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Analysis of The Effect of Elephant Grass (*Pennisetum purpureum*) Cutting Length on Silage Characteristics with a Shelf Life of 63 Days

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ABSTRACT

Background: One of the feed preservation techniques is silage to anticipate forage shortages in the dry season. One of the factors that affect the characteristics of silage is the length of grass cutting.

Aims: The purpose of this study was to determine the effect of the length of elephant grass cutting (Pennisetum purpureum) on the quality of silage characteristics including physical, chemical and biological qualities with a shelf life of 63 days.

Methods: The method used was an experiment with a Completely Randomized Design (CRD) design, the treatment used was the length of elephant grass cutting, with cutting levels of 3 cm, 5 cm, and 7 cm, each treatment was repeated 5 times and stored for 63 days. The variables observed were the physical characteristics of silage including texture, color, aroma using organoleptic tests with 15 somewhat trained panelists, then the chemical characteristics test by measuring the pH value of the silage and the biological characteristics test by assessing the presence of fungi in the silage. Data analysis used was the ANOVA test (analysis of variance) using the F test. If the F test shows a significant or very significant effect, it is continued with Duncan's Multiple Range Test (DMRT) test.

Results: The results of statistical analysis of the effect of elephant grass cutting length on silage characteristics showed that P1, P2, and P3 had no significant effect on texture, aroma, and pH value ($P>0.05$), while on color and the presence of fungi there was a significant effect ($P<0.05$). The conclusion of this study is that there is no significant effect on texture, aroma, and pH value of silage, while on color and the presence of fungi silage there is a significant effect. Suggestions for further research are expected to conduct further analysis on color, fungi, proximate tests, and palatability tests.

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1. Introduction

Elephant grass is a forage whose production will be high during the rainy season and low during the dry season, so that forage preservation technology is needed, namely silage, to anticipate forage shortages during the dry season. There are two types of forage (HMT), namely fresh and preserved. Forage productivity in the rainy season is high, while in the dry season its productivity is very low. To overcome the shortage of HMT in the dry season, there needs to be an innovation in preservation technology, one of which is silage. According to Eskilden (2019) silage is a technology for preserving forage by fermentation using lactic acid. Silage is used to overcome forage shortages during the dry season (Randu, 2021). The success of the silage making process can be seen from its physical and chemical qualities. The silage making process includes adding additives, silo filling methods, compaction methods, and closing the silo (Anjalani, 2017).

Chopping grass to the right size facilitates the fermentation process for lactic acid bacteria and produces good silage. According to Hidayat (2006), cutting grass will increase the efficiency of feed use with a size of 2-5 cm. Norgaard (2011), stated that the benefits of using chopped plants during silage preparation can increase density, reduce air leakage, and improve fermentation quality. According to McEniry et al. (2007), plants that are chopped precisely to a theoretical length of 19 mm will increase silage density and maximize the silage process compared to unchopped plants.

This study was conducted to determine the effect of the cutting length of elephant grass (pennisetum purpureum) on the characteristics of silage including physical, chemical and biological quality with a storage period of 63 days.

2. Methods

2.1 Location and Time of Research

The study was conducted over 63 days, from July 13, 2024, to September 14, 2024, at the Integrated Laboratory of the Faculty of Agriculture and the Animal Nutrition and Feed Laboratory of Kadiri Islamic University, Kediri.

2.2 Tools and Materials

The tools used include rulers, stationery, duct tape, cutting knives with a diameter of 45 cm, plastic bags, sacks, black plastic bags, rubber straps, analytical digital scales (capacity 500 gr with an accuracy level of 0.01 gr), hanging digital scales (capacity 50 kg with an accuracy level of 10 gr), buckets, sample stickers, cardboard, trays, pH parameter paper, blenders. The materials used in this study were elephant grass (Pennisetum purpureum) obtained from the land of the Integrated Laboratory of the Faculty of Agriculture Uniska as much as ± 15 kg, molasses ± 1.5 liters, 1.5 liters of distilled water.

