DRF-496
[1-5]

RESEARCH ARTICLE Asian Journal of Dairy and Food Research

# Feeding Rate, Dry Matter and Organic Matter Digestibility of Local Sheep Fed Moringa Leaf and Palm Oil Supplemented Diets

Sista Rizqiana[1], Wardhana Suryapratama[2], F.M. Suhartati[2]

10.18805/ajdfr.DRF-496

## ABSTRACT

**Background:** Animal feed stuff especially forages in Indonesia are generally of low quality, hence the need to process them into silage. In addition, to improve nutrition in silage, it also needs to be enriched with additional supplements from other plant materials such as moringa and palm oil. The objective of this study to evaluate the effect of *Moringa* leaf meal (MLM) and palm oil (PO) supplementation on the nutrient content of feed and the growth of local sheep.

**Methods:** The research used 18 local male sheep aged eight months with a weight of 18.9. The supplementation feed used was moringa leaf meal 2% (by dry matter) and palm oil 0.5% of the feed. The research design was completely randomized (CRD) with three treatments and having three sheep in six replicates. The treatments include: P0: basal feed as control diet; P1: P0 + 2% moringa leaf meal; P2: P1 + 0.5% palm oil.

**Result:** The analysis of variance showed that the treatment had no significant effect on feeding rate and organic matter digestibility (P>0.05) but had a significant effect (P<0.05) on dry matter digestibility. The use of 2% moringa leaf meal and 0.5% palm oil for supplementation on silage-based feed does not interfere with the feeding rate of sheep and tends to increase the digestibility of organic matter but significantly increases dry matter digestibility.

**Key words:** Digestibility, Feeding rate, Moringa leaves, Palm oil.

## INTRODUCTION

Sheep is a livestock commodity that has the potential to be developed because it has high economic value. The productivity of sheep is closely related to the quality of available local feed resources. In the dry season, grass is usually less available. The quality of grass that grows in Indonesia is of low quality because it contains high crude fiber and low digestibility. The low quality and quantity of feed require a touch of feed preservation technology, namely silage. Silage is animal feed that has a high moisture content. The provision of silage balanced with concentrate in sheep is sufficient to meet the required nutrient needs. However, increasing nutrient intake for livestock can be done by supplementing various kinds of feed ingredients, one of such which can be used for supplementation is Moringa leaf meal and palm oil. Sarwatt *et al*. (2004) stated that adding a Moringa leaf meal to the Chloris gayana hay feed significantly increased the digestibility of dry matter and crude fiber in dairy goats. Okwari *et al*. (2013) stated that giving Moringa leaves can improve the detrimental effects of oxidized palm oil.

Utilization of Moringa leaves as supplement in livestock feed is generally used to improve ration efficiency, growth performance, reproductive performance and meat production. Moringa oleifera leaves have a lot of nutrients, like protein, carbohydrates, ash, fat and dietary fiber. Each of these nutrients is present in the following amounts: protein is 25.30%, carbohydrates are 29.80%, ash is 9.95%, fat is 7.75% and dietary fiber is 24.97% (Penalver *et al*., 2022). The high protein content in Moringa leaves is expected to improve feed digestibility. The positive impact of *Moringa oleifera* dry leaf powder supplementation on production performance may stem from enhanced feed consumption, noticeable nutrient digestibility and favorable ruminal fermentation conditions (Saini *et al*., 2024). To support enhanced digestibility, palm oil supplementation is also carried out. Palm oil can be used as a feed mixture with a limit of not exceeding 5% of the feed. Fat from the oil can be used as a defaunation agent. Wang *et al*. (2025)

[1]Department of Science, Faculty of Agriculture, Lambung Mangkurat University, Jl. A. Yani Km. 36, Banjarbaru, South Kalimantan, Indonesia.
[2]Department of Science, Faculty of Animal Science, Jenderal Soedirman University, Jl. Dr. Soeparno No.60, Purwokerto, Central Java, Indonesia.

**Corresponding Author:** Sista Rizqiana, Department of Science, Faculty of Agriculture, Lambung Mangkurat University, Jl. A. Yani Km. 36, Banjarbaru, South Kalimantan, Indonesia.
Email: sista.rizqiana@ulm.ac.id
ORCID: https://orcid.org/0000-0001-7694-4428

**How to cite this article:** Rizqiana, S., Suryapratama, W. and Suhartati, F.M. (2025). Feeding Rate, Dry Matter and Organic Matter Digestibility of Local Sheep Fed Moringa Leaf and Palm Oil Supplemented Diets. *Asian Journal of Dairy and Food Research*. 1-5. doi: 10.18805/ajdfr.DRF-496.

