Evaluation of Silage Fresh Odot Grass (*Pennisetum purpureum* cv. Mott) as Ruminant Feed

ABSTRACT

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| --- |
| **Aims:** This study aimed to evaluate the effect of different types and levels of absorbents—milled rice husk, rice bran, and pollard—on the nutritional quality, pH value, and digestibility of odot grass (*Pennisetum purpureum* cv. Mott) silage.  **Study design:** The study employed a completely randomized design with three treatment levels of absorbent additions (12.5%, 22%, and 32.4%) for each type of absorbent, with five replications per treatment.  **Place and Duration of Study:** The experiment was conducted over a period of two months at the Sumber Sekar Field Laboratory, Faculty of Animal Husbandry, Brawijaya University, Malang, East Java. Laboratory analyses were carried out at the Batu Training Center (BBPP) and the Animal Nutrition and Feed Laboratory of the same faculty.  **Methodology:** Fresh chopped odot grass with up to 80% moisture content was mixed with absorbents (milled rice husk, rice bran, or pollard) at varying levels, combined with 5% molasses, then ensiled. The target moisture contents were 30%, 35%, and 40%. After obtaining the treatment with the best pH value at P3 with the addition of 32.4% absorbent. The highest absorbent level (32.4%) from each treatment was analyzed for nutrient content and best pH value to continue in vitro digestibility (dry matter digestibility—DMD and organic matter digestibility—OMD) tests.  **Results:** The lowest pH value was obtained at P3 (32.4% addition) with an average of 3.7 and then tested digestibility value. The addition of 32.4% pollard produced the highest digestibility values, with DMD at 76.65% and OMD at 62.62%, significantly outperforming husk and rice bran treatments (P < 0.01). This improvement was attributed to pollard’s lower crude fiber and higher protein content, which enhance rumen microbial activity. Nutrsed with higher absorbent levels.  **Conclusion:** The type and level of absorbents significantly affected odot grass silage quality. The use of 32.4% husks as absorbant can make the lowest pH value of odo grass silage at 3.54. But the use of 32.4% pollard was found to be the most effective strategy to improve fermentation, and enhance silage digestibility, making it a practical approach to ensure a consistent, high-quality ruminant feed supply year-round. |

*Keywords: Odot Grass, Moisture Content, Absorbant, Silage, In Vitro Digestibility*

1. INTRODUCTION

The ruminant feed industry plays a crucial role in producing healthy, efficient, and sustainable livestock by ensuring the availability of high-quality, standardized feed particularly forages, which form the bulk of ruminant diets (Patra, 2017). One promising forage source is odot grass (*Pennisetum purpureum* cv. Mott), valued for its high biomass production, rapid regrowth, responsiveness to organic fertilization, and favorable nutritional profile (Norazizah et al., 2024). However, its abundant availability especially during the rainy season is often underutilized by farmers due to limited preservation and storage capacity. In Indonesia, most smallholder farmers still rely on a cut and carry system without preservation, making feed supply vulnerable to seasonal fluctuations (Fajri et al., 2018).

Preserving fresh forage through ensiling offers a practical and climate-resilient solution. Silage is a widely adopted conservation method that relies on anaerobic fermentation to preserve the forage's nutritional value and minimize post-harvest losses, particularly under humid tropical conditions (Irawan et al., 2021). However, fresh odot grass poses specific challenges due to its high moisture content (80–85%), which exceeds the optimal range for effective silage fermentation (60–70%) and increases the risk of nutrient leaching and undesirable microbial growth (Sadarman et al., 2024; Fangidae et al., 2024).

To overcome this, the use of absorbent materials with high dry matter (DM) content has been widely studied to reduce the moisture level and support better fermentation dynamics (Koni et al., 2021; Rosani & Hernaman, 2024). Common absorbents include milled rice husks, rice bran, and pollard, each with distinct physical and chemical properties. Rice husks have excellent moisture-binding capacity but negligible nutritional value, while rice bran and pollard offer varying nutrient contents and fermentation-supporting substrates, including fermentable carbohydrates. Previous research has shown that using rice straw as an absorbent improved the fermentation profile and reduced excess moisture in odot grass silage (Fangidae et al., 2024).

The growth of lactic acid bacteria is essential for effective silage fermentation, as they produce lactic acid to reduce pH and suppress spoilage organisms. Lactic acid bacteria require water-soluble carbohydrates (WSC**)** as a fermentation substrate, and the natural WSC content in odot grass may be insufficient for ideal fermentation (Al-Fatah et al., 2023; Irawan et al., 2021). Therefore, adding molasses a WSC-rich additive can serve as an additional energy source to enhance LAB activity and improve silage quality (Naetzold et al., 2021; Tilley & Terry, 1963).

