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Research Article

Digestibility of Dry and Organic Matter of Oil Palm Leaves Through Fermentation Using Different Levels of Alfalfa Microbacteria-11

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Abstract. Fermentation of oil palm leaves is one of the processes of processing oil palm leaf waste into alternative animal feed through the activity of microorganisms. This process will change the structure of the leaves, which were originally hard and difficult to digest, to be softer and can increase the nutrient content, especially crude protein, and reduce the crude fiber content. This research aims to determine the effect of nutrient content in palm leaf fermentation using MA-11 on the value of Dry Matter Digestibility and Organic Matter Digestibility. This study used a completely randomized design (CRD) with a one-way pattern with four treatments and each treatment was repeated three times. P0: 250 grams of palm leaves + 0 ml dose of MA-11, P1: 250 grams of palm leaves + 2 ml dose of MA-11, P2: 250 grams of palm leaves + 4 ml dose of Ma-11, P3: 250 grams of palm leaves + 6 ml dose of Ma-11. The results of the study showed that the average value of Dry Matter Digestibility was obtained P0: 22.70%, P1: 24.95%, P2: 27.81% and P3: 45.64%, the average value of Organic Matter Digestibility was obtained P0: 17.68%, P1: 23.51%, P2: 25.78% and P3: 44.58%. The conclusion of this study is that palm leaf fermentation using a dose of 0 ml to 6 ml with a fermentation period of 9 days has a very significant effect on increasing the value of Dry Matter Digestibility and the value of Organic Matter Digestibility.

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INTRODUCTION

Feed is a key factor in the livestock business as it significantly impacts animal productivity. The high cost of feed often presents a challenge for farmers. A solution to reduce these costs is using alternative feed ingredients that are more economical yet still nutritious, ensuring that livestock productivity remains optimal (Yulianti *et al*., 2019). The abundant oil palm leaves in Indonesia have the potential to be used as feed for ruminants, helping to reduce dependence on commercial feed. The high lignin content (15.35%) makes it difficult to digest. Processing methods such as fermentation or the addition of enzymes are needed to break down the lignin and improve the digestibility of the leaves, making them a more efficient and economical alternative feed (Kucharska *et al*., 2018).

Palm oil plantation waste, such as palm leaves, pressed fiber, and empty fruit bunches, can feed ruminants, especially during the dry season. Oil palm leaves, typically underutilized, can be used as feed after processing to reduce the lignin content that is difficult to digest. The dry matter content in palm leaves is comparable to that of natural grass, making it a good source of fiber. Proper utilization can improve farm efficiency and reduce plantation waste (Joseph, 2020).

Oil palm leaves can serve as a fairly good feed source for livestock, especially when natural grass is scarce, such as during the dry season. The dry matter content in oil palm leaves, like grass, gives palm leaves the potential to meet the fiber and other nutritional needs of ruminants such as cattle and goats.

The challenges faced in utilizing palm oil plantation waste are that palm leaves have a high crude fiber content and low protein, resulting in low digestibility (Rusli *et al*., 2021). Plantation waste can be improved through feed processing innovations, which include physical, biological, and chemical processes. Efforts to improve nutritional quality can be achieved through fermentation (biological). Proper feed processing is necessary to enhance the quality of palm leaves as livestock feed, thereby adding value, reducing environmental pollution, and increasing feed supply.

Fermentation is one technology to improve the quality of feed from waste by using microbes to degrade crude fiber and reduce lignin and anti-nutritional compounds, thereby improving the digestibility of the feed (Rathwa & Prajapati, 2019; Yafetto *et al*., 2023).

The success of the fermentation process is determined by the ability and capability of microbes to adapt to the substrate that will be used as nutrition for microbial growth and development (Kårlund *et al.,* 2020). MA-11, as an activator, contains cellulolytic (fiber-digesting), proteolytic (protein-digesting), and amylolytic microbes. The role of MA-11 in the fermentation process of cassava peel is crucial in breaking down organic materials and enhancing the nutrient content in the cassava peel. MA-11 is one of the activators capable of quickly breaking down all organic materials and increasing the nutrient content in the feed material.

