Utilization of Urea-Treated Rice Straw and Whole Sugar Cane Crop as Roughage Sources for Dairy Cattle during the Dry Season

M. Wanapat, S. Chumpawadee and P. Paengkoum

Department of Animal Science, Faculty of Agriculture, Khon Kaen University, Khon Kaen 40002, Thailand

ABSTRACT : Two experiments were conducted to study the use of urea-treated rice straw (UTRS) and whole sugar cane (WSC) crop as roughage sources for dairy cattle during the dry season. Experiment I, four rumen-fistulated dairy crossbred steers were assigned to receive roughage treatments according to a 4×4 Latin square design: T_1=urea-treated (5%) rice straw, T_2=UTRS and WSC at 75:25% DM, T_3=UTRS and WSC at 25:75% DM, and T_4=WSC. Experiment II, three rumen fistulated, late lactating multiparous Holstein-Friesian crossbreds were randomly allotted to a 3×3 Latin square design to receive three types of roughages; T_1=WSC, T_2=UTRS, T_3=WSC+UTRS at 50:50% DM. It was found that combination of UTRS and WSC at 75:25 ratio significantly increased DM intake while intake of WSC alone was lowest. Moreover, inclusion of UTRS into WSC enhanced digestibilites (Exp. I). In Exp. II, combination of UTRS with WSC at 50:50 ratio (DM) enhanced DM intake (kg/d) ($p<0.05$) and especially milk yield, milk fat and protein percentages. The findings suggest the combined use of WSC and UTRS improved the feeding values of these roughages for dairy cattle during the dry season. (*Asian-Aus. J. Anim. Sci. 2000. Vol. 13, No. 4 : 474-477*)

Key Words : Whole Sugar Cane, Urea-Treated Rice Straw, Dairy Cattle, Intake, Milk Yield, Milk Compositions

INTRODUCTION

Urea-treated rice straw has been reported to contain higher nitrogen, higher digestibility less rumen retention time, higher VFA production, higher overall intake, and thus enhances the performance of ruminants, as compared to untreated rice straw (Wanapat, 1985; Hart and Wanapat, 1992). Dairy farmers in Thailand have been using urea-treated rice straw as a sole source of roughage during the dry season (Wanapat, 1994). However, whole sugar cane crops or tops have been available during the dry season, and contain higher protein and some fermentable carbohydrate. Ferriero and Preston (1976) and Preston (1983) have reported success in using sugar cane stalk, tops and by-products for ruminant feeding. It could be of nutritional importance if these two roughages could be efficiently integrated in the dairy feeding system since they are generally available during the dry season. Therefore, the objectives of these experiments were to assess the feeding values of urea-treated rice straw in combination with WSC crop as roughage sources for dairy cattle during the dry season.

MATERIALS AND METHODS

Experiment I

Four rumen fistulated dairy crossbred steers about two years of age were randomly allotted into a 4×4 Latin square design to receive four roughage treatments;

T_1 = Urea-treated rice straw (UTRS),
T_2 = UTRS and whole sugar cane (WSC) at 75:25% (DM),
T_3 = UTRS and WSC at 25:75% (DM),
T_4 = WSC.

Urea-treated rice straw was prepared by using 5 kg urea+100 kg water, mixing on to 100 kg of straw, and then covering up for 10 days before feeding to the cattle. Whole sugar cane was harvested at 6-7 months and chopped to about 2-3 inches before feeding. UTRS and WSC were mixed in the above proportions before being given to the cattle. All animals were adapted to their diets for 14 days before being individually penned in metabolism crates for 7 days of total excreta collections. Roughages were fed *ad libitum* and daily intakes were measured while cottonseed meal were given in small amount (0.3% BW/d). Feeds, feces and urine were sampled for chemical analyses. Rumen fluid and blood were sampled at 0 and 4 h post-feeding to be analyzed for pH, NH_3-N (Bremner and Keeney, 1965) and BUN (Crocker, 1967). Digestion coefficients were calculated (Schneider and Flatt, 1975). All means were subjected according to analysis of variance and treatment means were compared by Duncan's New Multiple Range Test (SAS, 1996).

