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Organoleptic Quality and Nutrition of Rice Straw Silage Utilizing Local Microorganisms of Cattle Rumen Fluid at Different Inoculum Levels

Stefanus Sio[1], Gerson F. Bira[1*], Matius S. Batu[2], Lukas Pardosi[3], Regina J. Mau[1], Maria O. Klau[1], Jenabeba Hoar[1]

[1]Department of Animal Science, Faculty of Agriculture, Universitas Timor, Jl. El Tari, Km-9 Kefamenanu, North Central Timor, East Nusa Tenggara, 85613, Indonesia.
[2]Department of Chemistry, Faculty of Agriculture, Universitas Timor, Jl. El Tari, Km-9 Kefamenanu, North Central Timor, East Nusa Tenggara, 85613, Indonesia.
[3]Department of Biology, Faculty of Agriculture, Universitas Timor, Jl. El Tari, Km-9 Kefamenanu, North Central Timor, East Nusa Tenggara, 85613, Indonesia.

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ABSTRACT

Feed quality very depends on changes in the weather where in short rainy conditions the feed is abundant, mean while, long dry conditions cause feed availability to be limited. One of the abundant feeds is rice straw, but the use of rice straw needs to be considered for its nutritional content, thus its utilization requires to be processed first. This study aimed to utilize local microorganisms (MOL) of Bali cattle rumen fluid at different inoculum levels on the quality of fermented rice straw silage to over come feed shortages in dryland. The study used a completely randomized design (CRD) with 4 treatments and 4 replications, namely R0: Rice Straw + Rice Bran 10% + molasses 3% (Without MOL of cattle rumen fluid/control); R1 : Rice Straw + Rice Bran 10% + molasses 3% + MOL of cattle rumen fluid 5%; R2 : Rice Straw + Rice Bran 10% + molasses 3% + MOL of cattle rumen fluid 10%; R3: Rice Straw + Rice Bran 10% + molasses 3% + MOL of cattle rumen fluid 15%. The percentage of molasses and cattle rumen fluid was adjusted to the weight of chopped rice straw. Data were analyzed using analysis of variance (Anova). The results showed that the treatment had a significant effect ($P<0.05$) on the organoleptic quality (color, texture, smell, presence of fungi and pH) and organic matter, crude protein, crude fat, crude fiber, carbohydrate, nitrogen free extract and gross energy (nutritional content) of rice straw silage, dry matter and gross energy had no significant effect ($P>0.05$). It can be concluded that the higher MOL of cattle rumen fluid level use, the greater organoleptic quality and nutritional content of rice straw silage obtained.

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Introduction

Climatic and environmental conditions in dry land cause livestock productivity to fluctuate in line with environmental changes. Feed quality depends on seasonal condition, where as feed tends to be abundant in rainy season, in contrast to dry season as feed is limited in the environment (Tahuk and Bira, 2020). Manu *et al.* (2007) stated that a common situation in dry land areas is a lack of water which affects the growth of grass causing a very fast rate of photosynthesis and leads to a decrease in grass quality which is characterized by an increase in cell walls. As the result, farmers must find alternative feed ingredients to meet the needs of livestock such as rice straw. Usually, after the grain is harvested, the rice straw is left to rot and even burned, although the rice straw can still be used as animal feed.

Rice straw is a waste from the rice plant after the grain is taken. High production of rice straw (FAO, 2014) makes it potential as a source of animal feed, although containing high content of cellulose, hemicellulose, silica and lignin (Yanuartono *et al.*, 2017). The nutritional content of rice straw is categorized as low (Oskoueian *et al.*, 2021) with composition of 79.09% dry matter, 3-6.44% crude protein and 29.16-33.10% crude fiber, 1.13% crude fat, 0.03% calcium (Ca), 0.48% phosphorus (P) with high amount of cell wall bonds (Yuliantonika *et al.*, 2013; Mulijanti *et al.*, 2014; Aquino *et al.*, 2020). Its nutritional content makes rice straw potential to be used as a source of animal feed, but it needs to be processed physically, chemically, and biologically to improveits quality and reduce the amount of cell wall bonds.

One way to process rice straw in to a proper feed is through silage method. Silage is a method of preserving feed under anaerobic conditions (Nahak *et al.*, 2021). The silage-producing process that is important to note is lactic acid bacteria which can function to optimize the ensilage phase (Bira *et al.*, 2020), prevent the growth of spoilage bacteria (Muck, 2010) and increase the nutritional content of low-quality feed ingredients (Sangadji, 2020). Lactic acid bacteria can be obtained from several sources including by using soluble carbo-