Digestibility tests measure how well livestock can digest and utilize feed. Feed with a high digestibility rate means that the animal's body more easily absorbs the nutrients contained within it (Mayulu *et al.,* 2022). The higher the digestibility of the feed, the more nutrients can be used to support growth and production (such as milk or meat) and meet the animal's basic energy requirements (Hassen *et al*., 2022). Digestibility is calculated by comparing the nutrient content consumed by the livestock and the nutrients excreted through

feces, reflecting how much of the nutrients can be utilized by the animals. Digestibility also assesses the animal's ability to digest feed components, such as crude protein. Feed that is easily digested provides more benefits to livestock, while feed with low digestibility can hinder growth and productivity (Del *et al*., 2021).

The digestibility value of feed indicates how well the nutrients in the feed can be digested and utilized by livestock (Mayulu *et al*., 2018; Seyedalmoosavi et al., 2022) . High digestibility means the feed can provide the necessary nutrients for the animal's basic needs and production. The digestibility of dry and organic matter is important for feed efficiency, as it affects livestock feed consumption. Feed with high nutritional content but low digestibility will not be maximally utilized. Digestibility assesses whether the given ration meets the livestock's needs.

The Dry Matter Digestibility Coefficient (DMC) is used to assess feed quality, measuring how well dry matter can be digested and utilized by livestock (Aryanto *et al*., 2024). The higher the DMC value, the greater the likelihood that the nutrients in the feed will be absorbed and used by the animals, indicating high-quality feed. In ruminant livestock, feed digestibility is influenced by microbes in the rumen that help digest high-fiber materials. The digestibility of dry matter, which consists of both organic and inorganic materials, is crucial because a decrease in dry matter digestibility will reduce nutrient utilization, lower feed efficiency, and impact livestock productivity (Lovendahll et al., 2018). A reduction in dry matter digestibility will decrease the animal's ability to absorb nutrients from the organic matter in the feed, ultimately lowering feed efficiency and potentially hurting livestock health and productivity (Huda *et al*., 2018).

RESEARCH METHODS

The research was conducted over 3 months, from December 2023 to January 2024, at the Faculty of Bantara University Sukoharjo Laboratory. The materials used included oil palm leaves, molasses, urea, and MA-11 solution. The tools used included a Grass Cutting Machine, tarpaulins/plastics, buckets, and fermentation plastic. The research method used was a Complete Randomized Design (CRD) with a one-way pattern involving four treatments with three replications for each treatment. The treatments were as follows: P0: oil palm leaves + MA-11 0 ml + urea 2 g + molasses 5 ml; • P1: oil palm leaves + MA-11 2 ml + urea 2 g + molasses 5 ml; P2: oil palm leaves + MA-11 4 ml + urea 2 g + molasses 5 ml; P3: oil palm leaves + MA-11 6 ml + urea 2 g + molasses 5 ml

Fermentation was carried out for 9 days. The data obtained from the research were analyzed using statistical analysis of variance (ANOVA). If differences between treatments were found, further testing was conducted using the Duncan Multiple Range Test (Wulandari et al., 2018).

RESULTS AND DISCUSSION

Dry Matter Digestibility

Alfafa microbacteria (MA-11), as an activator, can break down organic matter quickly and increase the nutritional content in feed, especially in dry matter (Nastava *et al*., 2024; Tandang *et al*., 2024). The higher the dose of MA-11 provided, the higher the dry matter digestibility of the feed. This digestibility is highly dependent on the microbial population, where the success of the fermentation process is determined by the ability of the microbes to

adapt to the substrate used as a source of nutrition

The Dry Matter Digestibility values from the fermentation of oil palm leaves using MA-11 are presented in Table 1.

Table 1. Average Dry Matter Digestibility of oil palm leaves after fermentation using Alfalfa Microbacteria (MA-11)

Test	Doses MA-11 in the fermentation of palm forage			
	P0	P1	P2	P3
1	22,36	23,54	29,23	45,27
2	24,04	22,47	27,74	47,46
3	21,70	28,83	26,45	44,18
Average	22,70 ± 0,6966[a]	24,95 ± 1,9661[a]	27,81± 0,8032[b]	45,64 ± 0,9644[b]

Note: The average row shows significant differences (P<0.01).