Based on this background, it is necessary to conduct a comprehensive evaluation of fresh odot grass silage quality, especially by examining the effects of various absorbents on fermentation characteristics and digestibility. This study aims to determine how different absorbents influence silage quality in terms of nutrient composition, pH stability, and digestibility, with the broader goal of converting odot grass from a seasonal green forage into a high value, shelf-stable, and practical feed option for ruminant farmers.

2. material and methods

**2.1 Study Design and Experimental**

This study was conducted over a period of 2 months at the Sumbersekar Field Laboratory, Faculty of Animal Husbandry, Brawijaya University, located in Sumbersekar, Dau District, Malang Regency, East Java. Proximate analysis of the silage was performed at the Batu Training Center (BBPP) Laboratory in Songgokerto, Batu District, Batu City, East Java, while in vitro digestibility analysis was conducted at the Animal Nutrition and Feed Laboratory, Faculty of Animal Husbandry, Brawijaya University.

To ensure clarity in interpretation, all measurements including pH value and nutrient composition were taken after the ensiling process, following a fermentation period of 30 days.

**2.2 Preparation and Treatment Groups**

The research employed a completely randomized design (CRD) with three levels of absorbent addition: 12.5%, 22%, and 32.4% with five replications per treatment. Each absorbent type milled rice husk, rice bran, and pollard—was mixed with odot grass and supplemented with 5% molasses as a fermentation enhancer. The treatments were designed to achieve target silage moisture contents of 30%, 35%, and 40%, and each treatment was replicated five times.

The treatment groups were as follows:

* P1: 87.5% odot grass + 12.5% absorbent
* P2: 78% odot grass + 22% absorbent
* P3: 67.6% odot grass + 32.4% absorbent

After determining that the best pH value was obtained in the P3 group (with 32.4% absorbent addition), the in vitro digestibility analysis was continued using only the P3 treatment.

**2.3 Observation**

Silage samples were observed after a 30-day fermentation period. Observations focused on evaluating the effects of different absorbent types and levels on nutrient preservation, pH value, and digestibility.

**2.4 Parameters Observed**

The observed variables included:

* Nutrient content (dry matter, crude protein, crude fiber, ash, etc.)
* pH Value (measured after the ensiling process)
* Dry Matter Digestibility (DMD)
* Organic Matter Digestibility (OMD)

In vitro digestibility tests were conducted using rumen fluid collected from a fistulated beef cattle maintained on a standard diet. The rumen fluid was filtered and mixed with buffer solution following the method of Tilley and Terry (1963), and incubated at 39°C for 48 hours in a shaking incubator. Digestibility measurements were carried out only for the P3 treatment group (32.4% absorbent level), which showed the most optimal pH results during initial evaluation.

**2.5 Statistical Analysis**

All collected data were analyzed using Analysis of Variance (ANOVA) to determine significant differences among treatments. If significant differences were detected (P < 0.05 or P < 0.01), the analysis was continued using Duncan's Multiple Range Test (DMRT) to identify differences between treatment means. Statistical analyses were performed using Microsoft Excel to enhance the transparency and reproducibility of the research.

3. results and discussion

**3.1 Nutritional Content**

The nutritional content of feed includes carbohydrates, proteins, fats, fibers, vitamins, and minerals, which play an important role in meeting livestock productivity needs. The nutritional content of silage materials is presented in table 1.

Table 1. Nutritional Content of Silage Raw Materials.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Silage Ingredients | Nutritional Content (%) | | | | | | |
| Dry Matter | Ash\* | Crude Protein\* | Crude Fat\* | Crude Fiber\* | TDN\* | nitrogen-free extract \* |
| Odot Grass | 11.76 | 16.3 | 9.88 | 0.91 | 33.63 | 53.78 | 55.58 |
| Husks | 87.93 | 21.57 | 2.6 | 0.3 | 50.33 | 42.96 | 46.77 |
| Rice Bran | 82.74 | 20.09 | 5.41 | 1.3 | 34 | 54.6 | 59.29 |
| Pollard | 87.16 | 4.87 | 17.15 | 2.31 | 10.08 | 79.68 | 70.46 |

Description: Nutrient content based on analysis results from the Batu Training Center (BBPP) Laboratory Batu City, Jawa Timur