2.3 Research Methods

The method used is an experimental method with a Completely Randomized Design (CRD) design, the treatment is the length of elephant grass cutting, with cutting levels of 3 cm, 5 cm, and 7 cm, each treatment is repeated 5 times and stored for 63 days. Observed variables: 1). Physical characteristics include: texture, color, odor, 2). Chemical characteristics include: pH changes, and 3). Biological characteristics include: the presence of fungi

The research procedure is presented through a flowchart in **Figure 1.**

Caption: dotted line to differentiate the preparation process from the silage making process

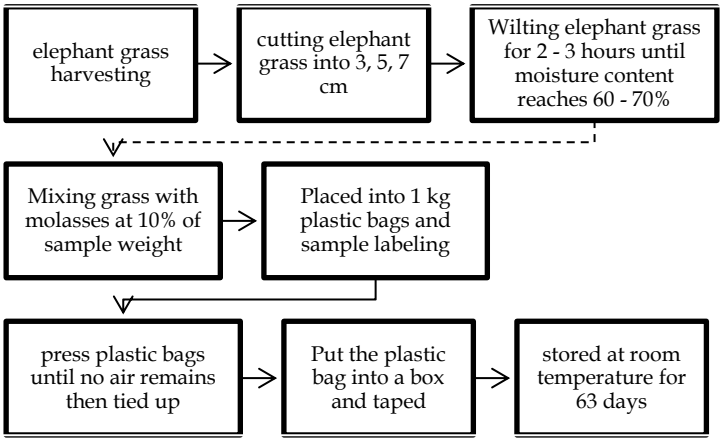

Figure 1. Flowchart of the Silage Making Process (dotted line to differentiate the preparation process from the silage making process)

The physical character data collection procedure was carried out by testing samples on the 63rd day of silage harvest using organoleptic tests to observe the physical characteristics of the silage. Observations of the physical characteristics of the silage in this study were carried out visually and by touch by 15 semi-trained panelists covering texture, color, and odor. The silage assessment scores according by McElhlarry (1994) are presented in **Table 1**.

Table 1. Silage Assessment Score

Criteria	Characteristics	Score	Average
Texture	Mushy	1-3	2
	Currently	4-6	5
	Hard	7-9	8
Color	Dark brown	1-3	2
	Chocolate	4-6	5
	Fawn	7-9	8
Aroma	Not sour	1-3	2
	Slightly sour	4-6	5
	Sour	7-9	8

Chemical characteristic data was collected by measuring the pH of the silage. The method used to collect data on pH changes was to mix the silage with distilled water and then grind it using a blender. Then, pH parameter paper was dipped in and waited 5-10 seconds to determine the pH change in the silage. Silage quality standards according by Skerman and Riveros (1990) are presented in **Table 2**.

Table 2. pH score

Criteria	Characteristics	Score
Ph Value	Good	4.2
	Currently	4.4
	Bad	4.5

Biological characteristics data collection was conducted by observing the presence of fungi in newly opened silage. Observations of the characteristics of fungal presence were carried out by weighing the affected silage and calculating the fungal load using the following calculation.

$$\%presence\ of\ fungi = \frac{weight\ of\ silage\ with\ fungi}{total\ weight\ of\ silage} \times 100\%$$

After the calculations were carried out, observations were made on the characteristics of the mushrooms. Observations of the characteristics of the mushrooms according by Macaulay (2004), in Elviriadi, et al. (2023) were based on **Table 3**.

Table 3. The presence of fungi

Criteria	Characteristics	Score
The presence of mushrooms	None/little (less than 2% of total silage)	3-4
	Medium (2%-5% of total silage)	2-3
	A lot (more than 5% of total silage)	1-2

The data analysis method used is the ANOVA (analysis of variance) test using the F test. If the F test shows a real or very real effect, it is continued with the Duncan's Multiple Range Test (DMRT) (Steel and Torrie, 1992). According to Ghozali, (2016) the F test is conducted to see the effect of all independent variables simultaneously on the dependent variable. The level used is 0.5 or 5%, if the significance value of F <0.05, it can be interpreted that the independent variables simultaneously affect the dependent variable or vice versa.

