Physical Characteristics Evaluation of Kumpai Minyak Grass (*Hymenachne amplexicaulis)* Silage

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ABSTRACT

The study aimed to evaluate the nutritive value of Kumpai Minyak grass (*Hymenachne amplexicaulis*) silage. A total of 700g of *Hymenachne amplexicaulis* chopped with size 3-6 cm were used for silage by adding molasses levels (0, 2,5, and 5%) as well as the level of lactic acid bacteria (LAB) (0, 2, and 4 %). Silage inserted into a clear plastic bag and the air was removed. The silages were ripened for 21 days. Each treatment was done five times replication. The variables measured were physical quality and pH. Research data were analyzed by analysis of variance (ANOVA), if there was a significant difference between the treatments it will precede with Duncan's Multiple Range Test. The physical quality characteristics of silage were generally good. The addition of LAB did not affect (P> 005) on pH (4,10 to 4,21) but the addition of molasses gave significantly affect (P <0.05) on pH (3,69 - 4,84). The combination between LAB level and molasses level with the best physical quality was found in 4% LAB and 5% molasses levels.

Keywords: Grass *Hymenachne amplexicaulis*, Molasses, *Lactobacillus plantarum*, Silage.

INTRODUCTION

Ruminants are mostly fed in the form of forage, but the quality, quantity, and continuity are still very limited. Various efforts to increase livestock production in order to meet the needs of animal protein sources will be very difficult to achieve if the availability of forage is not proportional to the needs and population of livestock. Utilization of swamp grass (a local native grass species) as a substitute for the common cultivated grass is one effort to overcome the problem. Utilization of swamp land for supporting forage production has been done to a very limited extent by traditional ranchers both as seasonal pasture for buffalo and cow buffaloes as well as a forage source. Swamp grasses are of various kinds, some of the forages have been identified and have high enough biomass, for example, Kumpai Minyak grass (Fariani, 2008). The productivity of this grass is strongly influenced by seasonal differences. In the rainy season, productivity is abundant while in the dry season it decreases. Efforts by farmers to anticipate the lack of availability of grass during the dry season is to prolong the shelf life of the Kumpai Minyak grass which is abundant in the rainy season and one method of preservation is through the making of silage.

Silage is a preservation technology of feed ingredients in fresh condition with the help of lactic acid bacteria. The addition of silage additives such as soluble and easy to dissolve the silage. This material can be added to forage made silage because it can stimulate the growth of lactic acid bacteria to produce lactic acid. The use of molasses as an additive can result in quality silage because it provides readility available energy for fermentation by LAB thereby producing lactic acid during the silage process. Production of lactic acid produced during the silage process serves to reduce the pH and increase the acidity, hence preserving the grass.

Research on forage processing technology based on local feed of Kumpai Minyak grass with the addition of silase additives in the form of molasses and inoculant *Lactobacillus* *plantarum* has not been done before. This study aims to examine the physical characteristics Kumpai grass silage as ruminant feed and to establish the optimum level of molasses and inoculants of LAB to achieve high quality silage.

MATERIALS AND METHODS

This research was conducted for four months starting from August to November 2016. This research was conducted at Animal Feed Technology Laboratory and Nutrition Biochemistry Laboratory, Department of Animal Feed Nutrition, Faculty of Animal Science, Universitas, Gadjah Mada, Yogyakarta.

Kumpai Minyak grass was obtained from Pampangan Village, South Sumatera Province. The harvested grass was then aerated for approximately 10 hours to reduce the water content to 60-65%. The forage was chopped with a chopper to sizes of 3-6 cm. A total of 700 g of Kumpai Minyak grass samples with a water content of 65% were placed in plastic bags and ensiled for 21 days, with addition of three levels of molasses (0, 2.5 and 5.0% DM) and three levels of LAB (0, 2 and 4 % DM) . All ingredients were well mixed before ensiling. The bags were pressed or compacted so as to reduce the air between the materials. After the filling process was completed, air in the bags was withdrawn using a vacuum pump before sealing the bags.

