ADDITIONAL OF FEED SUPPLEMENT AND CONCENTRATE TO INCREASE THE RUMEN DEGRADABILITY OF RICE STRAW FERMENTED ON CATTLE RATION

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Abstract. *This study aims to get the best ration in the use of rice straw fermented (RF) as a basal feed for cattle farms. The RF is made by fermenting rice straw using Rhizopus oligosporus. The concentrate consists of many locally available feed ingredients. The supplement composed of several feeds as a multi-nutrient to supplement a deficient substance in the ration. There were 4 treatment rations consisting of RF = 100% RF (control); RFS = RF + 10% supplement; RFSC = RFS + 10% concentrate; RFSC2 = RFS + 20% concentrate. The ration was tested by in vitro digestion using bovine rumen fluid with 48 hours incubation at 39 ºC under anaerobic condition. The results showed the addition of supplements significant increasing the digestibility of dry matter, organic matter, crude protein, and hemicellulose while the addition of concentrates significant increasing the concentration of VFA and digestibility of NDF and cellulose. The best composition was 80:10:10 (% DM) of RF, supplement and concentrate respectively.*

Keywords: rice straw; supplement; concentrate; cattle ration; digestibility

1. Introduction

Rice straw mostly (> 60%) consists of cell walls composed of cellulose, hemicellulose, lignin, and silica (Ghasemi et al., 2013). The limiting factor of rice straw is the low nutritional value and digestibility so that it is unable to provide adequate nutrition for high-producing ruminants (Liu et al., 2015). Rice straw contains high silica 12-16% and lignin 6-7% which inhibits rumen microbial degradation in the digestive process (Singh & Kumar, 2018). Rice straw can be used as a substitute forage feed although it cannot be used as a complete ration and its use must be supplemented with concentrate (Nazli et al., 2018).

Feed originating from local raw materials can be used such as sago pith, bran, cassava and coconut pulp as a concentrate of cheap valuable energy sources. The addition of concentrate in the fermented rice straw is expected to provide a ready ability carbohydrate that can be used for microbial growth and digestive activity in the rumen (Wanapat et al., 2013). Cattle feed supplement reported by Ramaiyulis et al., (2018) can interact positively with concentrate feed on increasing the digestibility of low-quality forage.

The effect of adding concentrate and supplement in a ration of rice straw fermented base hypothesized that can improve the digestibility of rice straw fermented so it needs to be investigated because there is still little information available about this. The study aims to determine the ability of the supplements and concentrates feed on increasing the digestibility of rice straw fermented in the rumen in vitro. The results of this study can be used as a basis for in vivo research to optimize the use of fermented straw as a forage for beef cattle.

2. Materials and Methods

The rice straw was chopped with a chopper machine with a size of 1-2 cm. Then it was mixed with a 10% bran (dry basis) and inoculated with the fungus *Rhizopus oligosporus* using tempeh juice and incubated for 21 days under anaerobic conditions. The nutrient content of rice straw fermented is shown in Table 1. The supplement according to formula C of cattle feed supplements (Ramaiyulis, et al., 2019). The Concentrate consisting of local feed ingredients namely bran, sago pith, cassava and coconut pulp with nutrient content are shown in Table 1. Rice straw fermented, supplements and concentrates are arranged in the research treatment as displayed in Table 1 and made in 4 replications.

Table 1. Composition and nutrient content of the treatment ration

Items	Treatment Rations				RF	Supplement	Concentrate
	RF	RFS	RFSC	RFSC2			
Ingredients (% DM)							
Rice straw fermented	100	90	80	70	-	-	-
*Supplements	-	10	10	10	-	-	-
**Concentrates	-	-	10	20	-	-	-
Chemical composition (% DM)							
Organic matters	87.06	87.18	87.89	88.59	87.06	88.26	94.12
Crude protein	9.82	11.17	11.19	11.21	9.82	23.31	11.64
Crude fiber	30.69	28.65	26.67	24.70	30.69	10.31	10.19
NDF	70.35	66.03	62.65	59.27	70.35	27.16	36.56
ADF	45.33	42.15	39.83	37.51	45.33	13.56	22.10
Cellulose	28.43	26.53	25.65	24.77	28.43	9.44	19.64
Hemicellulose	25.02	23.88	22.82	21.77	25.02	13.60	14.46
Lignins	8.99	8.09	7.19	6.29	8.99	0.82	0.96
Tannins	-	0.05	0.05	0.05	-	-	-

* Supplements: Formula C supplements (Ramaiyulis et al., 2019).