**Submitted:** 04-01-2025 **Accepted:** 08-07-2025 **Online:** 24-10-2025

say that oil helps increase how much feed animals eat because it can pick up the smell of the feed, which makes them want to eat more. They link this increased eating to how well the feed is digested. Polviset *et al.* (2020) also stated that supplementation of 3% in rations increased DM and total VFA digestibility, without adverse effects on nutrient intake of beef cows. Based on the description above, the provision of Moringa as a feed supplement can improve feed digestibility, so it is necessary to study further information regarding the use of Moringa leaf and palm oil for nutrient digestibility in local sheep.

## MATERIALS AND METHODS

The study was undertaken at the Experimental Farm dan Animal Feed Nutrition Laboratory, Faculty of Animal Science, Unsoed, Central Java, Indonesia. The livestock used were 18 local male sheep aged about eight months and with a body weight of 18.9, obtained from breeders in Banyumas Regency, Central Java, Indonesia. Before the research, all experimental livestock were dewormed and their hair shaved. Research sheep are placed in individual cages. The cage is made of wood and equipped with a feed bucket and drinking water for each individual animal. The rations used during the study consisted of elephant grass silage and concentrate. Silage is made from elephant grass (*Pennisetum purpureum*), while the concentrate consists of bran and coconut cake. The supplementation feed used was Moringa leaf flour and palm oil. The experimental design used in the study was a completely randomized design (CRD) with three treatments and having three sheep in six replicates. The treatments used include P0: basal feed as control diet; P1: P0 + 2% Moringa leaf flour; P2: P1 + 0.5% palm oil. The experimental ration composition showed in Table 1.

Maintenance of sheep is carried out for two months in an individual pen. Provision of rations at the time of adaptation 3.5% of body weight. It then continued the preliminary period for two weeks. Furthermore, the collection period was carried out for seven days. Variable measures include:

Dry matter digestibility =

$$\frac{\text{Dry matter intake - Dry matter feces}}{\text{Dry matter intake}} \times 100\%$$

Organic matter digestibility =

$$\frac{\text{Organic metter intake - Organic matter feces}}{\text{Organic matter intake}} \times 100\%$$

Feeding rate is calculated when the sheep started to eat the given feed. Feeding rate is observed by measuring the spent feed (in grams) for 30 minutes.

## RESULTS AND DISCUSSION

### Feeding rate

The average results of observations of nutrient digestibility and feeding rate of local sheep during the study are presented in Table 2. The feeding rate of the research sheep was around 8.15-9.69 g/head/minute. Treatment of P0 (control diet) with basal feeding in elephant grass silage and concentrate showed the highest feeding rate of 9.69±2.31 g/head/minute. The analysis of variance showed that the treatment had no significant effect (P>0.05) on the feeding rate of sheep. However, paying attention decreases the amount of feed consumed per minute. This can be due to several factors, including the physical characteristics of the feed, palatability, sex of livestock, condition of the livestock and feeding behavior. Sheep are livestock with a very picky character about the feed. This has an impact on the feeding behavior of the livestock itself. This is reinforced by the opinion of Johansson (2011) that the percentage or amount of different feed can affect the feeding behavior of local sheep. The quality and composition of feed ingredients can affect chewing rate.

Upon observation, the eating behavior of sheep was different. Some sheep devour their feed without being picky about what to eat, some see and sniff their food first and some choose their feed when they eat. These behaviors affect feeding rate and feed intake. Table 2 shows that dry matter intake decreases with decreasing feeding rate. Several factors affect animal feed consumption are the feed's appearance, aroma, texture and taste. This affects livestock feeding behavior, impacting animal feed consumption. The quality and composition of feed ingredients can affect chewing rate. From the conditions at the time of the study, the quality of basal feed (P0) was classified as low quality. Still, it had the fastest feeding rate compared to the feed supplemented with treatment. This is likely related to the level of palatability. Livestock palatability significantly affects the rate of feeding of livestock. Based on the feed given in the study regarding aroma or odor, basal feed (P0) has a distinctive silage aroma that stands out because it does not provide additional supplementary feed. Meanwhile, in the P1 and P2 treatments, there were additional Moringa leaf flour and palm oil so that the aroma of the feed tended to be slightly bitter.