Sample Analysis

Physical characteristics analyses conducted on silage samples included color, odor, texture and the presence of molds. Analysis of pH was carried out using a pH. For pH determination distilled water was added to silage samples at a ratio of 10:1 and the pH recorded (Nahm, 1992). Determination of NH_3 was carried out following the method of Chaney and Marbach (1962) using a spectrophotometer.

Data analysis

Data obtained from observations and measurements were analyzed based on factorial design (two-way ANOVA). Differences among the treatment means were compared using Duncan's Multiple Range Test (DMRT) (Steel and Torrie, 1993). The calculation was done using XLstat Pearson Edition software version 2014.5.03 (Addinsoft).

RESULTS AND DISCUSSION

Physical Quality

The results of a physical quality evaluation of Kumpai Minyak grass silage in terms of color, odor (acid), texture and molds are shown in Table 1. The average s color score of silage produced was 1.24 which means that the silage is yellowish green. The results of this study indicate that the processing of silage with the addition of molasses and lactic acid bacteria resulted in silage colour which was indicative of good silage. In line with the opinion of Saun and Heinrichs (2008) and Rostini, (2004) that a good quality silage shouldl be bright green to yellow or brownish green depending on the silage material. The color change is due to a large number of fermentation products from biochemical reactions that occur both by bacterial activity and during aerobic fermentation or anaerobic fermentation. High temperatures during the ensilage process can cause silage discoloration, resulting in brownish colour which is a result of Maillard reaction (Gonzalez *et al*., 2007). Good silage has a color that is not much different from the color of the raw material (Abdelhadi *et al*., 2005).

Table 1. Physical quality analyze of Kumpai Minyak grass silage with different levels of molasses (0, 2.5, and 5%) and LAB (0, 2, and 4%)

Code	Color	Odor	Texture	Molds
M0B0	1.12	2.64	1.20	2.00
M0B2	1.80	2.92	2.00	2.10
M0B4	1.04	2.48	1.10	1.60
M2.5B0	1.04	1.92	1.00	1.70
M2.5B2	1.00	2.12	1.00	1.20
M2.5B4	1.68	2.16	1.60	1.60
M5B0	1.32	2.64	1.50	2.80
M5B2	1.04	1.96	1.00	2.20
M5B4	1.12	1.92	1.00	2.20
Average	1.24	2.31	1.30	1.90

Description : M: molasses, B: lactic acid bacteria; Color (score 1 = yellowish green, 2 = yellow, 3 = brownish yellow, 4 = dark brown); Odor (score 1 = very acidic and fresh, 2 = acid, 3 = less acid, 4 = rotten); Texture (score 1 = not clot and not slimy, 2 = slightly clumped and slightly slimy, 3 = lumpy and slimy, 4 = very clothed and very slimy); Molds (score 1 = absent, 2 = little, 3 = abundant on the surface, 4 = many at all observation points)

The average silage aroma scores ranged between 2.33 and 2.31. This means that the resulting silage aroma is acidic. The smell of acids arises due to the formation of acids, especially lactic acid fermentation conducted by lactic acid bacteria during the silage process takes place. The acid odour generated by silage is caused in the process of making active anaerobic silage bacteria fermentation to produce organic acids. The ensiling process occurs when oxygen has been used up, plant respiration will stop and the atmosphere becomes anaerobic. Under such a condition fungi cannot grow and only anaerobic bacteria remain active, especially acid-forming bacteria (Susetyo *et al*, 1969).

The average silage texture score generated ranged between 1.10 and 1.30. This meant that the silage texture produced was not lumpy and not slimy. This is because all silage treatments have appropriate moisture content for a fermentation process in the range of 60% to 65%. Macaulay (2004) suggests that the silage texture is affected by the water content of the material at the beginning of the ensilage, the silage with high moisture content (> 80%) will show a slimy, soft and moldy texture. While low water content silage (<30%) has a dry texture and overgrown with molds. The addition of molasses and *L. plantarum* which causes a decrease in pH that inhibits the growth of fungi causing a slimy silage texture.

