INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN MULTIDISCIPLINARY EDUCATION

ISSN (print): 2833-4515, ISSN (online): 2833-4531

Volume 04 Issue 01 January 2025

DOI: 10.58806/ijirme.2025.v4i1n09, Impact factor- 5.138

Page No. 94 - 101

The Effect of Commercial Complete Feed Substitution with Moringa Leaf Meal (Moringa Oleifera L.) On Protein Digestibility and Energy of Grower Pigs

Gregoria Oktviani Mindung[1], Sabarta Sembiring[2], David A. Nguru[3], Ni N. Suryani[4]

[1,2,3,4]Department of Animal Science, Faculty of Animal Husbandry, Marine Affairs and Fisheries, Nusa Cendana University

ABSTRACT: The purpose of the study was to determine the effect of commercial complete feed substitution with moringa leaf meal (Moringa oleifera) on protein digestibility and energy of grower pigs. The material used was 12 landrace castration pigs aged 3-5 months with an initial weight of 38-55 kg with an average of 45.17 kg (KV = 13.31%). This study used a complete randomized design (CRD) with four treatments and three replicates. The treatment is T0: 100% CCF, T1: 90% CCF+ 10% MLM, T2: 85% CCF+ 15% MLM, T3: 80% CCF+ 20% MLM. The research variables were protein and energy consumption, protein and energy digestibility. The results of this study showed that the effect of commercial complete feed substitution with moringa leaf meal had an insignificant effect (P>0.05) on the consumption and digestibility of protein and energy of grower phase pigs. The conclusion of this study is that effect of commercial complete feed substitution with moringa leaf meal (Moringa oleifera) has the same effect on the consumption and digestibility of protein and energy of grower phase pigs.

KEYWORDS: Consumption, Crude Protein, Digestibility, Energy, Grower Pig, Moringa Leaves

INTRODUCTION

Feed management is an aspect that needs to be considered in the pig farming business because it affects the productivity of pig farming. Therefore, it is necessary to make the right combination of the nutritional needs of livestock, the nutritional content of the feed and the amount of feeding (Armayanti et al., 2023). Protein and energy are two important factors that determine the quality of feed and must meet the standards needed in livestock rations, the balance of protein and energy rations greatly determines the efficiency of nutrient utilization which ultimately affects livestock productivity (Tamaviwy et al., 2015). Protein in the ration serves to repair body tissues, grow new tissues, and as an antibody for livestock (Sudradjat & Lilis, 2019). Providing rations to livestock with low protein content can cause a weak immune system of the livestock, which has an impact on the productivity of the livestock (Sjofjan et al., 2019).

The high price of feed makes farmers provide potluck feed without paying attention to the daily nutritional needs of livestock. Giving potluck feed without paying attention to the balance of nutrients needed by livestock can affect the productivity of pigs so that it requires longer maintenance time (Ndolu et al., 2024). Protein is the most expensive ingredient in a feed, so the higher the protein content in the feed, the more expensive it will be (Parisi et al., 2020), where 70-80% of production costs are feed costs (Wenda et al., 2019). Raw materials for protein sources that are still widely imported cause feed prices to be prone to price increases (Indartono, 2021).

One of the problems faced by farmers is the difficulty of meeting the availability of feed in a sustainable manner in both quality and quantity (Nguru et al., 2022). One strategy to reduce high feed costs, farmers can use local resources as a substitute for commercial feed (Sembiring et al., 2020). The use of local feed must pay attention to the balance of nutrients in feed that is easily digested and absorbed so that it can be used by livestock (Ly et al., 2014). One of the local resources that has the potential to be used as a feed source of protein is moringa leaves with a protein content of 24.14%, fat content of 6.11%, crude fiber of 11.44%, moisture content of 10.96%, and ash content of 9.45% (Kantja et al., 2022). Moringa leaves contain all the essential amino acids needed by the body (Moyo et al., 2016). However, in giving it to livestock, it is necessary to pay attention to the maximum limit because moringa plants have anti-nutrient substances, namely tannins 0.3% and saponins 6.4% which when given in large quantities can interfere with the absorption process of nutrients in the digestive tract (Sukria et al., 2018)