*Corresponding author: Gerson F. Bira
E-mail address: Gersonbira@yahoo.co.id

hydrates (Gao *et al*., 2021). One that can be utilized is the local microorganism of bali cattle rumen fluid. Commonly, in the case of cattle slaughtered at slaughterhouse, the rumen contents are thrown away and become unutilized waste. Rumen fluid itself generally contains high quantity of bacteria followed by protozoa and fungi (Ramaiyulis *et al*., 2019; Gonzales *et al*., 2014). The use of local microorganisms on rice straw fermentation is considered very effective and efficient. Microbes originating from rumen fluid can utilize components of the total ration mix for their growth and activity, thereby reducing organic matter, crude protein, and crude fiber content of feed (Tasse *et al*., 2020). Rumen microorganisms can also synthesize and secrete cellulose enzymes that can hydrolyze plant cell walls, hence can reduce the high crude fiber content in feed (Lunagariya *et al*., 2017). The aim of this study was to utilize local microorganisms (MOL) of cattle rumen fluid at different inoculum levels on the quality of fermented rice straw silage to overcome feed shortages in dry land.

Materials and methods

Time, place, tools and Materials

The research was carried out from June-September 2021 at the Faculty of Agriculture, Timor University, starting with the production of rice straw inoculum and silage, while laboratory analysis was performed at the Laboratory of Feed Chemistry, Faculty of Animal Husbandry, Nusa Cendana University. The tools used were plastic barrels with a capacity of 10 kg as silos, thermos, plastic bottles with a capacity of 1000 ml, cutting tools, analytical balances, writing instruments, destruction flasks, erlenmeyer flasks, ovens, pH meters, filter paper, measuring cups and analytical equipment for proximate analysis and questionnaire for panelists. Materials used were rice straw, Bali cattle rumen fluid, molasses, coconut water and materials for proximate analysis.

Research Procedure

Production of Inoculum

Bali cattle rumen fluid was taken at the Kefamenanu slaughterhouse and stored in a plastic container. The fluid was then filtered to separate it from large and coarse particles. As much as 250 ml of rumen fluid was mixed with 250 ml of coconut water and 250 ml of molasses (200 molasses and 50 ml of water), performed this procedure for 16 treatments. The coconut water function as a microbial culture medium and molasses as a source of energy for microorganisms in the cattle rumen fluid. The mixed rumen fluid was then put in a thermos at 40ºC and stored for 21 days at room temperature (Yulianto, 2019).

Production of Rice Straw Silage

Rice straw was taken and chopped to 2-3 cm size. The chopped rice straw was mixed with rice bran and sprinkled with inoculum mixed with molasses according to the treatment. The rice straw was then put into a plastic barrel by pressing it, hence the chopped layer became solid (anaerobic principle) (Nahak *et al*., 2021). The silo (plastic barrel) filled with rice straw and inoculum was stored at room temperature for 21 days.

Data Collection Procedure

After 21 days the silo was opened and the silage pH was measured. Silage was then assessed its physical properties of smell, texture, color, and presence of fungi using sensory testing. Also, silage was determined its nutrient content using proximate analysis.

Variable

Organoleptic Quality

The organoleptic quality assessment consists of: smell, texture and presence of mushrooms by sensory testing. The percentage of mushrooms was measured by weighing the number of moldy parts compared to the total amount of rice straw, while pH was measured using a pH meter. Assessment of rice straw silage organoleptic quality is shown in Table 2.

Nutritional Content

Rice straw silage contains: dry matter content (DM), crude protein (CP), crude fat (cf), crude fiber (CF), found through proximate analysis (AOAC, 1990) and NFE was analysed using the nitrogen-free extract method. The amount of NFE fermented rice straw was calculated using formula NFE = DM - (ash+CP+cf+CF).

Research Methods

The research method used in this study was a completely randomized design (CRD) consisting of 4 treatments and 4 replications. The treatment given is as follows:
R0: Rice Straw + Rice Bran 10% + Molasses 3% (Without MOL of cattle rumen fluid)

Table 1. Nutrient content of rice straw before silage production

Rice straw nutrient content								
DM (%)	OM	CP	cf	CF	CHO	NFE	GE	
			%DM				MJ/kg DM	Kcal/kg DM
90.27	73.53	5.87	0.7	28.68	64.67	38.99	12.85	3.058,88

Results of Feed Chemistry Laboratory Analysis, Faculty of Animal Husbandry, Nusa Cendana University (2021). DM= Dry matter, OM= Organic matter, CP= Crude protein, cf= crude fat, CF= Crude fiber, CHO= Carbohydrate, NFE= Nitrogen free extract, GE= Gross energy.

Table 2. Organoleptic assessment of rice straw silage

Organoleptic	Score			
	9.0-10.0	7.0-8.9	5.0-6.9	0.0-4.9
Color	Same color as before fermentation	Yellowish green	Brownish yellow	Dark chocolate
Texture	Very soft	Soft	Rather rough	Rough and fragile
Smell	Same smell as before fermentation	Strong smell	Sour smell	Musty smell
Fungi	None/few	Moderate	Many	A huge amount

R1: Rice Straw + Rice Bran 10% + Molasses 3% + MOL of cattle rumen fluid 5%
R2: Rice Straw + Rice Bran 10% + Molasses 3% + MOL of cattle rumen fluid 10%
R3: Rice Straw + Rice Bran 10% + Molasses 3% + MOL of cattle rumen fluid 15%

The percentage of molasses and cattle rumen fluid was adjusted to the weight of the chopped rice straw.