3. Results and Dicussion

The results of statistical analysis of the effect of elephant grass cutting length on silage characteristics including texture, color, aroma, pH value, and the presence of fungi with 3 treatments, namely differences in elephant grass cutting length consisting of P1 cutting length 3 cm, P2 cutting length 5 cm, P3 cutting length 7 cm at a storage period of 63 days, can be seen in **Table 4.**

Table 4. Data Analysis Results

Treatment	Texture	Color	Aroma	pH value	Presence of Fungi (%)
P1	4.60±1.14	6.40 ±0.54b	5.22±0.30	4.20±0.44	2.41±0.38b
P2	4.60±0.54	4.20±0.44a	5.40±0.66	4.20±0.44	1.03±0.65a
P3	5.00±0.00	6.00±0.00b	5.44±0.52	4.00±0.00	2.27±0.75b

Description: P1 (cutting length 3 cm), P2 (cutting length 5 cm), P3 (cutting length 7 cm). a, b are notations, numbers with notations mean there is a real effect (P < 0.05) on the results of the ANOVA test. Numbers without notations mean there is no real effect (P > 0.05).

The analysis data shows that the average texture score is 4.60-5.00, which means that the silage texture characteristics are moderate. The average color score is 4.20-6.40, which indicates that the average color characteristic of elephant grass silage is brown. The average aroma score of silage is 5.22-5.44, which indicates that the aroma characteristic of silage is slightly sour. The pH value of silage has an average score of 4.00-4.20, which indicates that silage has a good pH value. The average presence of elephant grass silage fungi shows that in P1 and P2, it has an average of 2.27% - 2.41%, which means that the presence of fungi above 2% - 5% is included in the moderate category with a score of 2-3. P2

P2 has an average of 1.03%, which means that the presence of fungi less than 2% is included in the no/little category with a score of 3-4.

3.1 Physical Characteristics of Elephant Grass Silage

3.1.1 Texture

The results of the ANOVA test in Table 4 show that P1, P2, and P3 had no significant effect on silage texture (P>0.05). This indicates that cutting sizes of 3 cm, 5 cm, and 7 cm did not make a difference in silage texture.

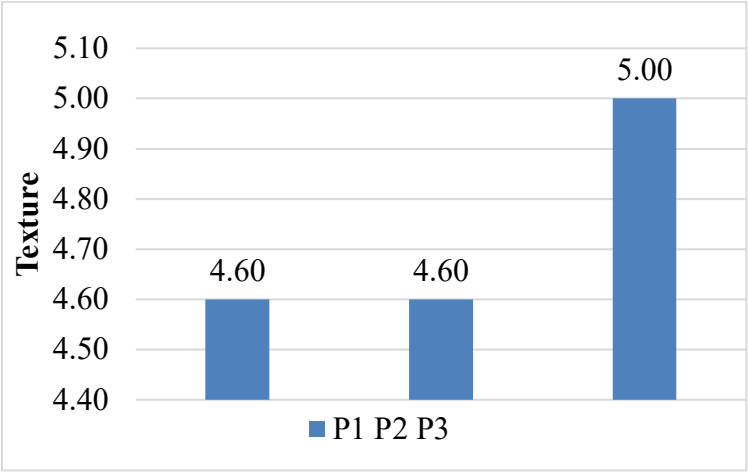

Figure 2. Graph of Average Treatment of Texture (*P1: cutting length 3 cm, P2: cutting length 5 cm, P3: cutting length 7 cm)*

In **Figure 2.**, it is known that the results of the long treatment of elephant grass cutting on the texture of the silage lead to moderate characteristics, not too hard or soft and not clumping, which indicates that the silage texture is good. This is in accordance with the results of Rasuli's research (2022), a good silage texture is not slimy, soft, and does not clump. According to Rostini (2014), the water content of the material at the beginning of fermentation affects the texture. According to Syahrudin (2023), a slightly hard silage texture indicates that the water content of the silage is low, and the absence of mucus in the silage indicates that the silage has good texture quality.

3.1.2 Color

The results of the ANOVA test in Table 4 show that P1, P2, and P3 significantly affected silage color (P<0.05). This indicates that the cutting sizes of elephant grass, 3 cm, 5 cm, and 7 cm, affected silage color.