Experiment II

Three rumen fistulated, late lactating multiparous Holstein Friesian crossbred cows were randomly

* Corresponding Author: M. Wanapat. Tel: +66-43-239-749, Fax: +66-43-244474, E-mail: metha@kku1.kku.ac.th.
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Table 1. Chemical composition of feeds used in the Experiment I

	DM	Ash	CP	NDF	ADF	ADL
	%	% of dry matter				
Urea-treated rice straw	50.5	23.2	8.5	72.4	57.1	6.6
Whole sugar cane	72.4	10.4	7.1	75.7	43.7	5.1
Cottonseed meal	92.5	7.2	41.2	37.2	19.1	10.7

Table 2. Effect of urea-treated rice straw (UTRS), whole sugar cane (WSC) or combinations on ruminal parameters, roughage intake and digestibility (Exp. I)

	UTRS	UTRS:WSC, % DM		WSC	SEM
		75:25	25:75		
DM intake					
kg/d	7.95[a]	7.75[a]	7.37[a]	5.56[b]	0.49
% BW/d	2.08[a]	2.55[b]	2.00[a]	1.50[c]	0.10
g/kg $W^{0.75}$/d	95[a]	112[b]	88[a]	66[c]	2.50
Ruminal pH	6.50	6.50	6.40	6.20	0.06
Ruminal NH_3-N, mg/dl	5.7	5.6	4.9	5.3	0.40
BUN, mg/dl	13.4[a]	11.5[ab]	8.5[a]	6.6[c]	1.05
Digestibility, %					
DM	67.1[a]	67.8[a]	61.5[a]	56.9[b]	2.68
OM	71.7[a]	71.5[a]	65.7[b]	62.0[b]	2.45
CP	57.5	59.0	59.1	58.0	3.30

[a,b,c] Values with different superscripts differ ($p<0.05$).

allotted according to a 3×3 Latin square design to receive three types of roughages as treatments:

T_1 = Whole sugar cane (WSC),
T_2 = Urea-treated (5%) rice straw (UTRS),
T_3 = WSC+UTRS at 50:50% (DM).

Roughages were fed *ad libitum* while concentrate (16% CP) was given at 1.5% BW/d. Ingredient and chemical compositions are presented in table 3. Each cow was individually housed in a metabolism crate for 7 days for total collection after 14 days adaptation to diet. Milk was recorded dairy and sampled for analysis. Feeds, feces and milk samples were collected during the collection period. Rumen and blood samples were taken at 0 and 4 h post-feeding for pH, NH_3-N (Bremner and Keeney, 1965), BUN (Crocker, 1697) analyses. All data were subjected to analysis of variance using Proc. GLM and treatment means were compared using Duncans New Multiple Range test (SAS, 1996).

RESULTS AND DISCUSSION

Experiment I

The chemical composition of the feeds is shown in table 1. As could be expected, UTRS contained higher crude protein (8.5%) than WSC which had 7.1% CP and 75.7% NDF. These values were similar to those reported by Wanapat et al. (1995), but cutting the WSC at 7 months after planting resulted in higher DM and NDF contents, and thus lower sugar content. DM intakes of UTRS alone were in a normal range (2.18% BW) while those of WSC alone were significantly lower (1.50% BW). The combination of UTRS:WSC at 75:25 gave the highest intakes (2.55% BW). Since UTRS had higher CP content, it also provided additional NH_3-N in the rumen. Therefore, the combination of UTRS and WSC could give more favorable results in terms of DM intake as well as DM and OM digestibilities. However, the higher level of WSC with UTRS resulted in lower intakes and digestibilities. These effects might be attributed to relatively lower ruminal pH (6.40 and 6.20) and NH_3-N (4.9-5.7 mg/dl), since optimal ruminal NH_3-N levels have been reported to be 15-30 mg/dl (Perdok and Leng, 1985; Wanapat and Pimpa, 1999) rather than only 4-5 mg/dl (Satter and Slyter, 1974). BUN concentration was highest in UTRS and lowest and in WSC fed groups. Digestibilities were lowest in WSC fed group and were improved in UTRS and WSC mixed-fed groups (75:25). It appeared that providing additional rumen degradable protein through UTRS improved WSC and WSC with UTRS. Based on this experiment the utilization of UTRS and WSC in combination gave the best results with DM intake and