Data Analysis

Data were analysed using analysis of variance (ANOVA) followed by Duncan's multiple range test to measure the differences (Steel and Torrie, 1995). Data analysis using SPSS version 21 software.

Results

Organoleptic Quality

Color

Table 3 shows that in general the use of MOL of cattle rumen fluid had a significant effect (P<0.05) on the color change of rice straw silage. Generally, the color of rice straw that was given MOL of cattle rumen fluid was brownish yellow (score 5.0-6.9) except for R0 which obtained 9.0-10.0.

Texture

The texture of the rice straw produced had changed from a slightly rough texture to soft. The higher MOL inoculum level of cattle rumen fluid used is assumed has higher impact on softening the texture of rice straw silage or a score of 7.13-7.78 (Table 3) indicating that the treatment has a significant effect (P<0.05).

Smell

The utilization of MOL of cattle rumen fluid at different inoculum levels had a significant effect (P<0.05) on the smell of rice straw silage. The smell produced is a sour smell with a score ranging from 5.28-5.43 (Table 3).

Fungi

Table 3 shows that fermented rice straw silage with MOL of cattle rumen fluid did not provide an opportunity for harmful fungi to grow at a score of 9.33-9.59, and there were no differences between treatments (R1, R2 and R3). In contrast to treatment R0 which scored 7.72 or quite over grown with fungi. The treatment showed a significant effect (P<0.05) on the presence of fungi.

pH

The data showed that the treatment had a significant effect (P<0.05) where the higher the inoculum level of cattle rumen fluid in rice straw silage, the lower the pH produced.

Nutritional Quality

Dry Matter and Organic Matter

In Table 1, rice straw without any treatment contained 90.27%DM but after treatment it decreased to R0 73.74±3.37% DM; R1 72.86 ±0.53%DM; R2 68.43±3.15%DM; R3 69.21±6.10%DM. However, the effect of treatment is not significant (P>0,05). The OM content of rice straw before being treated was 73.53%DM and the higher level of MOL of cattle rumen fluid MOL used in the rice straw fermentation process, the lower the OM value obtained with R0 73.43±0.83%DM; R1 72.04±0.47%DM; R2 70.07±0.83%DM; R3 69.64±2.77%DM. The OM content obtained showed a significant effect (P<0.05).

Crude Protein and Crude Fat

The resulting CP level had a significant effect (P<0.05). In this study, CP levels increased after been given treatment. Before being treated, the CP content of rice straw was 5.87%DM but after being given treatment it increased to R0 6.07±0.05%DM; R1 7.18±0.41%DM; R2 7.54±0.28%DM and R3 7.69±0.16%DM. Table 4 shows that the higher the MOL inoculum level of cattle rumen fluid used, the higher the cf content. The cf content increased from 0.70%DM to 2.03±0.04%DM (R3); 1.71±0.08%DM (R2); R1 1.57±0.16%DM (R1) and 1.26±0.22%DM (R0).

Crude Fiber and Carbohidrate

Crude fiber content of 27.32 (R0), 26.57 (R1), 25.97 (R2) and 25.54 (R3). The results of statistical tests showed a significant effect (P<0.05). The CHO produced in this study, from highest to lowest, were R0 66.06±1.07%DM, R1 62.88±0.57%DM, R2 61.89±0.69%DM, R3 63.49± 2.55%DM. The results showed that the treatment had a significant effect (P<0.05).

Nitrogen Free Extract and Gross Energy

The results showed that the treatment had a significant effect (P<0.05) on the NFE content of rice straw silage. The final NFE were R0 38.71±0.81%DM, R1 36.30±1.13%DM, R2 36.57±1.34%DM and R3 36.72±2.01%DM. The GE values obtained were R0 3,186.43 ± 42.94 (Kcal/kg DM), R1 3.159.47 ± 29.77 (Kcal/kg DM), R2 3.294.15 ± 446.60 (Kcal/kg DM), R3 3.221.29 ± 110.60 (Kcal/kg DM) and the results of statistical analysis showed no significant effect (P>0.05).

