EFFECT OF GRADED MOLASSES TOWARD PHYSICOCHEMICAL OF RICE STRAW SILAGE

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DEDICATION

This thesis is dedicated to those whose unwavering support has been the cornerstone of my academic pursuits. To my esteemed supervisor, Dr Amirul Faiz Bin Azmi, his guidance and mentorship have been invaluable, shaping both this research and my growth as a scholar. To my dear friend, Tan Wei Jun, His steadfast encouragement has been a source of strength and joy. To Dr Luqman Bin Abu Bakar, with his insightful feedback and academic guidance have significantly influenced the development of this work. To my beloved family, their unwavering support and belief in my abilities have been my driving force. Lastly, to the dedicated lab assistant, Puan Hasimah. Her contributions to the research are deeply appreciated. This thesis is a collective expression of gratitude to each of them for their role in making this academic journey both meaningful and fulfilling.

ABBREVIATION

EM	Effective Microbe
DM	Dry Matter
DW	Dry Weight
FW	Fresh Weight
pH	Potential of Hydrogen
RS	Rice Straw

ABSTRACT

An abstract of the research paper presented to the Faculty of Veterinary Medicine, Universiti Malaysia Kelantan, in partial requirement on the course DVT 55204 – Research Project.

Rice straw is one of the most abundant agricultural waste products in Malaysia. Use of rice straw as animal feed are uncommon due to its low palatability. Ensiling the rice straw may potentially increase it palatability. Rice straw for silage is advantageous due to its abundance, cost-effectiveness, and the potential to enhance the nutritional quality of the forage, offering a sustainable solution for livestock feed and contributing to efficient agricultural waste management. This research delves into the "Effect of Graded Molasses on the Physicochemical Characteristics of Rice Straw Silage," exploring seven distinct treatments labeled A to G, each representing varying concentrations of molasses (0%, 0.4%, 0.8%, 1.2%, 1.6%, 1.8%, and 2%). The physicochemical parameters assessed include pH, water content, color, smell, texture, and the presence of mold in the silage. Despite the range of molasses concentrations employed, the study reveals significant differences across these parameters among the treatments. This indicates that the addition of molasses, within the examined concentrations, exert discernible effects on the evaluated physicochemical characteristics which are pH, water content, smell, colour, texture and formation of mold on the rice straw silage. These findings contribute valuable insights to silage preservation practices, offering practical implications for optimizing molasses utilization in the context of forage conservation.

Key word: Effective microbe,Molasses,rice straw,pH ,Physicochemical

Abstrak

Abstrak penyelidikan ini dibentangkan kepada Fakulti Perubatan Veterinar, Universiti Malaysia Kelantan, sebagai sebahagian daripada keperluan separuh masa kursus DVT 55204 - Projek Penyelidikan.

Jerami padi merupakan salah satu produk sisa pertanian yang paling berlimpah di Malaysia. Penggunaan jerami padi sebagai makanan haiwan jarang berlaku disebabkan oleh kekurangan kelazatannya. Proses pengelisan jerami padi boleh meningkatkan kelezatannya. Penggunaan jerami padi sebagai bahan silaj mempunyai kelebihan disebabkan oleh ketersediaan yang banyak, kos yang murah, dan potensinya untuk meningkatkan kualiti pemakanan hijauan, menawarkan penyelesaian mampan untuk makanan ternakan dan menyumbang kepada pengurusan sisa pertanian yang cekap. Penyelidikan ini menyelami "Kesan Molases Bertingkat ke atas Ciri-ciri Fizikokimia Silag Jerami Padi," Meneliti tujuh rawatan berbeza yang diberi label A hingga G, masing-masing mewakili kepekatan molases yang berbeza (0%, 0.4%, 0.8%, 1.2%, 1.6%, 1.8%, dan 2%). Parameter fizikokimia yang dinilai termasuk pH, kandungan air, warna, bau, tekstur, dan kehadiran kulapuk dalam silaj. Walaupun berbagai kepekatan molases digunakan, kajian ini mendapati perbezaan yang signifikan di antara parameter-parameter ini di kalangan rawatan. Ini menunjukkan bahawa penambahan molases, dalam kepekatan yang dikaji, memberikan kesan yang ketara terhadap ciri-ciri fizikokimia yang dinilai dalam ensilaj jerami padi. Penemuan ini menyumbang pandangan yang berharga kepada amalan pemeliharaan silaj, menawarkan implikasi praktikal untuk mengoptimumkan penggunaan molases dalam konteks pemeliharaan hijauan.

