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The Quality of Dwarf Elephant Grass (*Pennisetum purpureum cv. Mott*) Silage Using Fresh Rumen Content Inokulan and Carbohydrate Source Additives with Different Incubation Time

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***Abstract*— *The purpose of this study was to examine the effect of using fresh beef rumen contents as an inoculant combined with carbohydrate source additives (cassava and rice bran) in making silage on fleigh value, and nutrient content (dry matter, organic matter, crude fiber, and crude protein) dwarf elephant grass silage (Pennisetum purpureum cv Mott). This research was conducted with an experimental method using a randomized block design with nested patterns where the second factor was nested into factor 1 with 3 replication groups. Factor 1: the level of addition of fresh cattle rumen content as an inoculant mixed with additives as much as 7.5% of the weight of dwarf elephant grass, S0 = 1 kg fresh dwarf elephant grass + 75 g additives (control), S1 = S0 + inoculants as much 37.5 g, S2 = S0 + 75 g inoculant. Factor 2: Duration of incubation (ensilage), namely for 0, 1, 2, 4, 12, and 21 days. The results showed that the best dwarf elephant grass silage was fleigh value (92.29), and had a low nutritional quality reduction which was indicated by no decrease in the nutritional quality of silage from the beginning of the incubation period (0 days) to The end of the incubation period (21 days) is shown in S2, namely treatment with the composition of dwarf elephant grass silage added 75 g of carbohydrate source additives and 75 g of cattle rumen content inoculant.*

***Keywords*— *Nutritional content, silage, dwarf elephant grass, incubation time.*

I. INTRODUCTION

The technology of making silage has long been known and is developing rapidly in countries experiencing winter. The principle of making silage is the forage fermentation carried out by lactic acid bacteria anaerobically. Lactic acid bacteria will use carbohydrates dissolved in water and produce lactic acid. This acid will play a role in decreasing the silage pH (Ennahar, et al., 2003). During the fermentation process, the resulting lactic acid will act as a preservative so that it can prevent the growth of rotting microorganisms. The silage fermentation process takes at least 21 days to achieve optimal results. Silage quality is achieved when lactic acid as the dominant acid is produced, indicating efficient acid fermentation when the decrease in silage pH occurs rapidly. The faster the fermentation occurs, the more nutrients contained in silage can be maintained (Schroeder, 2004). Silage is good when the nutritional value it contains is still high or does not experience a reduction. McDonald et al (1991) wrote that the quality of silage is not only assessed by the preservation of nutritional value but also how much of the silage has lost dry matter. In making silage, inoculants and additives are needed which play a role in minimizing failure in the ensilage process. Ridwan et al. (2005) stated that the low dry matter content and WSC (water-soluble carbohydrate) of fresh-cut tropical forages (C4) resulted in low fermentation quality. One solution is the addition of alternative inoculants to reduce costs and failures in the fermentation process as well as the addition of waste additives from beef rumen contents as inoculants and cassava flour and rice bran as an additive for carbohydrate sources. The contents of the beef rumen are slaughterhouse waste which has not been widely used as an alternative inoculant. The contents of the cattle rumen waste are feed ingredients that are consumed by livestock which are found in the rumen before they become phases and are excreted in the rumen after the animals are slaughtered so that the nutrients contained in the feed ingredients consumed by livestock have a content that is not much different from the nutritional content of the feed before consumption of livestock. . The addition of beef rumen content as an inoculant combined with rice bran additives and cassava flour as an additive source of carbohydrates in making mini elephant grass silage is expected to play a role in avoiding failures in silage making and can produce silage with good quality.