** Concentrates: sago pith, bran, cassava, and coconut pulp.

DM: dry matter; NDF: neutral detergent fiber; ADF: acid detergent fiber.

RF: rice straw fermented; RFS: RF + 10% supplements; RFSC: RFS + 10% concentrate: RFSC2: RFS + 20% concentrate.

In vitro experiment was carried out following the method (Tilley & Terry, 1963) using the rumen fluid of Bali beef cattle (*Bos sondaicus*) obtained after animals were slaughtered in abattoirs. Rumen liquid was mixture with McDougall buffer solution consist of 19.6 g $NaHCO_3$, 7.42 g $Na_2HPO_4.7H2O$, 1.14 g KCl, 0.94 g NaCl, 0.24 g $MgSO_4.7H_2O$ and 0.08 g $CaCl_2.2H_2O$ in 1 liter of distilled water, at a ratio of 1: 4 and pH: 6.8. The allocation of in vitro treatment followed a randomized complete block design with individual rumen fluid donors as block expression.

A sample of 2.5 grams was put into the Erlenmeyer and added 250 ml of a mixture of rumen fluid and McDougall buffer and made 2 Erlenmeyer for each treatment unit. Then blew CO_2 gas for 30 seconds to create anaerobic conditions in Erlenmeyer and then covered with a vent ventilated rubber cap. The Erlenmeyer placed in a water-bath Shaker (Precision, USA) was incubated at 39 °C for 48 hours. Fermentation is stopped by immersing the Erlenmeyer in cold water.

The pH of the rumen fluid is measured using a pH meter (Hi9807-phep). Next centrifuged (Hitachi CR21, Japan) at 3,000 rpm for 15 minutes at 4 °C. The supernatant is used for NH_3 analysis by the Conway micro diffusion method and VFA analysis by the steam distillation method (AOAC, 1980). The residue was washed twice with distilled water with the same centrifuged and then filtered using Whatman 41 filter paper and dried in a 60 °C oven for 24 hours. Then proceed with proximate analysis (AOAC, 1990) to determine the content of dry matter, organic matter, crude protein and crude fiber in the residue.

Fiber fraction analysis was performed following the method of (Van Soest et al., 1991) to determine the content of neutral detergent fiber (NDF), acid detergent fiber (ADF), acid detergent lignin (ADL), hemicellulose (NDF-ADF) and cellulose (ADF-ADL)). NDF is determined by boiling 0.5 g of sample with 100 ml of neutral detergent solution (NDS) for 1 hour. NDS is made from EDTA, SDS, sodium tetraborate, monoglycolether, sodium dihydrogenphosphate, and distilled water. Then the sample is filtered in a glass crucible (coarse porosity 1), dried in a 105 °C oven and weighed. Whereas ADF is determined in the same way using acid detergent solution (ADS) which consists of CTAB, sulfuric acid, and distilled water. An addition of 72% H_2SO_4 was used to separate ADL.

Parameters were analyzed using Statistical Package for Social Science (SPSS, version 13.0, SPSS Inc., Chicago, IL). Analysis of variance (ANOVA) single factor is used to analyze data. If a significant effect is expressed at the probability level of $P < 0.05$, it is followed by Duncan's multiple tests to determine the average value that is significantly different at the level of $P < 0.05$.

3. Results and Discussion

rumen fermentability of rice straw fermented (RF) with the addition of supplements and concentrates is shown in Table 2. The addition of supplements to RF did not significantly influence VFA concentrations, but the addition of 10% concentrate increased VFA concentrations ($P < 0.05$). VFA concentration of rumen fluid is closely related to the rate of rumen fermentation, especially degradation of carbohydrates that produce carbon chains and protein degradation which liberates carbon chains that are reflected in VFA concentrations in rumen fluid (Russell, 2002). The addition of concentrate with raw materials of sago pith, bran, and cassava supplies of soluble carbohydrates thereby increasing the degradation of carbohydrates and increasing the concentration of VFA in the rumen.