Xin *et al.* (2025) said that using vegetable oil, especially protected palm oil in feed, makes animals eat more because they enjoy the smell, which makes the food more attractive to them. This is different from the results of the study, which showed that the feeding rate of sheep treated with the addition of vegetable oil in the form palm oil had

**Table 1:** Experimental ration composition.

| Feed stuff | Treatments (%) | | |
|---|---|---|---|
| | P0 | P1 | P2 |
| Elephant grass-silage | 40 | 40 | 40 |
| Concentrate | 60 | 60 | 60 |
| Total | 100 | 100 | 100 |
| Moringa leaf meal | - | 2 | 2 |
| Palm oil | - | - | 0.5 |
| Total | 100 | 102 | 102.5 |

the lowest feeding rate compared to other treatments, so the palatability of feed containing palm oil was considered low. The smell of palm oil and the texture of the feed, which tended to be sticky, were less preferred by livestock, so livestock tends to be picky about their feed. Apart from the texture and odor caused by the oil, the crude fat content in experimental feed can also affect the feeding rate of livestock. Table 2 shows a decrease in feeding rate in treatment P0 to P2, possibly due to increased feed quality, especially fat and energy. Patra (2013) mentions that high levels of essential fatty acids in the food given to ruminant animals might reduce how much they eat. Behan *et al*. (2019) suggest that adding fat to the diet of livestock that mainly eat forage-based feed works best, because fat acts as a source of energy. The reason energy efficiency improves when rumen-protected fat is supplemented is twofold: it reduces the amount of methane generated within the rumen and it enables the direct utilization of essential long-chain fatty acids by the animal. Palm oil contains an energy of 8300 kcal / kg, making the needed energy needed by sheep met faster. Strengthened by the opinion of Davies (1982) that there is an inverse correlation between consumption and energy content in the feed. The decrease in the level of livestock consumption is partly due to the high energy content in the feed given.

**Dry matter digestibility**

The dry matter digestibility of the experimental sheep ranged from 64.05-72.22%. Treatment P2 with feeding supplemented with 2% Moringa leaf meal and 0.5% palm oil showed the highest dry matter digestibility, 72.22 ± 0.04%. The analysis of variance showed that the treatment had a significant effect (P<0.05) on the dry matter digestibility in sheep. This indicates that the ration's nutritional composition affects the dry matter's digestibility. Oyedele *et al.* (2016) and Sultana *et al.* (2015) stated that the dry matter digestibility of goats fed a diet of Moringa leaf meal was higher when compared to goats fed other leaves. This is because the availability of cellulose from the ADF can be digested by livestock. Meel *et al.* (2019) stated that the fiber content of the feed also influences the digestibility of dry matter. Diets with low fiber content are more accessible to digest than high-fiber feeds.

Stated that the factors that affect the digestibility of dry matter include the level proportion of feed ingredients in the ration, chemical composition and protein levels. In line with the study's results, the highest dry matter digestibility was found in P2 treatment with supplementation of 2% moringa leaf flour and 0.5% palm oil, in which moringa leaf flour contained a high enough protein, namely 16.83%. Palm oil supplementation, as much as 0.5% in this study, can be considered adequate because it increases feed digestibility. In line with this research, Candyrine *et al.* (2019) stated that using oil supplementation could reduce the number of protozoa, thereby causing an increase in bacterial population and increased feed digestibility. Bhatt *et al.* (2011) also stated that the population of ciliate rumen protozoa decreased due to providing free oil to sheep, thereby increasing the digestibility of the feed.

It can be seen from the feeding rate data (Table 2) that the feeding rate is inversely related to dry matter digestibility. Feeding rate decreased in each treatment, while dry matter digestibility increased in each treatment. This means that the faster the livestock eat, the quicker the digestibility flow rate will be. The absorption is not optimal because the microbial process of degrading the feed is shorter, so the digestibility is low. Conversely, if the flow rate is slower, it will give time for the microbes to digest the feed properly. There is a correlation between consumption and feed digestibility. Feed intake will increase with increased feeding rate or feed particle rate. Bhokre *et al.* (2021) stated that the enhanced digestibility of diets supplemented with Moringa may result from low levels of structural carbohydrates and high-quality protein.

**Organic matter digestibility**

The organic matter digestibility in the experimental sheep ranged from 69.36 to 74.81%. Treatment P2 with feeding supplemented with 2% Moringa leaf meal and 0.5% palm oil had the highest organic matter digestibility value, 74.81 ± 0.03%. The analysis of variance showed that the treatment had no significant effect (P> 0.05) on the digestibility of organic matter in sheep. The higher the value of the digestibility of organic matter causes the feed intake to increase or vice versa. Feed intake is influenced by feed quality, animal body weight and feed digestion rate. How much food animals eat is connected to how well their bodies can break down the nutrients in that food. And how well the nutrients are broken down depends on how much and what kind of nutrients the animals are eating (Filleau *et al*., 2018).