The presence of molds observations ranged between 1.90 and 2.00, suggesting that the presence of fungi was minimum. At the time of opening the silage some molds were found on the surface of the silage, but the amounts were small. This was probably because at the time of charging into the silo there was still some air contained in between the green pile, that may provide some oxygen for the mold to grow. The process of silo filling was good and quick and anaerobic conditions were quickly achieved.

Silage Degree of acidity (pH) Value

The results of the acidity level determination (pH) of Kumpai Minyak grass silage with the addition of two treatments and different levels of molasses (0, 2.5, and 5%) and LAB (0, 2, and 4%) are presented in Table 2.

Tabel 2. Degree of acidity (pH) Kumpai Minyak grass silage with different levels of molasses (0, 2.5, and 5%) and LAB (0, 2, and 4%)

Level molasses (%)	Level LAB (%)			Mean effect means
	0	2	4	
0	5,00^{s}±0,05	4,78^{rs}±0,09	4,75^{rs}±0,10	4,84^{c}±0,08
2.5	3,92^{qr}±0,18	3,89^{qr}±0,14	4,16^{r}±0,16	3,99^{b}±0,16
5	3,69^{p}±0,13	3,64^{p}±0,05	3,74^{p}±0,03	3,69^{a}±0,07
Main effect means^{ns}	4,20±0,12	4,10±0,09	4,21±0,10	

^{ns}= *non significant*
^{abc}= Different superscripts in the same columns show significantly different (p <0.05)
^{pqrs}= Different superscripts in the same columns show significantly different (p <0.05)

The results showed that the level of addition of LAB did not give significant effect (p> 0,05) on pH, but on the addition of molasses and interaction between LAB and molasses had significant effect (p <0,05) on pH of the silage..

There was no significant differences (p>0.05) in pH between levels of LAB. The main effect means of pH for level of LAB were between 4.10 and 4.21. The highest pH value was for treatment at 4% LAB level, while the lowest was for silages with the addition of 2 % LAB. This suggests that the level of LAB did not influence the pH. It was thought that at 4% level LAB was not able to spur fermentation resulting in low production of lactic acid. This was supported by the opinion of Ratnakomala *et al*. (2006) that the inoculum concentration treatment did not give the significant difference to pH silage, so the smallest concentration of 1g was recommended to be added to silage preparation. Schroeder (2004) states that quality of silage is achieved when acid production dominated by lactic acid, faster pH decreases and fermentation process is perfect in a short time, therefore more nutrients can be maintained. The predominant growth of lactic acid bacteria characterized by low pH values suppresses the growth of undesirable microorganisms, such as clostridia are unable to survive under 4.5-4.8 pH (Perry, 1980). The result of research show that silage pH still in the normal range 4,2.

The main effect means of pH due to addition of molasses were significantly different (p<0.05) suggesting that adding solub le sugars was more effective in lowering the pH of the silages. The lowest pH values were for treatment at the 5% molasses level, while the highest was obtained from the silage without the addition of molasses. The higher the addition of molasses the lower was the resulting pH of silages. This suggests that the addition of molasses in the process of making Kumpai Minyak grass silage can provide a suitable condition for the development of lactic acid-forming bacteria so that the pH becomes rapidly decreased. This is in line with the opinion of Perry *et al*. (2003) who showed that the addition of carbohydrate-rich materials can accelerate the decrease in pH silage because carbohydrates are energy for lactic acid-forming bacteria. The average degree of acidity (pH) of Kumpai Minyak grass silage ranges from 3.78 to 4.88 produced good silage.

