Improving Starch Digestibility of Broken Rice by Soaking or Mixing with Different Levels of Cassava Chips in Cow

Abstract

Two experiments were conducted to evaluate the effect of soaking broken rice or mixing it with different levels of cassava chips on its utilization in cows. In the first experiment, 2 cows, fitted with a rumen, proximal duodenum and terminal ileum cannulae were offered soaked broken rice (24 hours prior to feeding) and unsoaked broken rice. Starch digestibility in the rumen and small intestines of cows that were fed soaked broken rice. Starch opposite was, however, the case in the large intestines. There were no significant (P> 0.05) differences in the total tract digestibility on the two diets. In the second experiment, cassava chips were mixed with broken rice at levels of 25:75, 50:50, 65:35 and 80:20, respectively and fed to the cows. With increasing level of cassava chips in the diets, starch digestibility in the rumen significantly (P<0.05) increased and the amount of digestible starch in the small intestines decreased (P<0.05). These results indicate some of the benefits of either soaking broken rice grains or mixing grains with cassava chips on their increased utilization in the rumen.

1. Introduction

Broken rice is a major by-product from rice mill and it plays an important role in animal feed by being a basal source of energy in the diet. Cassava is also another major source of energy with an equivalent amount of starch to broken rice (87.78 v.s 87.75% DM respectively), but less in crude protein content (3.11 vs 9.05%, respectively. Sathapanasiri *et.al.*, 1990). Digestibility of starch from broken rice and cassava in cows is shown in Table 1.

Table 1. Site and extent of starch digestion in cows fed	broken rice or cassava chip
(Sathapanasiri <i>et al.,</i> 1990.)	

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	Digeste	d starch	Digestion	coefficient	% Digestibility of total		
Site	g/cov	v/day			digestion		
	Broken Cassava		Broken Cassava		Broken	Cassava	
	rice		rice		rice		
Rumen	1780	2643	0.63	0.94	66	94	
Small intestine	750 135		0.74	0.74 0.83		5	
Large intestine	134	19	0.45	0.71	5	1	
Total tract	2264 2797		0.95	1.00	100	100	

It is shown that rice starch is digested less in the rumen compared to cassava starch and fairy high amount of rice starch (5%) is digested in the large intestine. Therefore, an introduction of soaking broken rice or mixing it with cassava may increase starch digestion

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in the rumen and small intestine, which can also decrease the amount of starch entering large intestine.

2 Materials and Methods

2.1 Animals.

Two crossbred (Holstein Friensian \times Thai indigenous) dairy cows fitted with rumen fistula and cannulae at the proximal duodenum and terminal ileum were used in this experiment.

2.2 Experimental diets:

The experimental diets were :

2.2.1 Soaked broken rice : The experimental diet is shown in Table 2. Broken rice was soaked in water for 24 hrs. prior to feeding.

2.2.2 Broken rice mixed with different levels of cassava chip. The experimental diets are shown in Table 3. TiO_2 was used as indigestible marker to determine nutrient digestibility at different segment of digestive tract.

2.3 Management :

 1×1 cross over design was used in this experiment and divided into 2 periods in experiment 2.1 and 4 periods in experiment 2.2.

Each period lasted for 20 days with 14 days for adaptation and 6 days for collection period. The animals were fed twice daily at 06.00 a.m. and 18.00 p.m. Rumen liquor was taken on the 2^{nd} and 5^{th} day of collection period at 07.00, 08.30 and 10.00 a.m. (1, 1.5 and 4 hours after feeding). It was then measured for pH value and ammonia - N analysis.

Duodenal and ileal digesta were spot sampled twice daily for 6 days of each collection period at 1 hr. interval of each day. Thus, the digesta was collected at 1 hr. interval after feeding. Faeces was collected immediately after each defecation. All of the samples were weighed and immediately stored at -20 °C before freeze-dried and ground for subsequent analysis. Starch was determined enzymatically (Brandt, *et al.*, 1987). and TiO₂ was analyzed (Brandt, *et al.*, 1983).

3. Results and Discussion

3.1 Nutrient composition

Nutrient composition of broken rice and cassava chip is shown in Table 4. Broken rice and cassava chip contain , more or less , the same amount of starch but protein content in broken rice is higher than that of cassava chip.

Item	Cassava chip	Broken rice
Dry matter	89.46	88.92
Crude protein	3.06	10.50
Starch	79.26	83.96
Crude fibre	3.46	0.73
Ash	2.51	0.67
Organic matter	97.49	99.33

Table 4. Nutrient composition of broken rice and cassava chip (% DM).