The digestibility of organic matter describes the availability of a given feed nutrient. High dry matter intake will be followed by increased high dry matter digestibility. This causes the digestibility of dry matter and organic matter to increase as well. In line with the results obtained, which showed that the highest dry matter digestibility was found in P2 treatment with 2% moringa leaf flour supplementation and 0.5% palm oil, the highest organic

**Table 2:** Average nutrient digestibility and growth in sheep.

| Parameter | P0 | P1 | P2 |
|---|---|---|---|
| Feeding rate (g/head/minute) | 9.69±2.31 | 9.29±3.31 | 8.15±2.31 |
| DM digestibility (%) | 64.05±0.08 | 65.79±0.18 | 72.22±0.04 |
| OM digestibility (%) | 70.70±0,15 | 69.36±0.15 | 74.81±0.03 |

DM: Dry matter; OM: Organic matter.

matter digestibility was found in treatment P2. This relates to certain substances contained in the feed in each treatment. The chemical composition of feed can affect its digestibility of feed, because the digestibility of a feed is closely related to the quality of the nutrients in the feed.

It is known that in Moringa leaf flour, there are phytochemicals compounds in the form of tannins and saponins. Penalver *et al*. (2022) mentioned that the leaves contain anti-nutritional components such as tannins, lecithins and protease inhibitors, which have little significance; therefore, they are safe for consumption. According to Yogianto *et al*. (2014), tannins and saponins can improve the digestibility of feed when used in low doses by providing a defaunating effect. Defaunation agents inhibit the growth of protozoa, allowing bacteria in the rumen to thrive, which in turn helps bacteria work more effectively in digesting the feed, leading to increased feed digestibility.

The digestibility of organic matter in this study was relatively higher than that of dry matter in each treatment. Yogianto *et al.* (2014) stated that the digestibility value of organic matter tends to be higher than that of dry matter digestibility. Organic matter is part of dry matter with reduced ash content, so the digestibility value of organic matter tends to be high. The ash content in treatment P1 was 13.08%, the highest compared to the other two treatments. This decreased the digestibility of organic matter in the P1 treatment and became the lowest digestibility of organic matter compared to other treatments. The digestibility of organic matter is higher than that of dry matter because the digestibility of dry matter still contains ash. Organic matter does not have ash and material without ash content tends to be easier to digest in the digestive tract. The higher the ash content in the feed, the worse the feed quality. Ash itself consists of minerals, but the types and amounts of minerals in the ash cannot be explained.

## CONCLUSION

Based on the research results, the treatment does not affect feeding rate of the sheep. Using moringa leaf meal with as much as 2% and 0.5% palm oil to supplement silage-based feed increased dry matter and organic matter digestibility in local sheep. So, this supplementation can be said to be effective as animal feed.

## ACKNOWLEDEGMENT

We would like to express our sincere gratitude to the officer in-charge Experimental Farm and Animal Feed Nutrition Laboratory, for their continuous support and the requisite facilities they provided.

### Disclaimers

The opinions and findings presented in this article belong exclusively to the authors and may not necessarily reflect the perspectives of their associated organizations. The writers are accountable for the precision and completeness of the information given, yet do not assume any responsibility for any direct or indirect losses arising from the utilization of this material.

### Informed consent

All experimental animal procedures have been conducted in accordance with animal welfare principles.

### Conflict of interest

The authors declare that they have no conflict of interest.

## REFERENCES

Behan, A.A., Loh, T.C., Fakurazi, S., Kaka, U., Kaka, A. and Samsudin, A.A. (2019). Effects of supplementation of rumen protected fats on rumen ecology and digestibility of nutrients in Sheep. *Animals.* **9(7):** 400.

Bhatt, R.S., NM. Soren, M.K. Tripathi and S.A. Karim. (2011). Effect of different levels of coconut oil Supplementation on performance, digestibility, rumen fermentation and carcass traits of Malpura Lambs. *Animal Feed Science and Technology.* **164:** 29-37.

Bhokre, S.M., N. Rajanna, A. Sarat Chandra, D. Nagalakshmi, D.B.V. Ramana and M. Shasi Kumar. (2021). Effect of inclusion of *Moringa oliefera* leaf meal on the growth performance, nutrient digestibility and carcass characteristics of deccani lambs. *Asian Journal of Dairy and Food Research.* **42(4):** 478-483.