Table 3. Organoleptic quality of rice straw silage

Variable	Treatment			
	R0	R1	R2	R3
Color	$9.34±0.11^{a}$	$5.51±0.29^{c}$	$5.70±0.18^{b}$	$5.96±0.07^{b}$
Texture	$5.30±0.08^{d}$	$7.13±0.05^{c}$	$7.43±0.22^{b}$	$7.78±0.05^{a}$
Smell	$9.18±0.21^{a}$	$5.28±0.24^{b}$	$5.38±0.21^{b}$	$5.43±0.26^{b}$
Fungus	$7.72±0.43^{b}$	$9.33±0.13^{a}$	$9.59±0.27^{a}$	$9.45±0.29^{a}$
pH	$6.20±0.33^{a}$	$5.43±0.51^{b}$	$4.85±0.47^{b}$	$4.60±0.42^{c}$

Data are presented asmean±SD. R0 : Rice Straw + Rice Bran 10% + Molasses 3% (without MOL of cattle rumen fluid / control); R1 : Rice Straw + Rice Bran 10% + Molasses 3% + MOL ofcattle rumen fluid 5%; R2: Rice Straw + Rice Bran 10% + Molasses 3% + MOL of cattle rumen fluid 10% R3: Rice Straw + Rice Bran 10% + Molasses 3% + MOL of cattle rumen fluid 15%. Different superscripts on the same line showed significant differences (P<0.05).

Table 4. Nutrient content of rice straw silage.

Variable	Treatment			
	R0	R1	R2	R3
Dry matter (%)[ns]	73.74±3.37	72.86±0.53	68.43±3.15	69.21±6.10
Organic matter (%DM)	73.43±0.83[a]	72.04±0.47[ab]	70.07±0.83[b]	69.64±2.77[b]
Crude protein (%DM)	6.07±0.05[c]	7.18±0.41[b]	7.54±0.28[ab]	7.69±0.16[a]
crude fat (%DM)	1.26±0.22[d]	1.57±0.16[c]	1.71±0.08[bc]	2.03±0.04[a]
Crude fiber (%DM)	27.32±0.24[a]	26.57±0.84[ab]	25.97±0.62[bc]	25.54±0.62[c]
Carbohydrate(%DM)	66.06±1.07[a]	62.88±0.57[b]	61.89±0.69[b]	63.49±2.55[b]
NFE (%DM)	38.71±0.81[a]	36.30±1.13[b]	36.57±1.34[ab]	36.72±2.01[ab]
GE (Kcal/kg DM)[ns]	3.186,43±42.94	3.159.47±29.77	3.294,15±446.60	3.221,29±110.60

Data are presented as mean ± SD. R0 : Rice Straw + Rice Bran 10% + 3% sugar water (without MOL of cattle rumen fluid / control); R1 : Rice Straw + Rice Bran 10% + sugar water 3% + MOL ofcattle rumen fluid 5%; R2: Rice Straw + Rice Bran 10% + sugar water 3% + MOL of cattle rumen fluid 10% R3: Rice Straw + Rice Bran 10% + sugar water 3% + MOL of cattle rumen fluid 15%. Different superscripts on the same line showed significant differences (P<0.05). NFE Nitrogen free extract, GE=Gross energy, ns: not significant.