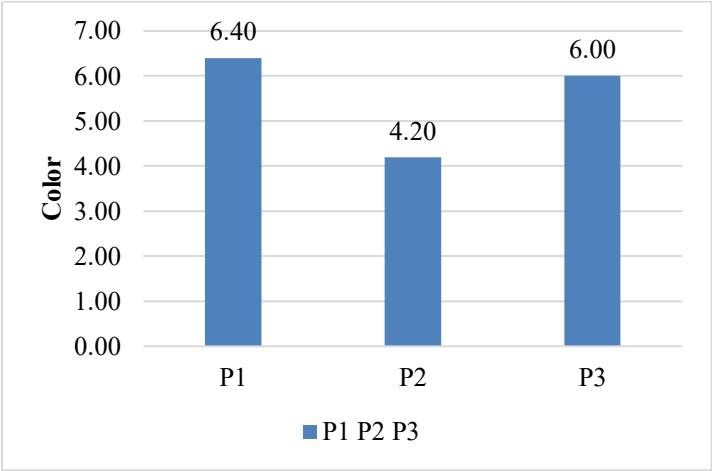

Figure 3. Graph of Average Treatment of Color (P1: cutting length 3 cm), P2: cutting length 5 cm, P3: cutting length 7 cm).

The results of the elephant grass cutting length treatment on silage lead to a brown color. In **Figure 3**, it is known that the cutting length treatment that received the best score was P1 or a cutting length of 3 cm with a color approaching yellowish brown. According to Hidayat (2014), good silage is light brown or yellowish. This shows that the cutting length of 3 cm affects the color of silage, with this size making the density of the silage more optimal and affecting the silage process. This is in accordance with the opinion of Davies (2007), that the limitation of optimal oxygen supply is related to the particle size of the material.

3.1.3 Aroma

The results of the ANOVA test on **Table 4.** showed that P1, P2, and P3 had no significant effect on the aroma of silage (P>0.05). This indicates that the cutting length of elephant grass of 3 cm, 5 cm, and 7 cm did not affect the aroma of silage.

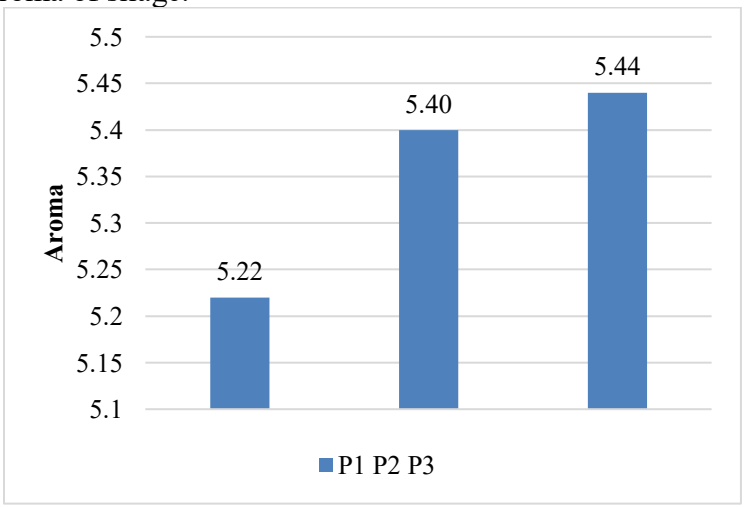

Figure 4. Average Treatment Graph Against Aroma (*P1:cutting length 3 cm, P2: cutting length 5 cm, P3: cutting length 7 cm)*

In **Figure 4.** it is known that the resultsThe long-term treatment of elephant grass cutting on the aroma of silage leads to a slightly sour aroma. This is consistent with McElhlary's (1994) statement, which states that aroma scores ranging from 4-6 with an average of 5 are classified as slightly sour. According to Akbar (2024), the aroma of silage is generally sour due to the fermentation process. Silage that

produces a sour aroma is good quality silage, where the sour aroma indicates that the fermentation process in the silo is running well.

3.2 Chemical Characteristics of Elephant Grass Silage

The results of the ANOVA test on **Table 4.**showed that P1, P2, and P3 had no significant effect on the pH value of the silage (P>0.05). This indicates that the cutting length of elephant grass of 3 cm, 5 cm, and 7 cm did not affect the pH value.