II. MATERIAL AND METHODS

This research was conducted with an experimental method using a randomized block design (RBD) with nested patterns where the second factor was nested into factor 1 with 3 replication groups.
Factor 1: the level of addition of fresh beef rumen content as an inoculant mixed with additives as much as 7.5% of the weight of dwarf elephant grass, S0 = 1 kg fresh dwarf elephant grass + 75 g additives (control), S1 = S0 + inoculants as much 37.5 g, S2 = S0 + 75 g inoculant. Factor 2: The duration of incubation (ensilage) was 0, 1, 2, 4, 12, and 21 days. This study uses dwarf elephant grass at the age of 40-50 days which is cut one day before the time of silage making to wilt or reduce the moisture content in dwarf elephant grass. The water content contained in the silage-making dwarf elephant grass is expected to be around 60-70%. The contents of the rumen of fresh cattle were obtained from the Slaughterhouse (RPH) on Jalan Mojopahit Selatan, Mojorejo, Kec. Junrejo, Batu City.

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The additive used in this study was a mixture of rice bran (*Oryza sativa*) and cassava flour (*Manihot escullenta*) with a weight ratio of 1: 1. Mixing is done by weighing 2 kg of rice bran: 2 kg of cassava flour then mixed until homogeneous. The parameters observed included *fleigh* value, and nutritional quality (dry matter, organic matter, crude fiber, and crude protein).

A. Silage Making Procedure

Weighed the dwarf elephant grass was chopped manually, weighed as much as 1 kg, plus 75 g additives, mixed evenly as a control treatment (S0). Silage treatment S1 and S2 each were made with S0 added with 37.5 g and 75.0 g fresh rumen contents then mixed well. The S2 treatment was 1 kg mini elephant grass + 75 g of additives + 75 g of fresh rumen contents then mixed well. The silage material that has been evenly mixed is put into a plastic bag as a silo then sucked using a vacuum machine then tightly laced, then incubated with incubation times of 0, 1, 2, 4, 12, and 21 days.

The data were analyzed using variance (ANOVA) according to the nested randomized block design and if the results obtained were different, it was followed by Duncan's distance test. The mathematical model used in the analysis is (Sudarwati et al., 2019).

TABLE 1. The results of the proximate analysis of the silage constituent material of dwarf elephant grass.

Material	**Nutrient Content % Dry Matter**			
	Dry matter	**Organic matter**	**Crude fiber**	**Crude protein**
Dwarf Elephant Grass	22,13	85,05	30,41	7,23
Cassava flour	86,05	98,41	2,75	1,53
Rice Bran	91,59	87,60	16,39	9,80
Rumen Cattle U1 *	16,67	76,66	34,22	9,77
Rumen Cattle U2 *	19,23	86,22	35,34	12,62
Rumen Cattle U3 *	19,76	82,52	31,46	10,80

Description: * Group of tests
Source: Results of Proximate Analysis at the Laboratory of Animal Nutrition and Forage, Faculty of Animal Husbandry, Brawijaya University, Malang (2018).

TABLE 2. Dry matter (% dry matter) of dwarf elephant grass silage made using rumen contents plus additives and different incubation times

Treatment	**Incubation time (days)**						**Average**
	0	**1**	**2**	**4**	**12**	**21**	
S0	22,53±0,54	25,92±1,50	25,72±1,79	23,85±2,58	23,30±1,56	22,27±1,22	23,93±2,02
S1	23,06±0,90	22,72±3,18	26,12±2,14	24,33±2,79	22,45±2,01	22,01±1,48	23,45±2,35
S2	23,12±1,35	24,46±2,14	25,11±3,21	23,97±2,35	22,75±2,05	22,98±3,25	23,73±2,26

Note: The value shows no significant difference (P> 0.05).

TABLE 3. Organic matter (% dry matter) dwarf elephant grass silage made with different levels of rumen contents plus additives and incubation time.

Treatment	**Incubation time (days)**						**Average**
	0	1	2	4	12	21	
S0	87,05±0,21	86,95±0,62	86,86±0,66	86,49±0,42	86,27±0,59	86,17±0,60	86,63±0,57
S1	86,64±0,46	87,17±0,75	86,97±0,13	86,86±0,50	86,55±0,53	86,75±0,55	86,82±0,48
S2	86,98±0,47	86,7±0,44	86,63±0,39	86,74±0,20	87,03±0,39	86,76±0,22	86,81±0,34

Note: The value shows no significant difference (P> 0.05).

