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DETERMINATION OF NUTRIENTS DIGESTIBILITY, RUMEN FERMENTATION PARAMETERS, AND MICROBIAL PROTEIN CONCENTRATION ON ONGOLE CROSSBRED CATTLE FED RICE STRAW

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ABSTRACT

The utilization of rice straw in the diet is limited by the low of nutritive value and dry matter consumption. From the quantity point of view, the rice straw is very potential feed. The production of rice straw in Indonesia is 41 million tons annually, but just only 31 till 38 % is used as feed. Preliminary study was very important to determine the protein and energy availabilities of rice straw as single ingredient, and nutrient deficiencies could be determined. The study was conducted to determine nutrients digestibility, rumen fermentation parameters (NH_3 and pH), microbial protein concentration, and balance of nitrogen. Six female rumen fistulated Ongole Crossbred cattle were used in the experiment. The results indicated that the averages of total digestible nutrients of rice straw were 39.13 %, digestible protein was 1.82 %, and nitrogen balance was negative 0.26 %. The averages NH_3, pH, and microbial protein concentration of rumen fluid was 22.9 mg/l, 7.17, and 1.01 mg/ml, respectively.

Key words: Rice straw, Digestibility, Rumen fermentation parameters, Ongole Crossbred cattle

INTRODUCTION

The limiting factor for improving ruminants' production in Indonesia especially for cattle and buffalo is the availability and consistency supply of both quality and quantity of forage throughout the year. Objectives of livestock production in Indonesia are the improvement of integrated farming systems in specific area especially in increasing forage quality and quantity, as well as maintaining resources and environment.

Since most of land especially in Java and Bali is mainly used for crop production there will be an abundance crop residues, that could be used for ruminant feed stuff. Crop residues have been used by farmers as major component in animal diet especially in rural areas and in the dry season (Utomo, *et al.*, 1988), and is very important for low land areas, because it is available during dry season where green forages are scarce (Rangkuti *et al.*, 1986).

From the quantity point of view the rice straw is very potential feed. The production of rice straw is 40 million tons dry matter annually. It was estimated that harvested area of rice in Indonesia was 10.5 million ha (Biro Pusat Statistik, 1992), because of the average rice straw production was 3.86 ton dry matter per ha (Fak. Peternakan and DITJEN Peternakan, 1982). Unfortunately just only 31 to 38% is utilized as feed. Eventhough quantitatively rice straw can be utilized to replace forages, practical confirmation have to be tested, since the quality of rice straw is low (Lubis, 1992).

The preliminary research was very important to determine the rumen fermentation parameters, the protein and energy availability of rice straw as single ingredient.

MATERIALS AND METHODS

The experiment was conducted at the Department of Animal Nutrition and Feed Science, Faculty of Animal Science, Gadjah

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Six female rumen fistulated Ongole Crossbred cattle aged three to four years old with initial body weight of 250 to 270 kg were use in the experiment. The cattle were kept in stall fitted with feed and water trays, also harness as urine and feces separator. The cattle kept in the stall for three weeks as adjustment, preliminary, and collection period, consisted for one week each. The rumen fluid samples were collected at the end of collection period. Sample of rumen fluid for rumen parameters (pH, and NH_3) were collected every two hours during 24 hours at 08.00, 10.00, 12.00, 14.00, 16.00, 18.00, 20.00, 22.00, 24.00, 02.00, 04.00, and 06.00, respectively and then were all composited. The sample of rumen fluid for kinetics of parameters fermentation were collected at 07.00, 09.00, 10.00, 11.00, 12.00, and 14.00, while for microbial concentration were just collected at 07.00, 11.00 and 14.00, respectively. Rice straw (sun cured and chopped condition) and water were given *ad libitum*, started at 08.00.

The chemical composition of rice straw were determined by Weende method (Harris, 1970, the nutrients digestibility were determined by total collection method (Harris, 1970), ammonia concentration of the rumen fluid was determined by microdiffusion method (Conway, 1957), and microbial protein concentration were determined by Lowry method (Plummer, 1971).

