Ruminal Ca and P Releases from Diets with Different Portion of the Sugarcane Bagasse

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Abstract

The in sacco technique was used to study the ruminal Ca and P releases from diets with different portion of sugarcane bagasse. Three diets containing 15, 25, and 35% of sugarcane bagase were tested their kinetic of ruminal Ca and P degradabilities. Two adult male sheep fitted with rumen cannula were used in the in sacco technique. In the in sacco experiment, feed samples were placed in the nylon bag and inserted into ruminal cannula for 0, 1, 3, 6, 12, 24, and 48 h. The kinetic of ruminal Ca and P degradabilities were focused on rapidly soluble fraction (fraction *a*), potentially degradable fraction (fraction *b*), and the degradation rate of fraction *b* (*c*). The data were tested using analyse of variance based on a completely randomized design. While the portion of sugarcane bagasse increased ($P<0.05$) fraction *a* of Ca diet, the portion *b* of P diet was decreased ($P<0.05$) by the portion of sugarcane bagasse.In conclusion, the effect of increasing portion of sugarcane bagasse in diet on ruminal release of Ca may be differed with that ofthe ruminal P release.

1. Introduction

The ruminal degradation of forage mineralshad been studied into some extent [1]; [2]; [3]; [4]; [5]; [6].Ruminal mineral availability from forages may be affected by the form of mineral and cell wall association [5]. Some part of mineral was bond in cell wall component, therefore the amount of ruminal mineral release from agricultural waste is more lower than its concentrationconsistently [7]. The mineral ruminal release from agricultural waste based diet remains to be clarified.

The use of sugarcane bagasse as ruminant feed is restricted because the cellulolisic component is tightly bond to its lignin [8]; [9]. It is postulated that the higher portion of sugarcane bagasse in diets may result in more lower the amount of mineral ruminal release. This study clarified the ruminal Ca and P releases from diets with different portion of sugarcane bagasse. This was accomplished using the in sacco technique.

2. Materialsand Methods

2.1. Diet sample and thein sacco technique.

Three diets with different portions of sugarcane bagasse were tested in this study (Table 1). The diets those contained sugarcane bagasse with portion of 15, 25, and 35%,

respectively, were designed to be isoenergy and isonitrogenous. All samples of agricultural wastes were obtained from some local industries at Semarang city. Sugarcane bagasse was the waste product from local sugarcane mill.

Two male local thin tailed cross bred sheep with body weight average of 25 kg and aged at 24 months were used in this *in sacco* technique. Animals were fitted with ruminal cannulas with inside diameter of 3 cm.Sheep were housed in individual metabolic cages and fed on a diet containing 70% elephant grass, 9% rice bran, 11% coconut mill, 4% cassava waste, 5% sugarcane molasses, and 1% urea. The diet was offered at daily maintenance level and dringking water was available throughout experimental period.

The *in sacco* technique used nylon bags with dimension of 2 X 6 cm and mean pore size of 46 J.m. Each sample of 3.00 g was placed in the bag which was attached with 0.25 m weighted chain. The bags were suspended in rumen of sheep via cannula 30 min after morning feeding. Incubation times were 0, 3, 6, 12, 24, and 48 h with three bags per incubation time. Five replicatesof each sample of diet were testedfor each each tested diet andincubation time. Zero-hour bags were not incubated in the rumen but were washed in the same manner as incubated bags.

After time of incubation bags were removed and immersed in ice water for 15 min, the bags were washed with demineralized water using a washing machine for 5 min. The bags and sample residues were then dried at 60°C for 48 h and sample residues were prepared for chemical analyses.

2.2. Chemical and statistical analysis.

A part of each sample residue was analysed for the content of dry matter(DM) using method of [10]. The other part of each sample residue was ashed at 550 °C for 4 h for determination of Ca and P contents. The ash then was solubilized with 10 ml of 3 N HCl and boiled gently for 10 min under a watch glass [3].The solutions were transferred to 25 ml volumetric flasks and brought to the volume with distilled water. Contents of Caand Pwere then determined using the atomic absorption spectrophotometer.

Theruminal DM, Ca, and P disappearances(expressed as % of the initial amount) were calculated based on the their content of sample residues. The degradability data were then calculated to obtain the kinetic of ruminal DM, Ca and P degradabilities according to the equation, $P=a+b(1-e^{-ct})$ [11]where P is the amount degraded at time *t*, *a* is the rapidly soluble fraction, *b* is the potentially degradable fraction, *c* is the rate of degradation of fraction *b*. The parameters of ruminal degradability kinetic were focused on rapidly soluble fraction (fraction *a*), potentially degradable fraction (fraction *b*), and the degradation rate of fraction *b* (*c*) for DM, Ca and P, respectively. The data were tested using analyse of variance based on a completely randomized design.