III. RESULT DISCUSSION

The raw materials used in making silage in this study were dwarf elephant grass, cassava flour, rice bran, and inoculant with cattle rumen contents. The results of the proximate analysis of the constituent materials used in the study can be seen in table 1.

The results of the analysis of dry matter (% dry matter) of dwarf elephant grass silage were carried out with several levels of the rumen content as an inoculant plus additives and the incubation time is presented in table 2. From the test results in table 2, the results of the incubation time in the treatment showed no significant difference (P <0.05) on the dry matter content of the silage. The increase in dry matter of dwarf elephant grass silage occurred on the first day of incubation until the 4th day and decreased on the 12th and 21st days. In the ensilage process, there is an increase in water because in the ensilage process not only lactic acid is produced but lactic acid and water. On the 12th and 21st days, there tends to be a decrease again along with the cementation process so that there is the addition of lactic acid bacteria. This is in line with the opinion (Prabowo, 2013) which states that this decreasing trend is due to the addition of lactic acid bacteria, so that the more population of lactic acid bacteria, the higher the activity. This condition increases the conversion of dry matter into energy, so this event causes a decrease in dry matter content. According to (Gervais, 2008), changes in water content occur due to evaporation, substrate hydrolysis, or metabolic water production.

The results of the analysis of organic matter (% dry matter) of dwarf elephant grass silage made with several levels of rumen contents as inoculants plus additives and incubation time are presented in table 3. From the results of the study, the effect of treatment, and incubation time on the silage organic matter of dwarf elephant grass did not show a significant difference (P> 0.05). The average organic matter ranged from 86.89% - 86.56% which did not appear to have increased. This is in line with research (Ridwan et al., 2005) which states that the organic material contained by the addition of carbohydrate sources should increase, but in this study, it did not happen. This is presumably because the addition of DP 1% - 5% still does not affect the organic matter.

The results of crude protein analysis (% dry matter) of dwarf elephant grass silage made with several levels of rumen contents as inoculants plus additives and incubation time are presented in table 4. From the results of the analysis in table 4, the treatment levels of use of inoculants with rumen contents and incubation time show no. There is a significant difference (P> 0.05) in the crude protein content between dwarf elephant grass silage, there is no change in either a decrease or an

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increase in the protein content in the silage so that it can be said that the addition of carbohydrate source additives in the form of cassava flour and rice bran and the addition of filled inoculants cattle rumen can maintain the protein content in silage. The nutritional content of silage can be maintained by adding additives such as bacterial cultures (lactic acid bacteria), water-soluble carbohydrates, organic acids, enzymes, and nutrients (urea, ammonia, minerals) (McDonald, 1991).

TABLE 4. Crude protein (% dry matter) of dwarf elephant grass silage made using the contents of the rumen plus additives and different incubation times

Treatment	Incubation time (days)						Average
	0	1	2	4	12	21	
S0	6,69±0,36	6,69±0,50	6,74±0,68	6,47±0,57	6,38±0,77	6,52±0,44	6,58±0,50
S1	6,65±0,21	6,72±0,34	6,56±0,13	6,75±0,24	6,79±0,22	7,04±0,55	6,75±0,30
S2	6,65±0,48	6,67±0,62	6,61±0,32	6,65±0,32	6,67±0,47	6,91±0,42	6,69±0,39

Note: The value shows no significant difference (P> 0.05).

TABLE 5. Crude fiber (% dry matter) of dwarf elephant grass silage made using the contents of the rumen plus additives and different incubation times

Treatment	Incubation time (days)						Average
	0	1	2	4	12	21	
S0	29,41±1,22	28,87±2,03	28,95±1,78	29,25±1,27	28,90±1,29	29,06±0,92	29,07±1,25
S1	29,37±0,78	28,78±1,02	28,38±1,03	28,93±0,16	29,04±0,48	28,71±0,38	28,87±0,68
S2	29,29±0,35	29,54±0,06	28,70±1,21	29,21±2,39	28,76±0,53	28,5±1,36	29,00±1,12

Note: The value shows no significant difference (P> 0.05).