Supplementation of deep moringa leaves liquid feeding at the level of 15% with a ratio of 3.3% W/V improved energy consumption, protein consumption and energy digestibility but had no effect on the protein digestibility of pigs (Sijung et al., 2020). Supplementation of deep moringa leaves liquid feeding at the level of 15% with a ratio of 3.3% W/V resulting in a higher body weight gain and final body weight than the control without moringa leaves (Suryani et al., 2021). Supplementation of fermented moringa leaves at the level of 5% in basalt feed does not affect protein digestibility and energy of starter pigs (Rumlaklak et al., 2023). There has been no research on the substitution of commercial complete feed with moringa leaf meal so further research is needed. It is hoped that with the increase in the use of moringa leaf level and the processing of moringa leaves into meal can substitute commercial complete feed, reduce high production costs and provide the same results on the consumption and digestibility of crude protein and energy of pigs. The purpose of this study is to determine the effect of commercial complete feed substitution with moringa leaf meal on the consumption and digestibility of protein and energy of grower pigs.

MATERIALS AND METHODS

Livestock and Research Cages

This study used was 12 landrace castration pigs with an average body weight of 45.17 Kg (KV=13.31%). The research cage used is an individual cage consisting of two rows facing each other so that there are 12 plots with each measuring 2 m × 1.5 m and equipped with a feed place and a drinking place.

Research rations

The rations given to pigs during the study were complete feed produced by PT. Gold Coin with the code Classic I circulating in the market. The nutritional content of feed ingredients is presented in Table 1. The ingredient added in the basal ration is moringa leaf meal.

Table 1. Nutritional content of feed ingredients that make up the ration

Feed Ingredients	Nutritional Content							
	EM (Kcal/kg)	PK (%)	LK (%)	SK (%)	BK (%)	BO (%)	Ca (%)	P (%)
Commercial Complete Feed[(a)]	3252,20	15,00	3,00	7,00	87,00	92,00	1,20	0,45
Moringa Leaf [(b)]	1.318,20	24,14	6,11	11,44	89,04	90,55	3,65	0,30

Source : a) Label on the classic I gold coin sack, b) Kantja et al., (2022)

Table 2. Composition of Ration Treatment

Feed Ingredients	Ration Treatment %			
	R0	R1	R2	R3
Commercial Complete Feed	100	90	85	80
Moringa Leaf Meal		10	15	20
Total	100	100	100	100
Nutrient content from the calculation of treatment rations	R0	R1	R2	R3
BK (%)[1)]	88,79	87,85	87,60	88,03
BO (%)[1)]	90,58	90,58	90,63	90,94
Horsepower (%)[1)]	15,40	16,11	16,31	16,70
LK (%)[1)]	5,10	3,86	4,93	6,77
EN (%)[1)]	5,18	5,20	5,61	6,07
Ca (%)[2)]	1,11	1,20	1,24	1,27
P (%)[2)]	0,77	0,78	0,79	0,79
GE(Kkal/kg) [1)]	4210,05	4154,93	4196,48	4271,08
m (Cal/KG)[3)]	3321,73	3278,24	3311,02	3369,88

Remarks: 1) Results of Proximate Analysis of the Feed Chemistry Laboratory of FPKP Undana (2024)
2) Results of Proximate Analysis of the Soil Chemistry Laboratory of Faperta Undana (2024)
3) Sihombing Calculation Results (1997), ME= 78.9% GE

Research Methods

This research uses an experimental method. Furthermore, the experimental design was based on variation in pig body weight and followed a Completely Random Design (RAL) which consisted of 4 treatments and 3 replicates, resulting in 12 experimental units. The treatment is as follows:

R0 : 100% CCF
R1 : 90% CCF + 10% MLM
R2 : 85% CCF + 15% MLM
R3 : 80% CCF + 20% MLM

Research Procedure

The research has been carried out with the following procedures:

Moringa Leaf Meal Making Procedure

Moringa leaf meal is made from fresh leaves obtained from the city of Kupang and Kupang Regency, the process of processing moringa leaves into meal is as follows:

1. Freshly harvested moringa leaves are separated from the branches (the moringa leaves used are old moringa leaves)
2. The cleaned moringa leaves are then aerated for 4-6 days. The way to know which leaves are dry is to squeeze the leaves (if squeezed, the leaves will be easily destroyed).
3. Dried moringa leaves are then ground into meal.