Table 3. Chemical composition of the feeds used in the experiment

	DM	Ash	CP	NDF	ADF	ADL
	%	% of dry matter				
Urea-treated rice straw	55.4	25.7	8.9	72.1	49.9	7.5
Whole sugar cane	68.0	10.3	8.1	76.1	42.7	6.3
Concentrate	91.4	13.3	17.2	54.2	36.4	2.1
Concentrate mixture,	% by weight (air-dried)					
Cassava chip			75			
Cottonseed meal			17			
Urea			4			
Sulfur			1			
Salt and mineral mix			3			

digestibility especially at 75:25 level (table 2).

Experiment II

Chemical compositions of UTRS, WSC and concentrate are presented in table 3. Values were similar to those used in Exp. I. Intakes, ruminal characteristics, BUN, digestibilities, milk yields and compositions are reported in table 4 and 5. Intakes of UTRS and UTRS+WSC were similar and were higher ($p<0.05$) than those of WSC fed group. However, the use of a high level of concentrate in these cows resulted in similar ruminal characteristics and BUN which could have affected roughage intakes, although the results obtained in Exp. I, favored the combination of UTRS and WSC. Since WSC contained higher fermentable carbohydrate especially simple sugars, addition of fermentable non-protein nitrogen through urea could improve digestibility in the rumen. In this experiment (table 4 and 5), digestibilities were highest in UTRS and UTRS+WSC as compared to WSC alone. Higher digestibilities resulted in higher DM intakes. It was also probable the green sugar cane top could provide additional vitamin A in the combined UTRS ration. Significant enhancements were found in milk fat and protein percentages in the UTRS+WSC fed cows.

In this experiment, feeding the UTRS and WSC combination to late lactating cows resulted in the highest milk yield, fat and protein percentages. Therefore, in the long dry season when common roughages are normally scarce, the use of UTRS and WSC in good combination would serve as good sources in ruminant diets to improve productivity and sustainability of a dairy cattle production system.

Table 4. Effect of urea-treated rice straw (UTRS), whole sugar cane (WSC) or combinations on ruminal parameters, intake, and digestibility (Exp. II)

	UTRS	WSC	UTRS +WSC (50:50DM)	SEM
DM intake				
Roughage, kg/d	6.6^{ab}	5.9^{a}	7.6^{b}	0.28
% BW/d	1.8^{a}	1.6^{b}	1.8^{a}	0.04
g/kg $W^{0.75}$/d	87^{a}	81^{b}	95^{c}	2.11
Concentrate, kg/d	6.1	5.0	5.4	0.33
Ruminal pH	6.63	6.72	10.83	0.22
Ruminal NH_3-N, mg/dl	9.72	10.51	10.83	0.22
BUN, mg %	9.60	9.09	9.69	0.11
Digestibility, %				
DM	62.2^{a}	57.9^{b}	61.3^{a}	0.66
OM	68.7^{a}	62.8^{b}	65.6^{c}	0.73
CP	58.7^{a}	53.6^{b}	57.1^{c}	0.75
NDF	53.8^{a}	49.3^{b}	52.9^{ab}	0.68
ADF	49.3^{a}	45.0^{b}	48.5^{b}	0.68

^{a,b,c} Values with different superscripts differ ($p<0.05$).

Table 5. Effect of urea-treated rice straw (UTRS), whole sugar cane (WSC) or combinations on milk yield and composition in late lactating cows (Exp. II)

	UTRS	WSC	UTRS+WSC (50:50DM)	SEM
Milk yield, kg/d	4.21^{a}	4.26^{a}	4.47^{b}	0.05
3.5% FCM, kg/d	4.31^{a}	4.49^{a}	5.55^{b}	0.35
Fat, %	3.63^{a}	3.88^{a}	4.95^{b}	0.45
Protein, %	3.87^{a}	3.93^{a}	4.19^{b}	0.05
SNF, %	8.17^{a}	8.06^{b}	8.18^{a}	0.03

^{a,b,c} Values with different superscripts differ ($p<0.05$).

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