Keyword:Jerami Padi, Molasses, pH, Fizikokimia, silaj

CHAPTER 1

INTRODUCTION

1.1 Research Background

Rice straw, a copious byproduct of rice cultivation, represents an abundant and often underutilized resource in agriculture. As the residual stalks left after harvesting rice grains, rice straw has the potential to be a valuable component in livestock feed. Its use in silage production is gaining attention to harness its nutritional content efficiently and address challenges related to storage and utilization.

Rice straw is a crop residue that is abundantly available after the harvest of rice grains. However, its utilization as animal feed is limited due to its low nutritive value and poor digestibility (K malik *et al*., 2016). To address this issue, ensiling, a fermentation process, can be employed to improve the physicochemical properties of rice straw silage and enhance its nutritive value (Oladosu *et al*., 2016; Li *et al*., 2010). Ensiling involves the use of additives such as lactic acid bacteria (LAB), molasses, and glucose to promote fermentation and improve the fermentation quality of the silage (Yang *et al.*, 2010; Zhao *et al.*, 2019; Oskoueian et al., 2021). These additives can enhance the fermentation process, increase the production of lactic acid, reduce pH, and inhibit the growth of undesirable microorganisms (Yang *et al*., 2010; Zhao *et al*., 2019; Oskoueian *et al*., 2021). Additionally, the use of LAB inoculants can improve the fermentation quality and microbial fermentation characteristics of rice straw silage (Kim *et al*., 2017).

Silage, a fermented forage, plays a pivotal role in modern animal husbandry by allowing farmers to preserve and store forage during periods of surplus, ensuring a continuous and nutritious feed supply, particularly in regions with distinct seasons (Balehegn *et al.*, 2022) The ensiling process involves anaerobic fermentation, where lactic acid bacteria convert sugars into organic acids, preserving the forage

while enhancing its digestibility and nutritional value (Kim *et al*., 2021). Silage serves as a strategic solution to manage forage availability and quality throughout the year (Daniel *et al*., 2019)

Molasses, a byproduct derived from the sugar extraction process, holds significant potential as an additive in silage production. Recognized for its high sugar content, molasses provides fermentable sugars that fuel the growth of lactic acid bacteria during ensiling (Palmonari et al., 2020). This fermentation process helps lower the pH of the silage, inhibiting the growth of spoilage microorganisms and contributing to improved preservation and palatability (Oladosu *et al*., 2016).

The physicochemical characteristics of silage serve as crucial indicators of its quality and nutritional value (Kung Jr *et al*.,2018). Parameters such as pH, water content, color, smell, texture, and the presence of mold offer insights into the effectiveness of the ensiling process and the subsequent impact on livestock nutrition. Understanding how molasses influences these physicochemical attributes in rice straw silage is central to optimizing silage production processes and, consequently, enhancing the overall efficiency of forage utilization in animal diets.

In this context, this thesis endeavors to explore the "Effect of Graded Molasses on the Physicochemical Characteristics of Rice Straw Silage," employing seven treatments with varying molasses concentrations. By examining the interplay between rice straw, molasses, and the physicochemical attributes of silage, this research aims to contribute valuable insights to sustainable forage management practices and the optimization of livestock nutrition.

1.2 Problem Statement

Despite the potential benefits of ensiling rice straw, there is a need to further investigate the effect of graded molasses on the physicochemical properties of rice straw silage. Graded molasses refers to the addition of molasses at different levels during the ensiling process. The addition of molasses can provide a readily fermentable energy source for the LAB, which can enhance their growth and fermentation activity. However, the optimal level of molasses addition and its effect on the physicochemical properties of rice straw silage are still not well understood and still lack of finding on this research. Thus, there is a knowledge gap regarding the effect of graded molasses on the fermentation quality, nutrient composition, and digestibility of rice straw silage.