Ration Mixing Procedure

The feed ingredients used were weighed according to the percentage of each treatment (Table 2). After weighing, the commercial complete feed is mixed with moringa leaf meal according to the percentage of treatment. In this study, the difference in the form of feed used where the commercial complete feed is in the form of pellets while the moringa leaves are in the form of meal, so to get a more homogeneous ration, the ration is mixed with water with a ratio between feed and water is 2:1.

Providing rations and drinking water

Pigs are fed twice a day, in the morning and in the evening.The rations provided are weighed based on daily needs, which are based on 5% of the pigs body weight. The feed is provided in a wet form, with a 2:1 ratio of feed to water. Drinking water is available ad libitum and is replaced or refilled with fresh water whenever it runs out or becomes dirty. The Cages cleaning is carried out 2 times a day, in the morning and evening before the pigs are fed.

Ration and Fecal Sampling Procedure

To equalize the shape of the feed used, before the complete feed is mixed with moringa leaf meal is crushed first, then 200g is taken from each treatment and then analyzed in the laboratory. Stool collection was carried out daily during the last two weeks of the study period. Stool collection is carried out before feeding in the morning and evening, where feces are weighed and recorded fresh weight, then feces are dried by drying in the sun to obtain the dry weight. The dried feces were smoothed and 200g was taken from each treatment unit, so that 12 samples were obtained for analysis in the laboratory.

Research Variables

The variables observed in this study refer to the recommendations (Tillman et al., 1998).

1. Crude protein intake

Ration protein consumption in the study was calculated by the following formula:

CP Intake = Feed Intake x % Dry Matter of Feed x % Crude protein of Feed.

2. Crude protein digestibility

Protein digestibility in the study was calculated by the following formula:

$$\text{CPD} = \frac{\text{Crude Protein Intake} - \text{Crude Protein In Feces}}{\text{Crude Protein Intake}} \text{X100\%}$$

3. Energy consumption

Energy consumption (Kcal/kg) = Feed Intake × % Dry Matter of Feed × Gross energy of Feed.

4. Energy digestibility (ED)

Energy digestibility is calculated by the following formula:

$$\text{ED} = \frac{\text{Energy Intake} - \text{Energy in feces}}{\text{Energy Intake}} \text{X100\%}$$

Data Analysis

The collected data was analyzed using Analysis of Variance (ANOVA) to further test the difference between the treatments used

Duncan's multiple range test according to Gaspersz's (1991) instructions. The linear model of Complete Random Design (RAL) is:

$$Yij = \mu + \beta j + \tau i + \sum ij$$

Where:

Yij = Observation response due to the ith treatment in the j group
μ = Actual average value or general median value
bj = Effect of treatment to – j
TI = Influence of treatment to – i
∑ij = Experimental error in the treatment of the i group to j.

RESULTS AND DISCUSSION

The data from the research results of the effect of substitution of commercial complete feed with moringa leaf meal are presented in Table 3.