Statistical tests showed that adding MA-11 ranging from 0 ml to 6 ml in the fermentation of oil palm leaves for 9 days had a highly significant effect on the increase in dry matter digestibility ($P < 0.01$). MA-11, as an activator, contains cellulolytic, proteolytic, and amylolytic microbes. These microbes produce enzymes that can break down organic matter while also increasing the nutritional content of the oil palm leaves.

Microbes in the rumen play an important role in breaking down feed ingredients, so an increase in the microbial population produced by MA-11 will enhance feed digestibility. High dry matter digestibility indicates that microbes digest more nutrients, produce energy, and support their growth, increasing the amount of feed degraded. The improvement in feed digestibility is also related to the Dry Matter Digestibility Coefficient (DMC), where the higher the value, the more nutrients can be utilized by the livestock. Dry matter digestibility is greatly influenced by the composition of organic and inorganic matter in the feed, with organic matter being more easily digested by microbes. Providing higher doses of MA-11 improves dry matter digestibility and overall feed quality.

Organic Matter Digestibility

The research results data on the Digestibility of Organic Material from fermented oil palm leaves using MA-11 are listed in Table 2.

Table 2. Average Digestibility of Organic Matter from Fermented Oil Palm Leaves Using Alfalfa Microbacteria (MA-11 %)

Test	Fermentation dosage			
	P0	P1	P2	P3
1	19,42	27,34	22,67	42,25
2	15,09	22,09	25,63	48,17
3	18,54	21,10	29,05	43,31
Average	17,68 ± 1,3213[a]	23,51 ± 1,9362[a]	25,78 ± 1,8433 [b]	44,58 ±1,8225 [b]

Note: The average row shows significant differences (P<0.01).

The statistical test results in this study show that adding 0 ml to 6 ml of MA-11 in the fermentation of oil palm leaves, incubated for 9 days, significantly improved organic matter digestibility ($P < 0.01$).

The chemical composition of feed affects its digestibility because the quality of the nutrients in it determines how well the feed can be digested and absorbed by livestock. Feed with high digestibility contains nutrients that are easy to digest, allowing livestock to obtain

more nutritional value. The higher the digestibility of the feed, the more nutrients can be absorbed by the livestock, supporting their basic metabolic needs, growth, and production. Easily digestible feed allows livestock to convert it into energy and body mass more efficiently, improving weight gain and productivity (Boangmanalu *et al.,* 2016).

The digestibility of nutrients determines the quality of the feed, as the feed that is digested is calculated from the comparison between the nutrients in the feed consumed and those excreted in the feces (Ali *et al*., 2019). The higher the level of MA-11 given, the higher the digestibility of the organic matter in the palm leaves. This is because the digestibility of dry matter also increases with the addition of MA-11 in the fermentation of oil palm leaves (Table 1).

The dry matter of feed consists of organic and inorganic materials. Organic materials, including crude fat, crude protein, crude fiber, and nitrogen-free extract (BETN), can be digested by microbes. In contrast, livestock cannot digest inorganic materials such as ash. The digestibility of dry matter is enhanced by adding MA-11, as microbes in the rumen of livestock become more effective in breaking down organic materials, allowing the livestock to absorb more of the nutrients in the feed. According to studies by Suparwi (2017) and Boangmanalu *et al*. (2016), feed materials with the same nutrient content will have an organic matter digestibility level equivalent to the digestibility of dry matter. Adding MA-11 improves the digestibility of organic matter and the overall quality of the feed, helping livestock utilize nutrients more efficiently.

CONCLUSION

The fermentation of oil palm leaves using MA-11 in doses of 0-6 ml for a 9-day incubation period can improve the digestibility of dry and organic matter. MA-11 contains microbes that help break down fiber, protein, and starch in oil palm leaves, making the feed more digestible for livestock. This fermentation process reduces the lignin content, which is hard to digest, enhancing digestibility and nutrient availability. Using MA-11 can improve feed quality and efficiency in livestock use.

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