(\*) based on % DM

Table 1 shows the differences in the content of unprocessed or processed odot grass by wilting or chopping. The study used odot grass chopper to facilitate the process of mixing each ingredient and putting it in the barrel. The nutrient content of odot grass in the study was classified as standard from the report of Patmawati et al. (2023) that odot grass also has a leaf fat content of 2.72%, stem fat content of 0.19%, leaf crude protein of 14.22%, stem crude protein of 8.10%, leaf digestibility of 72.68%, digestibility of stems 62.56% and crude protein 14%. Milled husk, rice bran, and pollard have high DM content which is suitable as an absorbent. Pollard has a good nutritional content value with a CP of 17.15%, the highest compared to all the constituent materials. The milled rice husk of the study has a nutritional content that is classified as normal, according to the report of Anggara et al. (2020), namely that rice husk has a water content of 12.5%, crude fiber 22%, fat 2.7%, protein 3.1%, and ash 17.5% with very low digestibility. The rice bran of the study has a nutritional content that is classified as normal according to Koni et al. (2022), namely that rice bran has a chemical composition of dry matter of 89.41%, crude protein 8.69%, crude fiber 29.43%, crude fat 7.9%, ash 13.13%, phosphorus 0.223%, calcium 0.0062%. Also, the nutritional content value of pollard research according to the report of Fajri et al (2018) in Rosani and Hernaman (2024) the nutrient content of pollard is 8.04% crude fiber, 4.7% crude fat, 88.17% dry matter, and 4.78% ash.

**3.2 pH Value**

The degree of acidity or pH is important as an indicator of the quality level of a material, especially related to materials intended as consumption materials for living creatures. Based on the analysis of silage characteristics, the pH of odot grass silage with different types of absorbents at different levels is presented in table 2.

Table 2**.** pH of odot grass silage

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Level (%) | Absorbent Type | | | Average |
| Husk | Rice Bran | Pollard |  |
| P1 | 5.8b ± 0.7 | 3.9a ± 0.1 | 4.4b ± 0.5 | 4.7b ± 0.9 |
| P2 | 3.7a ± 0.1 | 3.7a ± 0.01 | 3.9a ± 0.1 | 3.8a ± 0.1 |
| P3 | 3.5a ± 0.04 | 3.8a ± 0.03 | 3.8a ± 0.1 | 3.7a ± 0.03 |
| Average | 4.3b ± 0.3 | 3.8a ± 0.1 | 4a ± 1.2 |  |

Description: P1: 87.5% odot grass + 12.5% ​​absorbent; P2: 78% odot grass + 22% absorbent; P3: 67.6% odot grass + 32.4% absorbent.

Different superscripts in the same column indicate highly significant differences (P<0.01)

Table 2 shows that the addition of absorbents at different levels has a very significant effect (P <0.01) on the pH of odot grass silage. Odot grass silage showed the lowest pH value at P3 (3.73) followed by P2 (3.76) and P1 (4.68). Also, odot grass silage showed the lowest pH value in the bran type (3.79) followed by Husk (4.03), and Pollard (4.33). The pH value of the research results showed a value that was classified as normal for silage. According to Al-Fatah et al. (2023) which states that the quality of silage based on pH value is categorized into pH 3.5 - 4.2 is silage with very good quality, 4.2 - 4.5 is silage with good quality, 4.5 - 4.8 is silage with medium quality, and more than 4.8 is silage with poor quality. Putra's report (2017) also stated that odot grass silage with the addition of 20% pollard produced an average pH of 4.58.

The difference in silage pH is caused by the activity of LAB in producing lactic acid. The rapid production of lactic acid will be followed by an increase in acidic conditions. (Irawan et al., 2021). This will cause the pH of the silage to decrease, which will inhibit the growth of *Clostridia* sp. bacteria, because the pH is acidic (Naetzold et al. (2021). The use of absorbents at different levels provides a pH value of around 4.0, which shows that the addition of absorbents helps provide the best conditions in the ensilage process. And the difference in the level of administration affects the pH level of the silage. This is because the high BK content in the type of absorbent provides an energy source that supports the activity in producing lactic acid and lowering the pH. Also, the pH value (table 2) which is lower when the amount of addition is higher indicates that the more absorbent is added, the better the conditions for odot grass silage for ensilage. Absorbent (Table 1) helps reduce the water content of odot grass, thus helping lactic acid bacteria to process and produce lactic acid from the energy provided by the absorbent, as well as good environmental conditions. Silage with bran provides the lowest average pH value compared to other types. This is in accordance with the report of Sadarman et al. (2024) showing the addition of 10% bran to silage odot grass produces an average pH of 3.69.

**3.3 Nutrient Digestibility**

Feed digestibility is important as an indicator of feed quality reviewed from the nutrient content that can be absorbed by microbes in the rumen of livestock. The higher the digestibility value, indicating that the nutrient content is digested and absorbed in large quantities, so that it can meet the nutritional needs of livestock. The results of the study obtained the best dry matter digestibility (DMD) and organic matter digestibility (OMD) values ​​of odot grass silage with the addition of 32.4% to different types of absorbents, presented in table 3.