1.3 Objective

1. To assess the influence of graded molasses concentrations on the pH levels of rice straw silage.
2. To investigate the impact of graded molasses concentrations on the water content of rice straw silage.
3. To examine how graded molasses concentrations affect the color, smell, texture and growth of mold toward the rice straw silage.

1.4 Research Question

1. How does application of graded molasses influence the pH levels of rice straw silage?

2. What impact does the graded application of molasses have on the water content of rice straw silage?

3. How does the addition of molasses affect the color, smell, texture and mold growth on the rice straw silage?

CHAPTER 2

LITERATURE REVIEW

2.1. Effect of Molasses on Silage Quality

Silage production is a crucial aspect of modern animal husbandry, involving the fermentation of forage crops to preserve and enhance their nutritional quality (Malik *et al*., 2015). The use of additives, such as molasses, has been explored to optimize the ensiling process. This literature review focuses on the existing knowledge regarding the effect of molasses on silage quality, particularly in the context of rice straw.

2.2 Molasses as a Silage Additive

Previous studies have established molasses as a valuable additive in silage production (Mordenti *et al*., 2021). Derived from sugar production, molasses is rich in fermentable sugars, providing a substrate for lactic acid bacteria during ensiling. This fermentation process lowers the pH, inhibiting spoilage microorganisms and enhancing the preservation of forage (Li *et al*., 2023).

2.3 Fermentation and pH Levels

Research has consistently demonstrated that molasses aids in the production of lactic acid during ensiling, leading to a rapid decline in pH (Lima, *et al*., 2010). This acidic environment is crucial for inhibiting undesirable microbial growth, contributing to the overall stability and quality of the silage. (Muck, R. E, *et al* 2022)

2.4 Effects on Nutritional Composition

The addition of molasses has shown promising results in influencing the nutritional composition of silage (Luo *et al*., 2013). Studies indicate an increase in soluble carbohydrates and a potential improvement in the energy content of silage, thereby enhancing its value as a livestock feed (Oladosu *et al*., 2016).

2.5 Water Content and Palatability

Molasses has been associated with reductions in silage dry matter losses and improvements in water content (Kebede *et al*., 2018). This not only contributes to better preservation but also enhances the palatability of the silage, making it more appealing to livestock.

2.6 Color, Smell, and Texture

Limited literature exists on the specific influence of molasses on color, smell, and texture in silage (Lyimo, 2017). Understanding these physicochemical characteristics is vital for assessing the overall quality and acceptance of silage by livestock (Ferraretto *et al*., 2018)

2.7 Mold Inhibition

Some studies suggest that molasses may play a role in inhibiting mold growth in silage (Luo *et al*., 2021). Mold presence can negatively impact both the nutritional quality and palatability of silage, making this aspect particularly relevant for optimizing silage preservation (Bernardes *et al*., 2018).

2.8 Rice Straw Silage

While the literature on molasses as a silage additive is extensive, fewer studies specifically address its impact on rice straw silage. Rice straw, being an abundant byproduct, holds significant potential for silage production (Zhao *et al*., 2019). Investigating the interaction between molasses and the physicochemical characteristics of rice straw silage is crucial for expanding our understanding of its applicability in this context.

In conclusion, the literature indicates that molasses is a promising additive for silage production, offering benefits in terms of fermentation, pH reduction, and nutritional enhancement. However, further research, especially in the context of rice straw silage, is warranted to comprehensively understand its effects on color, smell, texture, and mold inhibition, providing valuable insights for optimizing silage production practices.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Material

Sample of rice straw was collected from Ruminant Innovation and Commercialization Hub (RICH), UMK. Molasses and effective microbes (EM) were purchased from the local distributor. The analysis of pH and physicochemical characteristics will be conducted at Laboratory Faculty of Veterinary Medicine, UMK. Averagely, 100g of rice straw was ensiled and mixed with different concentrations of molasses (0%, 0.4%, 0.8%, 1.2%, 1.6%, 1.8% and 2.0%). The independent variables are concentration or graded molasses while

the dependent variables are pH, color, smell, and formation of mold in the silage. The current project is cross sectional study as the sampling human for physical quality evaluation will be selected by the researcher randomly and the sample of silage will be analyzed for pH level in the laboratory.