TABLE 6. Fleigh value silage dwarf elephant grass made with different levels of rumen contents plus additives and incubation time

Treatment	Long Incubation (day)						Average
	0	1	2	4	12	21	
S0	6,07±7,26[a]	42,17±6,09[a]	57,77±4,78[a]	78,03±14,37[a]	87,61±6,08[a]	86,87±6,34[a]	59,75±30,60[a]
S1	5,78±3,07[a]	47,78±14,73[a]	71,91±12,60[a]	80,33±8,55[a]	83,24±6,17[a]	89,01±5,09[a]	63,01±30,64[ab]
S2	5,91±3,98[a]	51,25±9,45[a]	69,88±2,56[a]	83,61±10,04[a]	91,83±6,10[a]	92,29±6,10[a]	65,80±31,79[b]

Note: The mean value with the notation (a-b) shows a significant difference (P <0.05).

The results of crude fiber analysis (% dry matter) of dwarf elephant grass silage made with several levels of rumen contents as inoculants plus additives and incubation time are presented in table 5. In this study, the level of rumen content and incubation time had no significant effect (P> 0.05) against crude fiber content. This is because the addition of carbohydrate additives and inoculants with the contents of the cattle rumen is still not sufficient to remodel the crude fiber content, namely cellulose and hemicellulose into simpler forms. Hemicellulose can function as a source of reserve sugar in silage and about 11-55% of this hemicellulose can be transformed into simpler ones (McDonald, 1984). Fiber contains cellulose, lignin, and other polysaccharides. These compounds have a complex bond that is very difficult to break down by microorganisms so that microorganisms cannot use crude fiber at the beginning of the fermentation process.

The data from the analysis of the *fleigh* value of dwarf elephant grass silage made with several levels of rumen content as an inoculant plus additives and incubation time are presented in Table 6. Table 6 shows that treatment and incubation time is significant (P <0.05) *fleigh* silage. It can be seen that the increase in fleigh value from the 0 day incubation period increases until the 21st incubation day. The best *fleigh* value is in the S2 treatment (92.29) almost close to 100 so that it can be said that the use of 7.5% of cattle rumen inoculum has resulted in very good quality silage. This is by the opinion (Santoso et al., 2009) which states that silage can be said to be of very good quality if the *fleigh* score approaches 100. Furthermore (Bakrie et al., 2014) states that the *fleigh* value is calculated based on the formula (Killic, 1984), namely NF = 220 + (2 X% BK - 15) - (40 x pH). If the fleigh value is 85-100 then the quality of the silage is considered very good, if the *fleigh* value is 60-80 then the quality of the silage is good, if the *fleigh* value shows the numbers 55-60 then the quality of the silage is a little good, whereas if the *fleigh* value shows the numbers 25-40 then medium quality silage. The quality of fermentation is classified as very bad if the fleigh value is <20. The value of fleigh depends on the high and low value of the dry matter and the pH of the silage. The average *fleigh* value of each treatment on day 21 was S0 (86.87), S1 (89.01), and S2 (92.29). This is supported by the high dry silage content (22.42% BK) and low pH value (4.01). This statement is supported by Wati et al, 2018 which states that high or low fleigh points depend on the dry matter value and silage pH, the higher the dry matter value and the lower the pH value, the higher the *fleigh* points will be.

IV. CONCLUSION

The best treatment is shown in S2, namely the treatment with the composition of dwarf elephant grass silage added 75 g of carbohydrate source additives and 75 g of cattle rumen content inoculum. The best *fleigh* value (92.29) and decreased nutritional quality with no decrease in the nutritional quality of silage from the beginning of the incubation period (0 days) to the end of the incubation period (21 days). A treatment that tends to maintain the quality of the silage content.

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