Table 2. Concentrations of VFA, NH3, and pH in the rumen in vitro of rice straw fermented with the addition of supplements and concentrates

Rumen Parameters	Treatment Ration				SE	P-value
	RF	RFS	RFSC	RFSC2		
VFA, mM	130.00^{b}	130.50^{b}	142.50^{a}	148.75^{a}	8.09	0.028
NH_3, mM	3.50^{b}	5.17^{a}	4.08^{b}	4.33^{b}	0.23	0.008
pH	6.99	6.99	6.98	6.92	0.02	0.051

^{a,b,c} differences in superscripts indicate significantly different mean values

VFA: volatille fatty acids; SE: standard error of mean: P: probability

RF: 100% rice straw fermented; RFS: RF + 10% supplements; RFSC: RFS + 10% concentrate: RFSC2: RFS + 20% concentrate

NH_3 concentration higest in RFS ($P <0.01$) compared to all other rations. NH_3 is the end product of crude protein degradation and NH3-deamination in the rumen. The condensed tannin content in supplements acts as protein protection from rumen microbial degradation (Ramaiyulis et al., 2019). Tannin is a polyphenol compound that is capable of binding and precipitating proteins so that it is protected from rumen microbial degradation which causes a decrease in NH_3 in the rumen (Dentinho et al., 2014). Therefore the production of NH_3 in this study came from the breakdown of urea to NH_3 contained in supplements.

Table 3 shows the digestibility of nutrients in the in vitro rumen of the rice straw fermented with the addition of supplements and concentrates. The lowest digestibility of dry matter and organic matter was found in RF rations (control) then increased with the addition of supplements (RFS) and highest besides 20% concentrate (RFSC2) ($P <0.01$). Digestion of dry matter and organic matter in the rumen shows the percentage of nutrients available to livestock as a result of fermentation by microbes in the rumen. Rumen digestion constitutes 85% of the total digestion of nutrients in the digestive tract of ruminants (Russell & Mantovani, 2001).

Table 3. Digestion of rumen in vitro of rice straw fermented with the addition of supplements and concentrates

Digestibility Parameters	Treatment Ration				SE	P-value
	RF	RFS	RFSC	RFSC2		
DMD	26.28^{c}	30.69^{b}	34.18^{b}	41.43^{a}	0.01	0.003
OMD	28.52^{c}	32.71^{b}	34.77^{b}	43.38^{a}	0.02	0.008
CPD	44.98^{b}	57.53^{a}	61.42^{a}	59.49^{a}	0.04	0.048
CFD	24.19	24.08	22.86	24.82	0.02	0.520

^{a,b,c} differences in superscripts indicate significantly different mean values

DMD: dry matter digestibility; OMD: organic matter digestibility; CPD: crude protein digestibility; CFD: crude fiber digestibility; SE: standard error of means; P: probability

RF: 100% rice straw fermented; RFS: RF + 10% supplements; RFSC: RFS + 10% concentrate: RFSC2: RFS + 20% concentrate

Crude protein digestibility was found to be lowest in the control rations, supplementation increased ($P <0.05$) the digestibility of crude protein, while the addition of concentrate had no significant effect. Supplements contain easily degraded protein that is urea and ready ability of carbohydrates as an energy source available that allows optimization of rumen microbial growth (Ramaiyulis et al., 2019). The protein content of rations is relatively low, ranging between 9.82-11.21%, while the standard of SNI for fattening beef cattle ration contains at least 13% crude protein (BSN, 2009).

4. Conclusions

In vitro digestibility in the rumen of rice straw fermented can be improved by the addition of supplements and concentrates. Supplements can increase the digestibility of dry matter, organic matter, crude protein, and hemicellulose, while the addition of concentrate can strengthen increased the digestibility of NDF and cellulose. The use of rice straw fermented in cattle rations is best obtained with the addition of a 10% supplement and 10% concentrate.

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