Discussion

The color change is based on changes in temperature during the fermentation process where the rumen microorganisms in the inoculum are able to change the cell structure of rice straw. The NH3 available in the MOL of cattle rumen fluid is able to change the structure of the rice straw tissue, hence the structure becomes soft (Kaur and Phutela, 2018) besides the heat energy formed during the fermentation process causes color damage to the rice straw before it is fermented (Suningsih *et al*., 2019). This will certainly affect the color of the straw silage after being fermented using MOL of cattle rumen fluid. The fermentation process that takes place gives a heat effect which damaging the strong structure of rice straw (Utama and Christiyanto, 2021). During the fermentation process, the temperature increases because microorganisms break down carbohydrates followed by the release of energy in the form of heat including H2O and CO2 so as to increase the fermentation temperature (Uhi, 2007). The fermentation process that took place with the addition of MOL of cattle rumen fluid resulted in a rice straw structure breakdown. Microorganisms that grow and develop have the potential to damage the harder structure of rice straw to become a softer texture of rice straw. There are physical, chemical and biological breakdown in hard structures that can occur in the fermentation process so that the digestibility of livestock is more efficient (Suningsih *et al*., 2019). The resulting score indicates that there is a distinctive smell of rice straw that turns into a distinctive smell of fermentation, namely sour. The sour smell indicates that the microorganisms that play a role are lactic acid bacteria. This is supported by Oladosu *et al*. (2016) that lactic acid and sugar bacteria which can spontaneously grow during the fermentation process will causes our smell. Lactic acid bacteria can improve the quality of agricultural waste as feed (Elijayanti *et al*., 2020) and rice straw contains sufficient lactic acid bacteria (Ni *et al*., 2015). In contrast to R0, the smell produced was the same as the smell before fermentation or a score of 9.18. This result shows that without the presence of microorganisms in the cattle rumen fluid, the fermentation process will not take place perfectly due to very few lactic acid bacteria available, thus the smell produced is the same as before fermentation. Fermentation is a strategic step in improving the quality of low-grade feed such as rice straw by involving several microorganisms (Nguyen *et al*., 2020). The absence of fungi indicates that the fermentation process can take place optimally so that lactic acid bacteria can prevent the growth of unwanted fungi. Normal fermentation process will provide a growth opportunity for lactic acid bacteria (Bira *et al*., 2020) and will increase in number if sufficient media and energy are added (Ficoseco *et al*., 2018), and can inhibit other pathogenic bacteria. In the rumen fluid there are various types and numbers of microorganisms that grow depending on the type of livestock and their consumption. In ruminants that are fed mainly forage (the condition of the animals which rumen fluid is taken), this bacterial species is found at a concentration of 104-107 cells/gram (Gonzales *et al*., 2014) and will increase to 1011/gram if sugar is added (Nagaraja and Titgemeyer, 2007). In the inoculum process in this study, the addition of 3% molasses was suspected to provide additional energy and positive bacteria so that it could prevent the growth of negative fungi. In the control treatment the presence of fungi was caused by the absence of bacterial seed supply from the MOL of cattle rumen fluid. pH data showed that the fermentation process has taken place perfectly (Yuvita *et al*., 2020) and the low pH reflects high lactic acid production (Kung and Shaver 2001). The increasing population and performance of microorganisms as a result of the addition of molasses, bran and cattle rumen fluid caused a decrease in pH. This indicates optimal fermentation process. Molasses and rice bran as energy sources for MOL of cattle rumen fluid. Lactic acid bacteria will degrade carbohydrates into lactic acid which results in a decrease in the pH of fermented rice straw. Rice bran treatment can stimulate the growth of lactic acid bacteria (Ridwan *et al*., 2005) then that the addition of inoculants aims to accelerate the decrease in environmental pH in the ensilage process, therefore bacteria that are able to live are bacteria that are resistant to acidic conditions (Hristov and McAllister, 2002). It is suspected that in this study there was an increase in the colony of lactic acid bacteria, thus the production of lactic acid was high and caused an acidic pH. Table 4 shows that the higher the level of MOL of cattle rumen fluid used in rice straw silage production tends to decrease the DM value although the value for each treatment had shown no significant effect. This is related to the presence of water that is still present in the rice straw. During fermentation, water will come out of the rice straw but most of it is still left in the rice straw. It is the water that is left behind which causes high water content, thus lowering DM (Lahr *et al*., 1983). During the fermentation process, native microorganisms of cattle rumen fluid use carbohydrates as an energy source that can produce water and carbondioxide molecules (Sharma *et al*., 2020) so that the population increases as a result of optimal fermentation process. According to Hamid *et al*. (1999), the tendency DM decrease during fermentation process is due to the catabolism of complex compounds into simple compounds, by liberating water molecules. The increasing population of microorganisms as a result of the use of MOL of cattle rumen fluid in rice straw fermentation resulted in high OM digested, thus OM would decrease. Higher number of microbes will produce higher digested organic matter digestion process although in fact OM can also be provided by microorganisms, but it is not comparable to that used by the microorganisms (Mayalulu *et al*., 2018). The presence of bacteria inoculation from rumen fluid in straw silage can change the carbohydrate composition of cell walls into organic acids (Ni *et al*., 2015) results in decrease in pH during fermentation (Table 3). As decreased pH value during fermentation process will terminate the aerobic phase. During the aerobic phase, dry matter loss occurs and is followed by loss of organic matter (Tabacco *et al*., 2011; Borreani *et al*., 2017). MOL of cattle rumen fluid contains proteolytic bacteria (Safika *et al*., 2020; Mantrawan *et al*., 2018) which produce protease enzymes to degrade proteins into polypeptides and then into simple peptides (Montemayor *et al*., 2009) results in increasing protein. The increase in CP is due to protein synthesis by the mold consortium (Suningsih *et al*., 2019) and lignin degradation which will free compounds bound to the lignocellulosic complex bonds (Prihartini *et al*., 2009). Basically, it is the ability of cattle rumen fluid microorganisms to break lignocellulosic bonds. The increase in crude fat content may be attributed to the ability of lactic acid bacteria to break down complex bonds into simpler ones such as fatty acids and alcohol (Ridla *et al*., 2016). The high level of cattle rumen fluid inoculum increases the ability of lactic acid bacteria to break complex bonds and this is also seen in the final pH. The higher the level of rumen fluid the lower (acidic) the final pH produced. The pH of silage is related to the production of lactic acid during the ensilase process, a low pH reflects a high production of lactic acid (Datta *et al*., 2020; Kim *et al*., 2021). The fiber content decreases as the MOL of cattle rumen fluid level used increases. The decrease in CF was due to MOL of cattle rumen fluid in the rice straw fermentation process results in changes in cell wall structure. This change in cell wall structure is caused by the hydrolysis process by the presence of microorganisms break the bonds of lignocellulose and lignohemicellulose and dissolve silica and lignin contained in the cell walls of fibrous feed ingredients (Komar, 1984). Prihartini *et al*. (2009) stated that the fiber fraction degradation is largely dependent on the production and activity of cellulolytic enzymes from fibrolytic microbes, the acidic environment as a result of MOL of cattle rumen fluid utilization (acidic) also supports lactic acid bacteria to stretch strong fiber bonds (Bata, 2008) so that can be easily used by livestock. The effectiveness of rice straw fermentation using MOL of cattle rumen fluid highly depends on the level of inoculum. The higher the inoculum level, the lower the CF content and the higher the content of other nutrients are. Low CHO at R1, R2 and R3 illustrates the high capability of microorganisms toutilize CHO as an energy source, hence the degradation process of fiber components becomes high and produces other nutrients such as high protein as well. One of the factors affecting food quality is fermentation (Sharma *et al*., 2020). This is in line with Ridwan and Widyastuty (2001), the addition of lactic acid bacteria inoculants aims to increase the bacteria population that already present in grass or forage made of silage. The NFE results show that the addition of rice bran and molasses is able to provide a carbohydrate source for the MOL of cattle rumen fluid that further used to degrade rice straw during fermentation. The more microorganisms utilize NFE as an energy source, the smaller the NFE value produced. NFE is a soluble carbohydrate fraction (Mayalulu and Suhardi, 2015) and in the process of producing silage, nitrogen-free extract material is needed as an energy source for lactic acid bacteria in carrying out fermentation (Abegunde *et al*., 2021). Statistically it shows that there is a difference between R0 and R1 while for R1, R2 and R3 there is no difference. This is related to the OM value obtained. Reduced OM value during the fermentation process caused a decreased NFE value, followed by decreased MOL level due to lactic acid bacteria can utilize this component as energy source (Widyastuti *et al*., 2014) for their growth thus showing not significant difference between treatments. The results showed that generally the energy generated from each treatment was the same. This is also related to NFE as similar to MOL, especially lactic acid bacteria which can utilize this component as an energy source. According to Parakkasi (1999), fermentation process in silage will change the structure as a result of the activity of microorganisms that can increase the utilization value of materials which leads to GE increase.

