DEGRADABILITY OF CEREAL STRAW USING IN SACCO AND MOBILE BAG TECHNIQUES

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Introduction

Many reports have been published to demonstrate various means to improve the nutritive value of cereal straw in ruminant feeding (Sundstol et al., 1978; Wanapat et al., 1985; Doyle et al. 1986). The close relationship with digestible dry matter intake and growth rate of ruminants (Ørskov et al. 1988) and nylon bag degradation values justifies this method to be used as a relevant tool to evaluate the changes occurring in the ruminal breakdown of straw. The mobile bag method has been used to study the lower-gut digestion of individual feeds in ruminants. The effect of treatments of various cereal straws on the degradability in the rumen and subsequently in the intestine was studied by using the bag methods.

Materials and Methods

In the experiment with 6 x 8 factorial (hours, feeds) arrangement of treatments in CRD, three ruminally and duodenally cannulated non-lactating cows were fed 2 kg hay, 2 kg barley straw and 1.5 kg barley with required minerals, given in two equal meals. The following straws, were tested: 1) Oat straw, chopped < 10 mm; 2) Oat straw, milled 2.0 mm screen; 3) Oat straw treated with aqueous NH_3 (3 %), chopped; 4) Oat straw treated with urea (46 % N) (5 %, w/w), cold water, chopped; 5) same as in (4), but in hot water; 6) Rye straw treated with aqueous NH_3 (3 %), chopped; 7) Rice straw, milled 1.0 mm screen; 8) Rice straw treated with urea (5 %, w/w), chopped.

The straw samples were weighed (2.3 g DM) into the nylon bags (6 x 12 cm, 41 μm) that were incubated in the rumen for 0, 2, 8, 24, 48 or 72 hours, then washed with cold water and dried (60 °C/24 h). The bags were weighed and pooled to make one sample for each occasion (animal, feed, hour). The degradation values were fitted to the equation $p=a+b(1-e^{-ct})$ (Ørskov and McDonald (1979).

To study the intestinal degradation, milled (1.0 mm screen) rumen-undegraded residual straw (72 h) was weighed (900 mg) into mobile bags (3.0 x 5.0 cm, pore size/free surface 10 μm/2 %) that were inserted to the duodenum, later collected from the faeces, thoroughly washed with water (38 °C/1.5 h) and dried (60 °C/24 h), weighed and pooled into one sample per animal and feed.

Samples were analysed for DM, ash, Kjeldahl-N, neutral detergent fibre (NDF) using standard procedures. The results were statistically analysed according to analysis of variance separately for each incubation period.

Results and Discussion

TABLE 1. DRY MATTER (g/kg) AND CHEMICAL COMPOSITION (g/kg DRY MATTER) OF THE STRAW

	Oat straw					Rye straw	Rice straw	
Straw	1	2	3	4	5	6	7	8
Dry matter	880	889	739	449	398	486	948	382
Nitrogen	7	7	20	18	26	34	6	11
Organic matter	928	928	928	927	935	958	838	842
NDF	835	832	711	801	784	801	689	723

Chemical composition and degradability are given in table 1 and 2. N content of straw was increased by NH_3 or urea treatment. Chemical treatment lowered fibrous fraction in oat straw but increased it in rice straw.

The degradation rate constant (c) was always similar. Nevertheless, the instantly degradable fraction (a) of oat straw OM was highest on urea (hot) compared to urea (cold) or NH_3 treatment. The respective value was higher for untreated (milled) rice straw than those for urea-treated (chopped) rice straw. The (a+b) values were, however, highest for oat straw treated with hot water-urea solution. Preparation of straw (milling vs. chopping) had a remarkable effect on potential degradation (a+b). However, NH_3 and urea

TABLE 2. DISAPPEARANCE (%) OF CEREAL STRAW, UNTREATED OR CHEMICALLY TREATED, FROM NYLON BAGS INCUBATED IN THE RUMEN, AND DISAPPEARANCE OF THEIR RUMEN-UNDEGRADED (72 h) RESIDUES FROM MOBILE BAGS PASSED THROUGH THE INTESTINE

	Organic matter									
Straw	1	2	3	4	5	6	7	8	SEM	Sig. level
Ruminal disappearance										
Incubation hours										
0	4.6	5.8	13.6	9.4	10.7	4.4	19.7	5.9	1.13	***
2	5.8	7.0	14.3	12.8	13.9	9.5	20.6	9.1	1.45	***
8	10.4	13.9	25.8	18.0	22.8	13.5	26.5	10.0	1.95	***
24	29.2	33.7	46.6	39.3	39.5	31.1	47.0	35.9	1.74	***
48	44.9	51.0	61.5	58.6	57.7	49.5	63.8	60.5	2.03	***
72	49.0	55.4	66.7	62.9	66.6	57.0	68.2	67.3	3.21	**
Constants										
a	5.1	−2.4	9.2	−2.5	11.1	0.5	9.4	−10.9		
b	58.4	62.8	61.2	70.0	69.6	66.8	69.2	86.9		
c	0.04	0.04	0.04	0.04	0.02	0.03	0.04	0.03		
a+b	53.3	60.4	70.4	67.5	80.7	87.3	72.6	76.0		
Intestinal disappearance										
	6.9	5.7	7.5	8.3	8.4	5.4	7.8	8.9	1.64	NS
					Neutral detergent fibre					
0	3.3	2.6	6.8	5.4	4.6	−1.7	11.0	−0.8	0.77	***
2	4.6	3.7	6.3	8.4	7.4	3.4	12.9	4.3	1.89	NS
8	10.5	12.7	18.8	12.3	17.4	7.3	19.3	6.0	2.12	**
24	30.2	34.1	42.4	38.3	37.7	28.2	43.1	33.7	1.77	***
48	47.8	52.7	58.8	57.1	57.6	49.1	61.2	61.6	2.55	**
72	52.0	58.6	65.5	64.7	67.7	58.2	66.8	68.4	3.97	NS
Constants										
a	−5.9	−4.2	0.4	−7.9	3.6	−7.9	−0.1	−16.7		
b	63.0	69.0	69.3	77.8	77.8	77.9	71.6	95.1		
c	0.04	0.03	0.04	0.04	0.02	0.03	0.04	0.03		
a+b	57.1	64.8	69.7	69.9	81.4	70.0	71.5	78.4		
Intestinal disappearance										
	8.2	5.6	9.6	6.6	7.3	7.6	7.4	5.1	0.75	*

markedly improved the potential degradation of NDF and the (b) values for NDF were particularly high with urea-treated rice straw. Higher temperature of water mixed with urea seemed to increase the treatment effect.

The averaged OM disappearance from mobile bags was clearly higher for the residues of urea treated straw compared to those of ammonia treated straw, but the disappearance of NDF tended to be higher on ammonia treatment. These results indicate a notable digestion of straw residues to take place in the lower gut, depending on the degree of actual digestion in the rumen.

(**Key Words**: Cereal Straw, Deradability, Treatment)

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