3. Results and Discussion

The ruminal release of mineral from forages were studied using the *in sacco* technique [1]; [2]; [3]; [4]; [5]; [6]. However, these studies reported only the amount of mineral release from roughages at given time of ruminal incubations, and the kinetic of ruminal mineral degradability was not discussed. Results of this study clarify the ruminal Ca and P releases from sugarcane bagasse based dietsby discussing their rapidly soluble fractions, potentially degradable fractions, and the degradation rates of potentially degradable fractions.

The rapidly soluble fraction of dietary DM were decrased ($P<0.05$) with the increasing portions of sugarcane bagasse (Table 2). The component of fraction *a* consists of soluble materials of cell content. The increasing portion of sugarcane bagasse increases contents of NDF and ADF, as the cell wall components, in diets (Table 1). The use of sugarcane bagasse in a bagasse based total mixed ration for goats is limited by their levels of fiber component [8]; [9].

Table 1. Ingredient and chemical composition of sugarcane bagasse based diets

Items	Portion of Sugarcane Bagasse		
	15%	25%	35%
Ingredient			
Rice bran	13	16	14
Coconut mill	10	10	10
Palmfrond mill	5	5	4
Wheat pollard	12	12	10
Ground nut shell	8	6	3
Coffee seed shell	10	5	3
Mize	2	2	5
Cassava waste	17	14	11
Sugarcane bagasse	15	25	35
Chemical composition			
Dry matter	90.18	90.09	89.88
Crude ash	7.43	7.73	7.72
Crude protein	12.00	12.09	12.35
Extract ether	4.04	4.06	3.95
Crude fiber	28.78	28.8	29.12
Nitrogen free extract	47.74	47.32	46.86
Total digestible nutrient[1]	60.65	60.63	60.30
Neutral detergent fiber	59	61.76	63.05
Acid detergent fiber	34.37	35.40	35.72
Calcium	0.34	0.32	0.30
Phosphorus	0.15	0.14	0.13

[1]Based on calculation

The potentially degradable fraction of diet was unaffected by the increasing portion of sugarcane bagasse (Table 2). The potentially degradable fraction is the slowly degraded part of feed in rumen. Table 2 shows that the effect of sugarcane bagasse portion on the degradation rates of potentially degradable fractions was non significant. This fact may be responsible for the effect of increasing portion of sugarcane bagasseon the potentially degradable fraction of diet.

Table 2 indicates that the rapidly soluble fraction of dietary Ca was increased ($P<0.05$) by the portion of sugarcane bagasse. However, the increasing portion of sugarcane bagasse in diet decreased ($P<0.05$) the potentially degradable fraction and the degradation rates of potentially degradable fraction of dietary Ca. Ruminal mineral availability of feed may be affected by the form of mineral and cell wall association [4]. It could be considered that amount of dietary Ca is more larger in cell content than that in cell wall component. However, the fractionation of dietary Ca in cell content and wall components remains to be elucidated.

The rapidly soluble fraction of dietary P was decreased ($P<0.05$) by the portion of sugarcane bagasse (Table 2). Whilst the portion of sugarcane bagasse increased ($P<0.05$) the potentially degradable fraction. In contrast with the dietary Ca, it could be considered that amount of dietary P is more larger in cell wall than that in cell content component. Although the information about fractionation of dietary P in cell content and wall components.

Table 2. Kinetic of ruminal degradability

Items		Portion of sugarcane bagasse			
		15%	25%	35%	SEM
DM	*A*	29.16[a]	28.5[a]	26.07[b]	0.81
	B	21.26	21.47	21.01	0.12
	C	7.47	5.61	6.86	0.47
	dT	41.88[a]	39.85[b]	38.21[c]	0.92
Ca	*a*	25.34[b]	28.39[a]	29.07[a]	0.99
	b	23.05[a]	16.33[b]	15.92[b]	2.00
	c	8.49[a]	8.49[b]	8.96[ab]	0.14
	dT	40.62[a]	38.21[c]	39.27[b]	0.60
P	*a*	26.76[a]	25.66[a]	17.67[b]	2.48
	b	22.12[b]	20.18[b]	25.98[a]	1.48
	c	7.91[b]	9.12[a]	7.64[b]	0.39
	dT	40.3[a]	38.69[b]	33.36[c]	1.82

[a,b,c]$P<0.05$

a : % of rapidly soluble fraction;
b : % of potentially degradable fraction;
c : degradation rates of potentially degradable fractionsin h;
dT : % of degradation theory. SEM: standard error of means.

The use of sugarcane bagasse as small ruminant feed had been clarified by some studies based on some parameters of protein and carbohydrate metabolisms[8]; [9]. Dietary Ca and P were known well involved partly in the nutrient metabolism. In this study, the sheep's ruminal Ca and P releases from sugarcane bagasse based dietwas elucidated. Such information may be useful for considering the supplementation of dietary mineral to meet the requirement of animal.

4. Conclusion

The increasing portion of sugarcane bagasse in diet increased ruminal Ca release and decreased ruminal P release. The mineral fractionation of sugarcane bagasse based dietremains to be clarified.

Acknowledgement

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