Conclusion

It was concluded that high MOL of cattle rumen fluid level, can improve and increase the organoleptic quality and nutritional content of rice straw silage.

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Conflict of interest

The authors have declared no conflict of interest

References

Abegunde, T.O., Babalola, S.O., Adeoye, B.T., Usman, A.O., Akinfemi, O.M., 2021. Nutritive value and preference of guinea-Grass ensiled with or without additive by West African Dwarf (WAD) goats. Tropical Animal Science Journal 44, 173-182.

AOAC (Association of Official Analytical Chemists), 1990. Association of Official Methods of Analysis. AOAC, Arlington, VA, USA.

Aquino, D., Barrio, A.D., Tranch, N.X., Hai, N.T., Khang, D.N., Toan, N.T., Hung, N.V., 2020. Rice straw-based fodder for ruminants. E-book sustaibnable rice straw management. ISBN. 978-3-030-32373-8.

Bata, M., 2008. Pengaruh molases pada amoniasi jerami padi menggunakan urea terhadap kecernaan bahan kering dan bahan organik In Vitro. Agripet 8, 15-20

Bira, G.F., Tahuk, P.K., Kia, K.W., Hartun, S.K., dan Nitsae, F., 2020. Karakteristik silase semak bunga putih (*Chromolaena odorata*) dengan penambahan jenis karbohidrat terlarut yang berbeda. Jurnal Sain Peternakan Indonesia 15, 367-374.

Borreani, G., Tabacco, E., Schmidt, R.J., Holmes, B.J., Mucks, R.E., 2017. Silage review: Factors affecting dry matter and quality losses in silages. Journal Dairy Science 101, 3952–3979.

Datta, F.U., Detha, A., Rihi, D., Foeh, N., dan Ndaong, N., 2020. Effect of lactic acid palm lactic bacteria on silage quality. Jurnal Kajian Veteriner 8, 211-217.

Elijayanti, Y., Mairizal., Adriani and Yurleni., 2020. Quality of palm fronds and rice straw fermented with probiotics as ruminant feed. Pakistan Journal of Nutrition 20, 507-512.

FAO (Food and Agriculture Organization of the United Nations), 2014. Rice market monitor, 17. http://www.fao.org/3/i3945e/i3945e.pdf

Ficoseco, C.A., Mansilla, F.I., Maldonado, N.C., Miranda, H., Macias, M.E.F.N.,Vignolo, G.N., 2018. Safety and growth optimization of lactic acid bacteria isolated from feedlot cattle for probiotic formula design. Frontiers in Microbiology 9, 2220.

Gao, R., Wang, B., Jia, T., Luo, Y., Yu, Z., 2021. Effects of different carbohydrate sources on alfalfa silage quality at different ensiling days. Agriculture 11, 1-13.

Gonzales, A.R.C., Barraza, M.E.B., Viveros, J.D., Martinez, A.C., 2014. Rumen microorganisms and fermentation. Archivos de Medicina Veterinaria 46, 349-361.