Table 3. Effect of Treatment on Research Variables

Variable	Treatment				P Value
	R0	R1	R2	R3	
Feed Intake (g/h/d)	2105,00± 229,13a	2095,00± 316.90 [a]	2160.00± 60,83 [a]	2261.67± 120.45 [a]	0.78
Crude Protein Intake (g/h/d)	324.23± 35.29 [a]	337.51± 51.05 [a]	363.17± 16.52 [a]	377.70± 20.11 [a]	0.27
Crude Protein Digestibility (%)	75.60± 4.61 [a]	76.43± 2.24 [a]	77.75± 2.49 [a]	80.49± 1.01 [a]	0.26
Energy Intake (Kcal/h/d)	7868.35± 856.47 [a]	7646.80± 1156.69 [a]	8185.77± 372.34 [a]	8503.58± 452.88 [a]	0.58
Energy Digestibility (%)	88.48± 0.63 [a]	88.86± 2.88 [a]	89.52± 0.36 [a]	89.92± 0.45 [a]	0.66

Remarks: Average values with the same superscript on the same line show no significant difference (P>0.05)

Effect of Treatment on Ration Consumption

Data in Table 3. shows that the average consumption of livestock rations in the study is 2095.00-2261.67 g/h/d. The results of this study are lower than those reported by Tatuin et al., (2022) who found that a combination of 12% moringa leaf flour and 3% katuk leaf flour resulted in a ration consumption value of 2775.00-3200.00 g/h/d.

Based on the results of the variety analysis, it was shown that the treatment had no significant effect (P>0.05) on the feed consumption of pigs in the grower phase. This indicates that the use of moringa leaf meal in commercial complete feed at the level of 10-20% does not have a different effect than without the use of moringa leaf meal on ration consumption. The insignificant difference in ration consumption is suspected because the use of moringa leaf meal does not significantly affect the palatability of rations. This is in accordance with Usfinit et al. (2019) that the level of ration consumption is affected by the palatability which includes the shape, smell, taste, color, and texture of the rations given. Apart from the palatability of rations, the frequency of administration and the physical form of each treatment are the same, causing the consumption of rations to be relatively the same. This is supported by Chassé et al., (2021)that the technique and frequency of administration affect ration consumption. The Duncan's multiple range test showed that there was no significant between the treatments of the consumption of the pigs in the study. The lack of a difference in ration consumption indicates that the level of palatability of each treatment ration is relatively the same. Consumption of the same ration due to the same level and method of feeding, which is consistent with Li & Patience, (2017) who reported that ration consumption was affected by the physical shape of the ration, body weight and environmental temperature.

Effect of Treatment on Protein Consumption

Data in Table 3. showed the average crude protein consumption of pigs was 324.23-377.70 g/h/d. The results of this study are higher than the results obtained Rengo, (2021) that the provision of rations with additional moringa leaf extract liquid feeding with different levels of up to 15% providing crude protein consumption levels ranging from 282.66-384.15 g/h/d. Empirically, the data in the table shows that the use of moringa leaf meal at the level of 10-20% increases the protein consumption of research livestock. This is because along with the increasing level of use of moringa leaves in rations, it can increase the protein content in the treatment rations (Table 2).

Based on the results of the variety analysis, it was shown that the use of moringa leaf meal as a substitute for commercial complete feed at the level of 10-20% had no significant (P>0.05) on protein consumption. This indicates that the use of moringa leaf meal in commercial complete feed at the level of 10-20% does not have a different effect than without the use of moringa leaf meal on protein consumption. The Duncan's multiple range test showed no significant differences between treatment pairs regarding protein consumption. There is no difference in protein consumption because the ration consumption and protein content of livestock rations are relatively the same. This is supported by Ly & Kallau, (2014) who reported that protein consumption was affected by the consumption and protein content of the ration. Furthermore, Kurz & Seifert, (2021) reported that high feed consumption leads to increased protein consumption to meet the amino acid needs of the cattle. The consumption of crude protein between each treatment is relatively the same, indicating that the use of moringa leaf meal can replace crude protein in commercial complete feed at the level of 10-20%, this is because moringa leaves contain crude protein up to 24.14% (Kantja et al., 2022). The combination of ration ingredients of each treatment complements the amino acid content resulting in no significant difference in protein consumption from each treatment (Suryana et al., 2014). Additionally Pexas et al. (2023) reported that the use of diverse protein sources in animal feed will increase protein consumption and also increase protein intake in the livestock's body.