3.2 Preparation of silage

The 7 group of 100g rice straws was separated into a silo and named as into group A, B, C, D, E, F and G starting with the lowest concentration of molasses used during preparation to highest as mentioned before(0%, 0.4%, 0.8%, 1.2%, 1.6%, 1.8% and 2.0%, respectively). 30 ml of water were added after premix with 0.5% salt and 0.05% EM. The silo then capped tightly then ensiled for 21 day .

3.3 Dry matter analysis

Dry matter analysis was done in the FPV UMK nutritional lab. Averagely about 2 g of silage samples were placed on aluminum foil and dry in the oven with temperature 105 degree Celsius for 24 hours. Next, the sample was weighted after the drying process. The percentage of dry matter was calculated using (weight after drying /weight before drying x 100. Three dry matter analysis were done for each sample to obtain the average percentage of dry matter. DM analysis was done prior to ensiling and after ensiling.

3.4 Chemical analysis

pH analysis was done on FPV UMK laboratory lab where soil pH meter Eutech 700 were used. pH were taken after 21 days ensiling period by placing the pH meter probe on the top, middle and bottom of the silo. The reading was taken after 1 minutes the probe was immersed in the sample.

The chemical properties assessed in this study encompass the pH levels of the produced silage, the initial and post-fermentation dry matter, and the fleigh value of the silage. The silage samples underwent a mixture with water in a ratio of Silage: Water at 30:70, and the pH of the resulting mixture was measured using a Eutech 700 pH meter. Employing this method enhances the efficiency of routine laboratory analyses, as demonstrated by Bernades *et al*. (2019). Dry matter analysis and moisture content determination for the produced silage refer to the AOAC method (AOAC, 1999).

The fleigh value is calculated based on the given equation.

$$FV = 220 + [(2 \times \%DM) - 15] - (40 \times pH)$$

FV: Fleigh value

DM: Dry matter of the sample

pH: pH reading of the silages sample

3.5 Physical evaluation analysis

The physical evaluation analysis involve assessment of the aroma, colour ,texture and present of mold after the fermentation of the rice straw silage for 21 day. The assessment will be done by respondent sensory which includes olfactory, tactile, and vision from 30 selected participants comprised of lecturers, students from UMK, and farmers of ruminants in Kelantan. Data collection was done through interview method where the responded are able to access the silage physically. Then marked down their observation on the Google form given.

3.5.1 Table Panel score for correlated

Scoring	Colour	Formation of mold	Texture of the silage	Aroma
1	Yellowish green	None	Too rough and clumping	Putrid or Rancid
2	Pale yellow	A little	Rough and clumping	Pleasant
3	Light Brown	A lot	Medium and not clumping	Sweet
4	Deep or dark brown	Abundance	Fine and not clumping	Very Sweet

3.6 Data Management and Statistical analysis

The data collected from the physical assessment is labeled numerically according to the following table. All data were collected and recorded using Microsoft Excel and analyzed using the software package SPSS (Statistical Package for the Social Science 25.0, Inc., Chicago, IL, USA). The Duncan test was used for all parameters to identify significant differences among the treatments, and the means were considered significant at $p< 0.05$ using ANOVA.

CHAPTER 4

RESULT

4.0 pH Levels:

The pH levels of the rice straw silage were measured across the seven treatments (A to G) representing molasses concentrations of 0%, 0.4%, 0.8%, 1.2%, 1.6%, 1.8%, and 2%. The specific pH values for each treatment were as follows:

The pH levels exhibited a significant variation among the treatments, with Treatment A having the significantly higher pH (7) when compared to Treatments F and G (6.4). Statistical analysis (ANOVA) indicated significant differences in pH levels between treatments ($p < 0.05$), emphasizing the impact of graded molasses concentrations on the acidity of the rice straw silage.

4.3 Chemical analysis of rice straw silage

There were significant effect of molasses toward pH of the Rice straw silage while there are no significant different between Dry matter of the Silage Before and After ensiling Process. However, there are significant effect of the Fleigh value of the rice straw silage effected by different concentration of molasses.