The result of statistical analysis showed that there was a significant interaction (p<0.05) between LAB level and molasses level on pH. The highest pH value (4.89) was obtained from the silage on treatment control, while the lowest was at the 2% LAB level and the 5% molasses level (3.64). It was suspected that the addition of molasses to the preparation of Kumpai Minyak grass silage had provided enough soluble carbohydrate substrate for LAB to form lactic acid resulting in a decrease in pH. The low pH of silage in this treatment was due to the addition of molasses resulting in an increase in the number of LAB and supported by sufficient availability of molasses that serve as the substrate driving the growth of lactic acid bacteria. To obtain good silage required a minimum amount of WSC contained in ensilage material of 3-5% DM (McDonald *et al*., 1991).

CONCLUSION

Based on the results of this study, it can be concluded that the use 5% molasses produced good physically quality and pH of Kumpai Minyak grass silage. The interaction between LAB level and molasses level with the best physical quality was found for treatment 4% LAB and 5% molasses levels.

REFERENCES

Abdelhadi LO, Santini FJ, Gagliostro GA. 2005. Corn silage of high moisture corn supplements for beef heifers grazing temperate pasture; effects on performance ruminal fermentation and in situ pasture digestion. Anim Feed Sci Technol. 118:63-78.

Chaney, A. L. and E. P. Marbach. 1962. Modified reagent for determination urea and ammonia. Clin. Chem. 8: 130 – 132.

Gonzalez, J. J. A., Hernandez, J. R. O., Ibarra O. O., Gomez, J. J. U., Fuentes, V.O. 2007. Poultry by-product meal as a feed supplement in mid-lactation dairy cows. J. Anim. Vet. Adv. 6: 139-141.

Fariani, A. 2008. Evaluation of Grass Swamp Nutritional Value as Ruminant Feed. Proceedings of National Seminar, Faculty of Animal Husbandry Andalas University.10-11 October 2008.

Macaulay, A. 2004. Evaluating silage quality. Avilable at: http://www1.agric.gov.ab.ca/$department/ deptdocs.nsf/all/for4909. htm. Accession date: Feb 2008.

McDonald, P., A.R. Henderson, and Heron SJE. 1991. The Biochemistry of Silage. Second Edition. Marlow: Chalcombe Publication.

Nahm, K. H. 1992. Practical Guide to Feed, Forage and Water Analysis. Yoo Han Publisher, Seoul.

Perry, T. W. 1980. Beef Cattle Feeding and Nutrition. Academic Press. New York.

Perry, T. W., A. E. Cullison and R. S. Lowrey. 2003. Feed & Feeding. Sixth Edition. Pearson Education, Inc. Upper SaddleRiver. New Jersey.

Ratnakomala, S., R. Ridwan, G. Kartina, and Y. Widyastuti. 2006. Influence of *Lactobacillus plantarum* 1a-2 and 1bl-2 inoculum on elephant grass silage quality (*Pennisetum purpureum*). Biodiversity. 7 (2): 131-134.

Rostini, T., L. Abdullah, K. G. Wiryawan, and P. D. M. H. Karti. 2014. Quality of Kumpai Minyak (*Hymenache Amplexicaulis Haes*) and Kumpai Stone (*Ischaemum Polystachyum* J Presl) Ensilage With Fermented Grass Extract. Research Report. Islamic University Kalimantan. South of Kalimantan.

Saun, R.J.V., and A.J. Heinrichs. 2008. Troubleshooting silage problems: How to identify a potential problem. Proceedings of the Mid-Atlantic Conference; Pennsylvania, 26 – 26 May 2008. Penn State's Collage. pp. 2 – 10.

Schroeder J. W. 2004. Silage fermentation and preservation. Extension dairy specialist. AS-1254. Avilable at: www.ext.nodak.edu/extpubs/ansci/dairy/as 1254w.htm. Accession date: June 2012.

Susetyo, S., Kismono, I., and Soewardi D. 1969. Forage Fodder. Directorate General of Livestock. Ministry of Agriculture. Jakarta.