RESULTS AND DISCUSSION

Chemical composition

The chemical composition of rice straw (sun cured condition) namely dry matter, crude protein, crude fiber, extract ether, nitrogen free extract, neutral detergent fiber, and organic matter were 89.20%, 5.12%, 32.33%, 1.3%, 39.34%, 81.03% and 78.09% respectively. The values were almost

Table 1. The kinetic of pH of rumen fluid of Ongole Crossbred cattle fed rice straw as single ingredient

Time of determination	Cattle number						Average
	1	2	3	4	5	6	
18	7.16	7.13	7.13	7.25	7.20	7.20	7.18
20	7.09	7.06	7.10	7.15	7.09	7.11	7.10
22	7.10	7.02	7.05	7.16	7.17	7.20	7.12
24	7.11	7.04	7.04	7.10	7.11	7.21	7.10
02	7.07	6.98	7.06	7.15	7.16	7.14	7.09
04	7.15	7.04	7.10	7.15	7.11	7.20	7.12
06	7.22	7.14	7.05	7.22	7.14	7.16	7.15
07	7.21	7.16	7.06	7.21	7.17	7.15	7.16
08	7.24	7.15	7.10	7.23	7.18	7.33	7.20
09	7.30	7.22	7.21	7.42	7.26	7.28	7.28
10	7.33	7.21	7.18	7.31	7.24	7.27	7.26
11	7.35	7.22	7.14	7.34	7.12	7.22	7.23
12	7.30	7.25	7.16	7.31	7.15	7.16	7.22
14	7.17	7.21	7.11	7.26	7.23	7.18	7.19
16	7.21	7.19	7.16	7.25	7.28	7.24	7.22
Average	7.20	7.19	7.11	7.23	7.17	7.20	7.17

Source: The pH was determined at the Lab. of Feed Technology, Dept. of Animal Nutrition and Feed Sciences, Faculty of Animal Sciences, Gadjah Mada University, Yogyakarta.

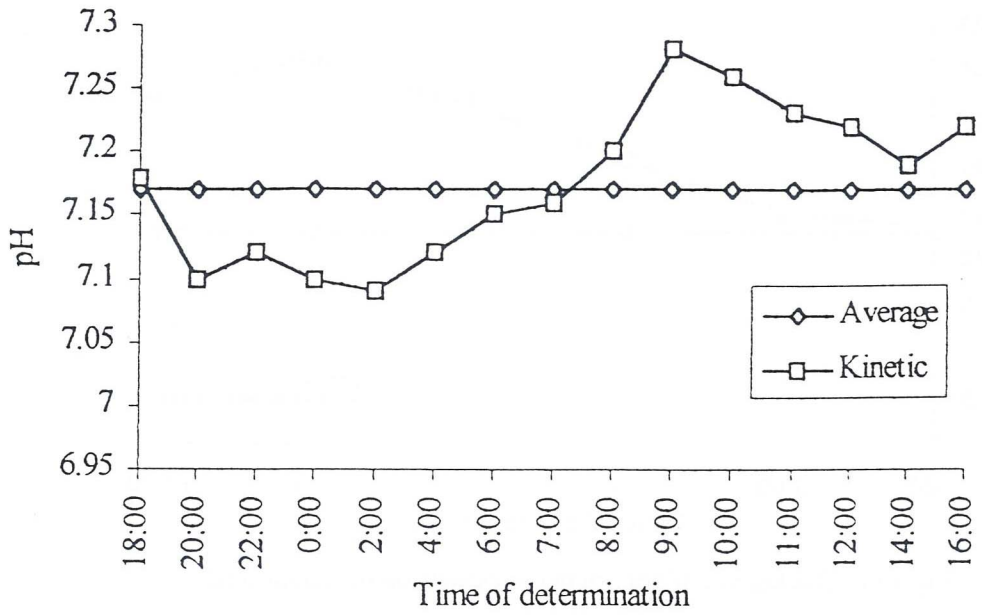

Figure 1: The kinetic of pH of rumen fluid of cattle fed with rice straw.

the same or similar to the chemical composition in Indonesia (Hartadi *et al.*, 1980).