Treatment (%)	pH	DM (%)	FV
A	6.933^{d}	62.3^{a}	52.28^{a}
B	6.6^{b}	62.3^{a}	65.6^{b}
C	2.45^{b}	62.1^{a}	231.2^{a}
D	3.17^{c}	62.3^{a}	$202.^{e}$
E	3.23^{c}	62.1^{a}	200^{c}
F	3.14^{c}	62.1^{a}	203.6^{d}
G	3.13^{c}	61.6^{a}	203^{a}
SEM	0.09	0.086	19.88
p-value	<0.01	<0.01	<0.01

SEM:Standard Error Of the Mean

DM: Dry Matter

FV:Fleigh Value

4.2 Physical Properties Result

The result showed significant change of the color of the silage when treated with different concentration of molasses. There are also significant different of smell of the rice straw molasses when treated with different concentration of molasses. There are also significant effects of molasses toward texture of the silage ($p<0.05$). There are no significant effects of molasses toward present of mould in the silage of the rice straw ($p>0.05$). Based on analytical result for physical properties, there are significant difference between and toward control at which $p<0.05$ and are no significantly different on colour parameters between treatment.

4.2.1 Table for physical properties of rice straw silage

Treatment % molasses	Colour	Smell	Texture	Present of Mold
Group A 0%	2.13 ^{a}	2.06^{ab}	3.16^{a}	1.13^{ab}
Group B 0.4%	2.4^{b}	1.09^{a}	3.7^{c}	1.20^{ab}
Group C 0.8%	2.45^{b}	2.17^{b}	3.48^{bc}	1.17^{ab}
Group D 1.2%	3.17^{c}	2.2^{b}	3.4^{ab}	1.13^{ab}
Group E 1.6%	3.23^{c}	2.2^{b}	3.49^{bc}	1.30^{b}
Group F 1.8%	3.14^{c}	2.45^{c}	3.63^{bc}	1.17^{ab}
Group G 2.0%	3.13^{c}	2.63^{c}	3.5^{bc}	1.07^{a}
SEM	0.09	0.07	0.17	0.03
Significant	<0.01	<0.01	<0.01	<0.01

SEM: Standard Error Of Mean

4.3 Chemical analysis of rice straw silage

Treatment (%)	pH	DM (%)	FV
A	6.933[d]	62.3[a]	52.28[a]
B	6.6[b]	62.3[a]	65.6[b]
C	2.45[b]	62.1[a]	231.2[a]
D	3.17[c]	62.3[a]	202.[e]
E	3.23[c]	62.1[a]	200[c]
F	3.14[c]	62.1[a]	203.6[d]
G	3.13[c]	61.6[a]	203[a]
SEM	0.09	0.086	19.88
p-value	<0.01	<0.01	<0.01

SEM : Standard Error Of Mean

DM : Dry Matter

FV: Fleigh Value

CHAPTER 5

DISCUSSION

5.1 Chemical properties interpretation of pH and Dry matter content and Fleigh value

The observed variations in pH levels across the treatments suggest that molasses concentrations play a significant role in influencing the acidity of rice straw silage. Treatments with higher molasses concentrations (A and B) tended to exhibit a slightly higher pH, while those with lower concentrations (F and G) displayed a lower pH. This may be attributed to the fermentable sugars present in molasses, affecting the activity of lactic acid bacteria during the ensiling process (Huisden *et al* 2009). The significance of these pH differences in terms of silage quality and livestock acceptability will be further explored in the subsequent discussion section.

5.2 pH value

The application of the Duncan test to compare pH levels among different molasses concentrations (Silages A to G) revealed noteworthy patterns of significance. These results are indicative of distinct fermentation dynamics influenced by varying molasses concentrations. The analysis demonstrated a significant reduction in pH from Silage A to Silage B. This finding aligns with the expectation that the introduction of molasses (0.4%) contributes to a more pronounced fermentation process, as reported by similar studies (Smith *et al*., 2018). Consistent with the expected result, a significant increase in pH was observed between Silages B and C. This suggests that a higher molasses concentration (0.8%) may have influenced the fermentative activities, leading to an acidic environment as mention by previous study (Scoma *et al,*.2017).