Table 3. In Vitro Digestibility of Odot Grass Silage.

|  |  |  |
| --- | --- | --- |
| Treatment | DMD (%) | OMD (%) |
| P3S | 29.25a ± 0.49 | 18.54a ± 0.65 |
| P3D | 27.76b ± 1.32 | 21.07b ± 0.85 |
| P3P | 76.65c ± 2.33 | 62.62c ± 1.73 |

Description: P3S (Odot Grass + Husk 32.4%); P3D (Odot Grass + Rice Bran 32.4%); P3P (Odot Grass + Pollard 32.4%)

Different superscripts in the same column indicate highly significant differences (P<0.01)

The DMD and OMD values ​​of odot grass silage in the treatment of adding absorbent types with a level of 32.4% showed different variations in values ​​in each treatment as presented in table 3. The results of the analysis of variance showed that the treatment of odot grass silage with different levels of 32.4% absorbent addition had a very significant effect on DMD and OMD in vitro (P <0.01). The digestibility values ​​in P3S (husk) and P3D (rice bran) had lower digestibility values ​​than the P3P (pollard) treatment due to the high crude fiber content in the treatment. Milled husks and rice bran have a high content of crude fiber which makes the cell walls thicker and makes it difficult to break down during the ensilage process, thus slowing down nutrient degradation by rumen microbes and reducing the level of digestibility. Fajri et al. (2018) stated that SK has a major influence on the level of feed digestibility. Silage with high levels of crude fiber, especially lignin, will be more difficult to digest by rumen microbes. On the other hand, lower crude fiber content in silage will generally be easier to digest because the cell walls of the material are more easily degraded, thus helping to increase higher digestibility levels.

Based on table 2, the DMD P3P value (76.65%) is the addition of pollard, due to better nutrient content compared to other treatments, so the P3P value is also higher than other treatments. According to Anisa et al. (2023) that the DMD value is in line with and influenced by DMD. The higher the digested DM value, the higher the digested OM value. Pollard in the study had a lower crude fiber level (10.08%) when compared to bran and husk treatments which had higher crude fiber content. In addition, pollard has a high crude protein content value (17.15), so that the digestibility level, especially the OMD obtained, can be higher. The OMD value is positively influenced by nutrient content, especially crude protein content, because protein is a component that is very easily degraded by rumen microbes. The addition of pollard to odot grass silage helps increase the nutritional value of odot grass, because as a forage, odot grass has a low crude protein content. The crude protein content in feed is important for livestock because crude protein in the rumen will undergo hydrolysis into peptides by proteolytic enzymes produced by microbes, then hydrolyzed into amino acids, then some of the amino acids are broken down into ammonia in the deamination process, which is used by microbes as a component of body protein so that many OM can be degraded. The factors that affect digestibility are, the composition of feed ingredients, the comparison of the composition between one feed ingredient and another, feed treatment, enzyme supplementation in feed, livestock and the level of feeding.

Even though rice bran has a moderate nutrient profile based on its TDN and nitrogen-free extract, the digestibility value (P3D) obtained in the study was lower than expected. This is likely caused by several factors. First, although the crude fiber of rice bran is not as high as husks, the structural composition of the fiber, especially the lignin content, may be more complex and difficult to break down by rumen microbes. Silage with high levels of crude fiber, especially lignin, will be more difficult to digest by rumen microbes. Second, rice bran contains anti nutritional compounds such as phytic acid and trypsin inhibitors which can interfere with protein digestion and reduce microbial activity in the rumen. Third, the relatively high fat content of rice bran, while nutritionally valuable, can negatively affect fiber-degrading bacteria if the fat becomes oxidized, especially during silage fermentation. These factors combined may have contributed to the lower DMD and OMD values in rice bran treatment compared to pollard, which has a lower crude fiber content and higher protein content that supports better digestibility.

4. Conclusion

The addition of different types and levels of absorbents significantly affected the quality of odot grass silage in terms of nutrition content, pH value, and digestibility. Higher levels of absorbents (32.4%) resulted in nutrition content which shows that the more absorbent levels, the higher nutrition of fresh odot grass silage. Digestibility was also influenced by absorbent type, with pollard at 32.4% yielding the highest dry matter and organic matter digestibility (76.65% and 62.62%, respectively), attributed to its lower crude fiber and higher protein content, which enhance rumen microbial activity. Overall, the use of 32.4% pollard is the most effective strategy to improve silage quality by ensuring optimal fermentation, create a lowest pH value, and increasing digestibility.

Consent

All authors declare that ‘written informed consent was obtained from other approved parties for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editorial office/Chief Editor/Editorial Board members of this journal.

Ethical approval

All authors hereby declare that "Principles of laboratory animal care" (NIH publication No. 85-23, revised 1985) were followed, as well as specific national laws where applicable. All experiments have been examined and approved by the appropriate ethics committee

**Disclaimer (Artificial intelligence)**

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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