Rumen fermentation

The pH of rumen fluid were determined gradually at 24 hours every two hours, but the kinetic of pH of rumen fluid were only determined at 07.00, 08.000, 09.00, 10.00, 11.00, and 12.00 (Table 1 and Figure 1).

Generally, the pH of rumen fluid were decreased at 2 till 6 hours after feeding (Hungate, 1960 and Church, 1976), in this study, the pH of rumen fluid were increased at 1 till 2 hours after feeding. However the average pH of rumen fluid during 24 hours was almost similar (7.17). The reason was because the cattle were fed with rice straw as single ingredient containing very low non-structural carbohydrate.

The ammonia concentration of rumen fluid was determined after the rumen fluid

Table 2. The kinetic and concentration ammonia of the rumen fluid of Ongole Crossbred cattle fed with rice straw (mg/l).

Time of determination	Cattle number						Average
	1	2	3	4	5	6	
07.00	27.5	26.5	21.1	22.1	22.6	21.5	23.6
08.00	30.9	27.6	22.3	30.3	20.6	19.5	25.2
09.00	31.4	29.8	32.8	32.0	31.8	26.5	30.7
10.00	38.6	31.5	44.2	36.4	35.4	34.4	36.7
11.00	44.2	44.5	35.9	47.5	48.5	28.2	41.5
12.00	48.1	49.7	35.9	36.4	29.2	28.2	37.9
Average of 24 hours	27.0	21.3	21.8	22.4	22.1	22.9	22.9

Source: The ammonia concentration were determined at the Lab. of Feed Technology, Dept. of Animal Nutrition and Feed Sciences, Faculty of Animal Science, Gadjah Mada University, Yogyakarta.

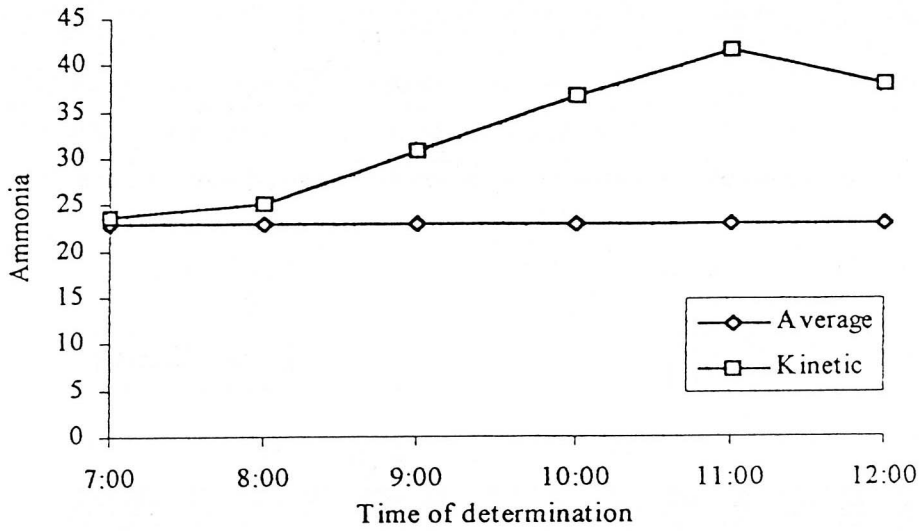

Figure 2: The kinetic of ammonia concentration of rumen fluid.

samples were composited. The rumen fluid sample were obtained at every 2 hours in 24 hours, but for the kinetic of ammonia concentration of rumen fluid were determined at 1 hour before feeding, view minutes after feeding, 1, 2, 3 and 4 hour after feeding, respectively (Table 2 and Figure 2).

The average of ammonia concentration of rumen fluid was very low (22.9 mg/l). The ammonia concentration was very low when it was compared to other researcher. Leng (1990) reported that ammonia concentration of rumen fluid minimum was 100 mg/l.

The ammonia concentrations of rumen fluid were depending on the diet. The cattle that was just fed with rice straw as single ingredient, received very low protein (5.12%), causing the ammonia concentration of rumen fluid very low, and the peak concentration reached at 3 hours after feeding.