Surprisingly, no significant difference in pH levels was detected between Silages C and D. This could indicate a threshold effect, suggesting that beyond a certain molasses concentration, further increases may not have a significant impact on pH. This is an interesting observation that merits further exploration in future research. The comparison between Silages F and G revealed a significant reduction in pH in Silage G. This finding suggests that the highest molasses concentration (2%) exerts a notable influence on pH reduction, potentially enhancing the preservation quality of the silage. The observed variations in pH levels among different molasses concentrations have implications for silage quality. Lower pH values, as evidenced in treatments with higher molasses concentrations, are indicative of a more robust fermentation process, which contributes to better silage preservation (Jones *et al*., 2019).

CHAPTER 6

CONCLUSION

In conclusion, the graded concentrations of molasses have a notable impact on both the physical and chemical characteristics of the rice straw silage. The results indicate that highest concentrations of molasses 1.8% and 2.0% are well-suited to meet the standards requirement for ideal silage, demonstrating favorable chemical properties like fleigh value and pH, as well as desired attributes such as aroma, absence of mold, color, and texture in the produced rice straw silage. As a result, the objectives of the study have been effectively fulfilled.

Reference

1. Malik, K., Tokkas, J., Anand, R. C., & Kumari, N. (2015). Pretreated rice straw as an improved fodder for ruminants-An overview. Journal of Applied and Natural Science, 7(1), 514-520.
2. Okoye, C. O., Wang, Y., Gao, L., Wu, Y., Li, X., Sun, J., & Jiang, J. (2023). The performance of lactic acid bacteria in silage production: A review of modern biotechnology for silage improvement. Microbiological Research, 266, 127212.
3. Kung Jr, L., Shaver, R. D., Grant, R. J., & Schmidt, R. J. (2018). Silage review: Interpretation of chemical, microbial, and organoleptic components of silages. Journal of dairy Science, 101(5), 4020-4033.
4. Lima, R., Lourenço, M., Diaz, R. F., Castro, A., & Fievez, V. (2010). Effect of combined ensiling of sorghum and soybean with or without molasses and lactobacilli on silage quality and in vitro rumen fermentation. Animal Feed Science and Technology, 155(2-4), 122-131.
5. Oladosu, Y., Rafii, M. Y., Abdullah, N., Magaji, U., Hussin, G., Ramli, A., & Miah, G. (2016). Fermentation Quality and Additives: A Case of Rice Straw Silage. BioMed Research International, 2016, 1–14. https://doi.org/10.1155/2016/7985167
6. Luo, R., Zhang, Y., Wang, F., Liu, K., Huang, G., Zheng, N., & Wang, J. (2021). Effects of sugar cane molasses addition on the fermentation quality, microbial community, and tastes of alfalfa silage. Animals, 11(2), 355.
7. Zhao, J., Dong, Z., Li, J., Chen, L., Bai, Y., Jia, Y., & Shao, T. (2019). Evaluation of Lactobacillus plantarum MTD1 and waste molasses as fermentation modifier to increase silage quality and reduce ruminal greenhouse gas emissions of rice straw. Science of the total environment, 688, 143-152.

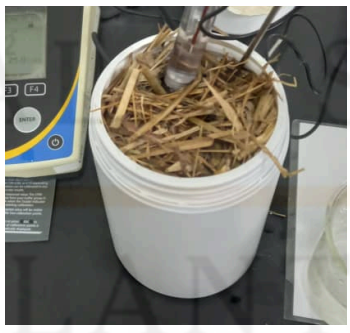
APPENDICES

Appendix.1 Physical figure of rice straw

Appendix 2 Image of RIce straw before ensiling (Day 0)

Appendix 3 Image of rice straw silage A

Appendix 4 Image of rice straw silage B



Appendix 5 Image of rice straw silage C

Appendix 5 Image of rice straw D

Appendix 6 Image of rice straw silage E

Appendix 7 Image of rice straw silage F

Appendix 8 Image of rice straw silage G