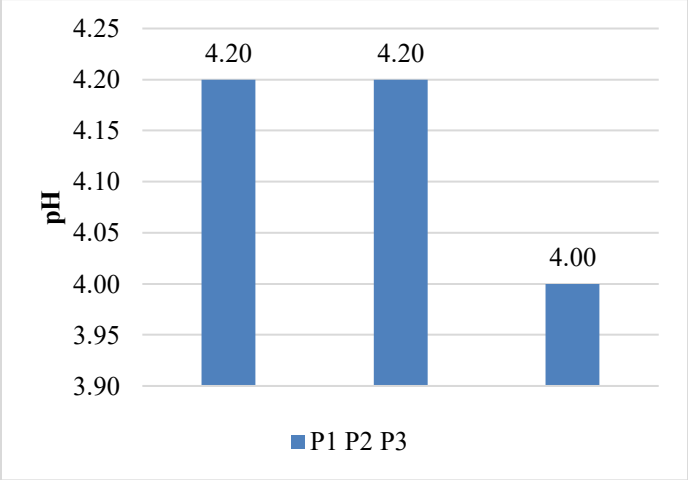

Figure 5. Average Treatment Graph Against pH Value (*P1:cutting length 3 cm, P2: cutting length 5 cm, P3: cutting length 7 cm)*

Based on **Figure 5.** It was found that the treatment in the study produced good quality silage with an average pH value of 4.00–4.20. This is in accordance with Sumarsih's (2015) statement that a pH with an average of 4 is considered good.

3.3 Biological Characteristics of Elephant Grass Silage

The presence of fungi is an indicator that determines the characteristics of low or high quality in silage. The results of the ANOVA test on **Table 4.** showed that P1, P2, and P3 had a significant effect on the presence of silage fungi (P<0.05). This indicates that the cutting size of elephant grass 3 cm, 5 cm, and 7 cm had an effect on the presence of silage fungi.

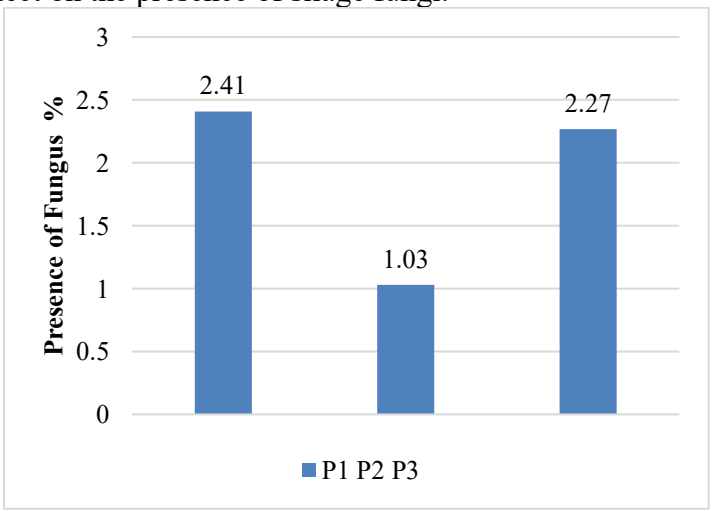

Figure 6. Average Treatment Graph for the Presence of Fungus (P1: cutting length 3 cm, P2: cutting length 5 cm, P3: cutting length 7 cm)

The results of the treatment of the length of elephant grass cutting on the presence of fungi showed that there was a difference in the percentage of fungal presence in P2 which indicated the presence of fungi less than 2% including none / little, while in P1 and P3 the presence of fungi was more than 2% which meant moderate.

Figure 6. it showed that the best treatment with the least percentage of fungi was P2 or a cutting length of 5 cm. In P1 or a cutting length of 3 cm, the highest fungal presence was obtained. This is inconsistent with the color results in P1, which was the best result. This is suspected to be due to a leak in the plastic bag during the manufacturing process in P1, which trapped air inside, causing aerobic conditions in the silage. This is in accordance with the opinion of Sadarman (2023), who stated that aerobic silo conditions indicate fungal growth in silage. Silage that is overgrown with fungi indicates a leak in the silo, resulting in damaged silage products.

4. Conclusions

The conclusion of this study is that the length of elephant grass cutting has a significant effect on the color and presence of fungi in silage, while there is no significant effect on texture, aroma, and pH.

5. Acknowledgment

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