Candyrine, S.C.L., M.F. Jahromi, M. Ebrahimi, W.L. Chen, S. Rezaei, Y.M. Goh, N. Abdullah, and J.B. Liang. (2019). Oil supplementation improved growth and diet digestibility in goats and sheep fed fattening diet. *Asian-Australasian Journal of Animal Science.* **32(4):** 533-540.

Davies, L.H. (1982). Nutrition and growth manual. Australian Universities Development Program (AUDP), Australia.

Filleau, A.H.B., Rinne, M., Lamminen, M., Mapato, C., Ampapon, T., Wanapat, M. and Vanhatalo, A. (2018). Review: Alternative and novel feeds for ruminants: Nutritive value, product quality and environmental aspects. *Animal.* **12(2):** 259-309.

Johansson, M.S. (2011). Chewing Behavior of Growing Cattle. Swedish University of Agricultural Sciences. Department of Animal Nutrition and Management. Swedish.

Meel, P., Gurjar, M.L., Nagda, R.K., Choudhary, S., Manju. and Meel, M. (2019). Effect of feedinng different levels of *Moringa oleifera* leaves on digestibility of nutrients in sirohi goat kids. *International Journal of Chemical Studies.* **7(2):** 1404-1408.

Okwari, O.O., Dasofunjo, K., Asuk, A.A., Alagwu, E.A. and Mokwe, C.M. (2013). Anti-Hypercholesterolemic and Hepatoprotective effect of aqueous leaf extract of *Moringa oleifera* in rats fed with thermoxidized palm oil diet. *Journal of Pharmacy and Biological Sciences,* **8(2):** 57-62.

Oyedele, O.J., Asaolu, V.O. and Odeyinka, S.M. (2016). Nutrient digestibility and growth performance of West African dwarf (WAD) goats fed foliage combinations of *Moringa oleifera* and *Gliricida sepium* with equal proportions of a Low-cost Concentrate. *Journal of Natural Sciences Research.* **6(18):** 20-29.

Patra, A.K. (2013). The effect of dietary fats on methane emissions, and Its other effects on digestibility, rumen fermentation and lactation performance in cattle: A meta-analysis. *Livestock Science.* **155(2):** 244-254.

Penalver, R., Zamora, L.M., Lorenzo, J.M., Ros, G. and Nieto, G. (2022). Nutritional and Antioxidant Properties of *Moringa oleifera* Leaves in Functional Foods. *Foods.* **11:** 1107.

Polviset, W., Prakobsaeng, N. and Wetchakama, N. (2020). Effect of supplementation of several edible plant oils on nutrient utilization and blood profile of beef cattle. *Asian Journal of Dairy and Food Research.* **39(3):** 245-250.

Saini, H., Kumar, V., Joshi, A. and Choudhary, M.L. (2024). Effect of Moringa (*Moringa oleifera*) dry leaf powder supplementation on production performance and economics of lactating rathi cows. *Asian Journal of Dairy and Food Research*: 1-5.

Sarwatt S V., Milang'ha, M.S., Lekule, F.P. and Madalla, N. (2004). *Moringa oleifera* and cottonseed cake as supplements for smallholder dairy cows fed Napier grass. *Livestock Research for Rural Development.* **16(6):** 13-20.

Sultana, N., Alimon, A.R., Huque, K.S., Sazili, A.Q., Yaakub, H., Hossain, J. and Baba, M. (2015). The feeding value of moringa (*Moringa oleifera*) foliage as replacement to conventional concentrate diet in bengal goat. *Adv. Animal and Veterinary Sciences.* **3(3):** 164-173.

Wang, G., Geng, W., Yang, H., Zhang, X., Zhang, H., Shen, B. and Liu, C. (2025). Effect of Essential oil on growth performance, rumen fermentation and nutrient digestibility of Hu sheep. *Indian Journal of Animal Research.* **59(8):** 1370-1375. doi: 10.18805/IJAR.BF-1914.

Xin, Y., Sun, H., Liu, S., Lan, B., Zhao, G., Yin, S., Zan, L. and Zhao, C. (2025). Effects of vegetable oils on feed intake, nutrient digestibility, ruminal parameters, lactation performance, and milk fatty acid composition in cattle: A meta-analysis. *Animal Feed Science and Technology*. **323:** 116286.

Yogianto, A., Sudarman, E., Wina. and Jayanegara, A. (2014). Supplementation effects of tannin and saponin extracts to dietswith different forage To concentrate ratio on *In vitro* Rumen fermentation and Methanogenesis. *J. Indonesian Trop. Anim. Agric.* **39(3):** 144-151.