The microbial protein concentration of rumen fluid was determined after the rumen fluid samples were composited. The rumen fluid samples were obtained at every 2 hours in 24 hours. The microbial protein concentrations of rumen fluid were shown in Table 3.

Table 3. The microbial protein concentration of rumen fluid (mg/ml)

Cattle number	1	2	Average
1	1.43	1.18	1.30
2	0.49	0.81	0.65
3	0.89	1.03	0.96
4	0.99	0.97	0.98
5	1.83	1.57	1.70
6	0.42	0.53	0.47
Average	1.01	1.01	1.01

Source: The microbial protein concentrations were analysed at Bionutrition Laboratory, Dept. of Animal Nutrition and Feed Science, Faculty of Animal Science, Gadjah Mada University, Yogyakarta.

Table 4. Digestible of dry matter (DDM%), digestible of organic matter (DOM%), digestible protein (DP%), digestible of neutral detergent fiber (DNDF%) and nitrogen balance (NB%) of Ongole Crossbred cattle fed with rice straw

Cattle number	DDM	DOM	DP	DNDF	NB
1	46.70	39.90	1.83	40.36	2.10
2	43.30	39.01	1.58	37.47	2.20
4	47.90	41.11	1.95	40.32	2.09
5	36.18	32.90	1.50	30.50	-1.50
6	51.40	42.46	2.25	43.44	-6.29
Average	45.60	39.13	1.82	38.50	-0.26

Source: Data analysed

The microbial protein concentration of rumen fluid was very low, the average value was just 1.01 mg/ml. One of the reasons is because the ammonia concentration in the rumen fluid was low too.

Digestibility

The digestible nutrients of rice straw were determined by total collection method (Table 4). Data of feed consumption, fecal and urine excretion are shown in Appendix 1, while feces composition and nitrogen concentration in the urine are shown in Appendix 2.

The result indicated that the averages of DDM, DOM, DP, DNDF, and NB of Ongole Crossbred cattle fed with rice straw were 45.60%, 39.13%, 1.82%, 38.50% and negative 0.26% respectively. Utomo (1979) reported that for roughages, DOM value was almost similar or identical with total digestible nutrients (TDN). It was assumed that the TDN of rice straw was 39.13%. Hartadi *et al.* (1980) reported that TDN of rice straw was 39%. However the result indicated that DP of rice straw was 1.82%, higher than that of 0.2% reported by Hartadi *et al.* (1980). It is because of the crude protein content of rice straw in this research was 5.12%, and was higher than that 3.7% reported by Hartadi *et al.* (1980). However the nitrogen balance was negative 0.26% indicating that feed stuff rice straw was deficient of crude protein, insufficient even for maintenance.

CONCLUSION

1. The averages of total digestible nutrients of rice straw were 39.13%, digestible protein was 1.82%, and nitrogen balance was negative 0.26%.
2. The average of rumen fluid on ammonia concentration were 22.9 mg/l, 7.17, and 1.01 mg/ml, respectively, in the mentioned treatments.

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Appendix 1. Feed consumption (FC) in dry matter (g), fecal excretion (g DM), and urine excretion (ml)

Cattle number	FC	Fecal	Urine
1	4110	2190	4985
2	4861	2755	6560
4	3676	1915	3200
5	3186	2033	3454
6	2459	1195	2382
Average	3658	2018	4116

Source: Data analysis

Appendix 2. Fecal composition in dry matter basis on crude protein (CP %), organic matter (OM%), and neutral detergent fiber (NDF%) content of feces, and nitrogen (N%) concentration of urine

Cattle number	Feces			Urine
	CP	OM	NDF	N
1	6.20	65.79	76.30	0.19
2	6.27	62.60	76.83	0.15
4	6.12	65.19	78.15	0.30
5	5.69	66.14	78.57	0.27
6	5.93	66.14	77.34	0.63
Average	6.04	65.17	77.44	0.31

Source: The fecal composition and N concentration in urine were determined at the Lab. of Feed Technology, Dept. of Animal Nutrition and Feed Science, Faculty of Animal Science, Gadjah Mada University, Yogyakarta.