. B. Karki and D. P. Rasali. 1997. Livestock feeds and feeding systems in the western hills of Nepal. Paper presented at the 2nd National Workshop on Livestock and Fisheries Research, Nepal Agricultural Research Council, Khumaltar, Lalitpur, Nepal.

Reddy, M. R., M. Chandrashekharaiah, T. Govindaiah and G. V. N. Reddy. 1993. Effect of physical processing on the nutritive value of bagasse in goats and sheep. Small Ruminant Research. 10(1):25-31.