Hamid, H., Purwadaria, T., Haryati, T., dan Sinurat, P., 1999. Perubahan nilai bilangan peroksida bungkil kelapa dalam proses penyimpanan dan fermentasi dengan Aspergillus niger. J. Ilmu Ternak dan Veteriner 4, 101-106

Hristov, A.N., McAllister, T.A., 2002. Effect of inoculants on whole-crop barley silage fermentation and dry matter disappearance in situ. J. Anim. Sci. 80, 510-516.

Kaur, K., Phutela, U.G., 2018. Morphological and structural changes in paddy straw influenced by alkali and microbial pretreatment. Detritus 3, 30-36.

Kim, D., Lee, K.D., Choi, K.C., 2021. Role of LAB in silage fermentation: Effect on nutritional quality and organic acid production-An overview. AIMS Agriculture and Food 6, 216–234.

Komar, A., 1984. Teknologi pengolahan jerami sebagai makanan ternak. Yayasan Dian Grahita Indonesia.

Kung, L., Shaver, R., 2001. Interpretation and use of silage fermentation analysis reports. J Focus on Forage 13, 1-5.

Lahr, D.A., Otterby, D.E., Johnson, D.G., Linn, J.G., Lundquist, R.G., 1983. Effects of moisture content of complete diets on feed intake and milk production by cows. J. Dairy. Sci. 66, 1891-1900.

Lunagariya. P.M., Gupta, R.M., dan Parnerkar, S., 2017. In vitro evaluation of total mixed ration supplemented with exogenous fibrolytic enzymes for crossbred cows. Veterinary World 10, 281-285.

Mantrawan, P.C.N., Besung, I.N.K., Suarjana, I.G.K., Suwita, N.K., 2018. Total bakteri pada berbagai umur dan lokasi peternakan sapi Bali di Nusa Penida. Buletin Veteriner Udayana 10, 122-126.

Manu, A.E., Baliarta, E., Keman, S., dan Datta, F. U., 2007. Pengaruh suplementasi pakan lokal terhadap produktivitas induk kambing bligon bunting tua yang dipelihara di padang sabana timor barat. Animal Production 9, 1-8.

Mayalulu, H., Suhardi, S., 2015. Nutrient potency of rice straw processed with amofer as cattle feed stuff in East Kalimantan. International Journal of Science and Engineering (IJSE) 9, 101-105.

Mayalulu, H., Fauziah, N.R., Haris, M.I., Christiyanto, M., Sunarso., 2018. Digestibility value and fermentation level of local feed-based ration for sheep. Animal Production 20, 95-102.

Montemayor, H.A., Rios, F.A., Lopez, M.P., Borjas, H.A., Diaz, J.L.O.V., Severiano, H.J., Avila, H.R.V., 2009. Effect of dry roasting on composition, digestibility and degradability of fiber fractions of mesquite pods (*Prosopis laevigata*) as feed supplement in goats. Tropical and Subtropical Agroecosystems 11, 237 – 243.

Muck, R.E., 2010. Silage microbiology and its control through additives. Revista Brasileira de Zootecnia 39, 183-191 (supl. especial).

Mulijanti, S.L., Tedy, S., dan Nurnayetti., 2014. Pemanfaatan dedak padi dan jerami fermentasi pada usaha penggemukan sapi potong di Jawa Barat. Jurnal Peternakan Indonesia 16, 179-187.

Nagaraja, T.G., Titgemeyer, E.C., 2007. Ruminal acidosis in beef cattle: the current microbiological and nutritional outlook. J. Dairy. Sci. 90, 17-38.

Nahak, O.R., Tahuk, P.K., Bira, G.F., Ambone, Y.B., 2021. The In Vitro digestibility of complete silage from Sorghum bicolor (L.) Moench ingredient using different additives. Bulletin of Animal Science 45, 90-94.

Nguyen, D.V., Vu, C.C., Nguyen, T.V., 2020. The current utilisation and possible treatments of rice straw as ruminant feed in Vietnam: A review. Pak. J. Nutr. 19, 91-104.

Ni, K., Wang, Y., Li, D., Cai, Y., Pang, H., 2015. Characterization, identification and application of lactic Acid bacteria isolated from forage paddy rice silage. Plos One 10, 1-14.

Oladosu, Y., Rafii, M.Y., Abdullah, N., Magaji, U., Hussin, G., Ramli, A., Miah, G., 2016. Review Article : fermentation quality and additives: a case of rice straw silage. biomed research international 2016, 1-14.

Oskoueian, E., Jahromi, M.F., Jafari, S., Shakeri, M., Le, H.H., Ebrahimi, M., 2021. Manipulation of rice straw silage fermentation with different types of lactic acid bacteria inoculant affects rumen microbial fermentation characteristics and methane production. Veterinary Science 8, 1-13.

Parakkasi, A., 1999. Ilmu Nutrisi dan Makanan Ternak Ruminan. UI Press. Jakarta.