3.2 Soaking broken rice.

Ruminal pH and concentration of ammonia-N in rumen liquor are shown in Figures 1 and Figures 2. It is indicated that the ruminal pH of cows that were fed soaked broken rice was lower than that of cows fed unsoaked broken rice. The lower ruminal pH may be effected by the fermentation rate of starch from soaked broken rice. The concentration of ammonia-N in rumen liquor of soaked broken rice was slightly lower than that of unsoaked rice. However, the concentration of ammonia-N of all diets were at adequate level for microbial growth in the rumen (Satter and Slyter, 1974). Starch digestibility is shown in Table 5. Soaking broken rice in water 24 hrs. prior to feeding had a tendency to increase the amount of starch digested, digestibility coefficient, digestibility of total starch consumed and digestibility of total starch digestion in rumen, small intestine and total tract. Therefore, the efficiency of starch utilization was also increased and resulted in decreasing amount of starch entering large intestine.

3.3 Mixing broken rice with different levels of cassava chip.

It can be seen from table 6. that increasing level of cassava chip in broken rice resulted in increasing the amount of starch digested, digestibility coefficient, digestibility of total starch consumed and digestibility of total starch digestion in the rumen. The amount of starch that entered and digested in the small intestine decreased. The digestibility of starch in total tract was also increased.

Table 2. Composition of the experimental diet with soaked broken rice (% D	(% DM).
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Item	Unsoaked broken rice	Soaked broken rice
Нау	54.85	54.85
Broken rice	33.86	33.82
Soybean meal	9.48	9.48
Mixed minerals/TiO ₂	1.85	1.85

Table 3. Composition of the experimental diet with different levels of cassava chip and broken rice (% DM).

Item	Levels of Cassava Chip and broken rice										
	25:75	80:20									
Rice straw	52.69	51.41	50.75	50.05							
Broken rice	26.31	17.50	12.44	7.11							
Cassava chip	9.04	18.04	23.10	28.44							
Soybean meal	10.19	11.28	11.95	12.65							
Mixed minerals/TiO ₂	1.77	1.77	1.77	1.77							



Figure1. Ruminal pH at different times after feeding in cow fed diets containing unsoaked or soaked broken rice



Figure 2. Ammonia-N concentration in rumen liquor at different times after feeding in cows fed unsoaked or soaked broken rice

4. Conclusions

It is generally accepted that in term of energy utilization, starch digestion should be restricted to the rumen and small intestine. In this study, it is suggested that a simple technique as soaking broken rice in water for 24 hrs. prior to feeding or mixing it with cassava chip of which starch from cassava is more digestible in the rumen (Sathapanasiri *et al.*, 1990), can increase digestibility of rice starch in the rumen and decrease the amount of starch digested in the large intestine. The total tract starch digestibility is , also, increased.

Table 5. Site and extent of starch digestion of cows fed unsoaked or soaked broken rice.

Site	Digested starch		Digestion coefficient		% Digesti	on of total	% Digestion of total		
	(g./cow/day)				cons	umed	digestion		
	unsoaked	soaked	unsoaked soaked		unsoaked	soaked	unsoaked	soaked	
Rumen	1228	1344	0.64 ^a	0.71 ^b	64	71	67	73	
Small	494	502	0.72 ^a 0.88 ^b		26	26	27	26	
intestine	111	25	0.60	0.32	6	1	6	1	
Large	1833	1871	0.96	0.98	96	98	100	100	
intestine									
Total tract									

Mean in the same row with differing superscript differ significantly (P < 0.05)

Table 6. Site and extent of starch digestion of cows fed broken rice mixed with cassava chip at different levels.

	Digested starch				Digestion coefficient			% Digestion of total			% Digestion of total					
Site		(g/cov	J/cow/day)				consumed			digestion						
	Cassava chip : Broken rice			Cassava chip : Broken rice			Cassava chip : Broken rice			Cassava chip : Broken rice						
	25:75	50:50	65:35	80:20	25:75	50:50	65:35	80:20	25:75	50:50	65:35	80:20	25:75	50:50	65:35	80:20
Rumen	1262	1650	1803	1920	0.53 ^a	0.71 ^b	0.78 ^b	0.82 ^b	53 ^a	71 ^b	78 ^b	82 ^b	57 ^a	71 ^{ab}	79 ^b	82 ^b
Small intestine	779 ^b	521 ^{ab}	311 ^a	294 ^a	0.71	0.74	0.59	0.68	34 ^b	22 ^{ab}	13 ^a	12 ^a	36 ^b	22 ^{ab}	13 ^a	13 ^a
Large intestine	158	160	191	122	0.45 ^a	0.83 ^b	0.81 ^b	0.84 ^b	6	6	7	5	7	7	8	5
Total tract	2197	2330	2305	2327	0.93	0.99	0.98	0.99	93 ^a	99 ^b	98 ^b	99 ^b	100	100	100	100

Mean in the same row with differing superscript differ significantly (P< 0.05)

5. References

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