Prihartini, I., Soebarinoto., Chuzaemi, S., Winugroho, M., 2009. Karakteristik nutrisi dan degradasi jerami padi fermentasi oleh inokulum Lignolitik TLiD dan BopR. Animal Production 11, 1-7.

Ramaiyulis., Ningrat, R.W.S., Zain, M., Warly, L., 2019. Optimization of rumen microbial protein synthesis by addition of gambier leaf residue to cattle feed supplement. Pakistan Journal of Nutrition 18, 12-19.

Ridla, M., Mulik, Y.M., Prihantoro, I., dan Mullik, M.M., 2016. Penurunan total tanin silase semak bunga putih (Chromolaena odorata) dengan aditif tepung Putak (*Coryphaelata roxb*) dan isi rumen sapi. Buletin Peternakan 40, 165-169.

Ridwan, R. dan Widyastuti, Y., 2001. Membuat Silase: Upaya mengawetkan dan mempertahankan nilai nutrisi hijauan pakan ternak. Warta Biotek LIPI 15, 9-14.

Ridwan, R., Ratnakomala, S., Kartina, G., dan Widyastuti, Y., 2005. Pengaruh penambahan dedak padi dan *Lactobacillus plantarum* 1BL-2 dalam pembuatan silase rumput gajah (*Pennisetum purpureum*). Media Peternakan 28, 117-123.

Safika., Sari, W.N., Ademi, G.V., Arsih, U.W., Darmawi, D., 2020. Kosakonia sp. proteolytic bacteria isolated from rumen and reticulum of Aceh cattle. Jurnal Kedokteran Hewan 14, 43-47.

Sangadji, I., 2020. Nutritional quality and fiber fraction of complete feed silage based on sago by-products, Imperata cylindrica and Leucaena leucocephala. Buletin Peternakan 44, 203-208.

Sharma, R., Garg, P., Kumar, P., Bhatia, S.K., Kulshrestha, S., 2020. Microbial fermentation and its role in quality improvement of fermented foods. Fermentation 6, 1-20.

Steel, R.G.D., Torrie, J.H., 1995. Prinsip dan prosedur statistika. Penerjemah Bambang Sumantri. Gramedia Pustaka, Jakarta.

Suningsih, N., Ibrahim, W., Liandris, O., dan Yulianti, R., 2019. Kualitas fisik dan nutrisi jerami padi fermentasi pada berbagai penambahan starter. Jurnal Sain Peternakan Indonesia 14, 191-200.

Tabacco, E., Righi, F., Quarantelli, A., Borreani, G., 2011. Dry matter and nutritional losses during aerobic deterioration of corn and sorghum silages as influenced by different lactic acid bacteria inocula. J. Dairy Sci. 94, 1409–1419.

Tahuk, P.K., Bira, G.F., 2020. Carcass and meat characteristics of male Kacang goat fattened by complete silage. Veterinary World 13, 706-715.

Tasse. A.M., Hafid, H., Patriani, P., Ananda, S.H., Nuraini., 2020. Nutritive value and rumen fermentability characteristics of the diet were supplemented by dried carboxylate salts mixture (DCM). IOP Conf. Series: Earth and Environmental Science 454, 2020 012058.

Uhi, H.T., 2007. Improvement of nutritive value of sago waste by biofer-mentation. J. Anim. Sci. 7, 26–31.

Utama, C.S., Christiyanto, M., 2021. The feasibility of fermented litter as a feed ingredient for ruminant livestock. Journal of Advanced Veterinary and Animal Research 8, 312-322.

Widyastuti, T., Hidayat, N., Indrasanti, D., 2014. Nutrient content of napier grass (*Pennisetum purpureum*) silage made with various additive and modified atmosphere in the silo. Animal Production 16, 11-17.

Yanuartono., Purnamaningsih, H., Indarjulianto, S., Nururrozi, A., 2017. Potensi jerami sebagai pakan ternak ruminansia. Jurnal Ilmu-Ilmu Peternakan 27, 40-62.

Yulianto, R., 2019. Nilai nutrisi dan produk fermentasi rumen in vitro limbah ekstraksi gambir difermentasi oleh MOL dengan perlakuan berbeda. Prosiding Seminar Nasional Teknologi Peternakan dan Veteriner Tahun 2019, 814-822.

Yuliantonika, A.T., Lestari, C.M.S., dan Purbowati, E., 2013. Produktivitas sapi Jawa yang diberi pakan basal jerami padi dengan berbagai level konsentrat. Animal Agriculture Journal 2, 152-159.

Yuvita, D., Mustabi, J., dan Asriany, A., 2020. Pengujian karakteristik dan kandungan lemak kasar silase pakan komplit yang berbahan dasar eceng gondok (*Eichornia crassipes*) dengan lama fermentasi yang berbeda. Buletin Nutrisi dan Makanan Ternak 14, 14-27.