Effect of Treatment on Crude Protein Digestibility

Data in Table 3. showed that the protein digestibility of the study pigs ranged from 75.60 -80.49%. The results of this study are lower when compared to the results obtained Nggadas et al. (2023) that the use of a combination of moringa flour and katuk flour at different levels up to the level of 15% provides a digestibility level ranging from 85.47-88.52%. This is because the protein content in the treatment ration is lower (Table 2) when compared to the protein content in the study ration which ranges from 17-20%. This is in line with the findings Prawitasari et al. (2018) which reported that the protein content of the ration affected the digestibility of the crude protein of the ration. Although the digestibility of crude protein is lower than that of other studies, it is still in the recommended value range, namely the digestibility of crude protein in cattle ranges from 75-90% (Tulung et al., 2022). Empirically, protein digestibility increases along with the increase in the level of moringa leaf meal in substituting commercial complete feed. This is in line with Nouman et al. (2015) that moringa leaves can improve protein digestibility because they are easy to digest. Furthermore, Foidl et al. (2017) reported that moringa leaves have high-quality protein that is easily digested and is influenced by amino acids quality.

Based on the results of the variety analysis, it was shown that the treatment of using moringa leaf meal as a substitute for complete feed at the level of 10-20% had no significant effect on the protein digestibility of phase pigs Grower. This indicates that the use of moringa leaf meal in commercial complete feed at the level of 10-20% does not have a different effect than without the use of moringa leaf meal on protein digestibility due to the relatively same nutritional content in the feed. This is consistent with the findings of Chojnacka et al. (2021) who reported that the high or low digestibility of protein depends on the protein content, the protein structure of the feed ingredients and the protein content that enters the digestive tract. The Duncan's multiple range test showed that the treatment of R3-R2, R3-R1, R3-R0, R2-R1, R2-R0 was not noticeable (P>0.05), there was no difference suspected because the use of moringa leaf meal provided the same level of palatability in the ration so that the ration consumption was relatively the same and the protein content digested was relatively the same, this was in line with Tulung et al. (2015) who reported that relatively similar amounts of ration consumption provided no difference in crude protein digestibility. The low protein content in the feed will result in lower digestibility. This is supported by Sinaga et al. (2011) who reported that feed with low crude protein content will produce low digestibility and vice versa.

Effect of Treatment on Energy Consumption

Data in Table 3. showed that the average value of energy consumption of treated feed ranged from 7646.80-8503.58 Kcal/h/d. The results of this study are higher than the results obtained Rumlaklak et al. (2023) that the fermentation of moringa leaves as much as 5% in basalt feed provides a consumption rate ranging from 6524.52-6738.07 Kcal/h/d in pigs. This is because the energy content of the ration in this study is higher, which indicates that the increase in the level of moringa leaves in substituting commercial complete feed can increase energy consumption from feed.

Based on the results of the variety analysis, it was shown that the use of moringa leaf meal in complete feed had no real effect (P>0.05) on the energy consumption of pig livestock in the phase Grower. This indicates that each treatment gives the same response to the energy consumption of the research pigs. The Duncan's multiple range test showed that there was no difference between the treatment of energy consumption. There is no difference in energy consumption because the ration consumption is relatively the same and the level of energy in the ration is relatively the same (Koroh et al., 2019). The balance of nutrients contained in the ration also affects the level of energy consumption, this is in line with the opinion Ly et al. (2017) who reported that the energy consumption of feed ingredients or rations depends on the compatibility of the food substances contained in them. Furthermore (Poluan et al. (2016) reported that there was no difference in ration consumption because the age, environment and content of food substances from the experimental ration were relatively the same. Rations with high energy content tend to be consumed in small quantities by livestock, so their protein intake will be reduced and vice versa. This is in line with Umboh et al. (2017) who reported that the higher the energy consumption will suppress the consumption of other food substances, on the contrary, the lower the energy consumption the higher the consumption of other food substances

Effect of Treatment on Energy Digestibility

Data in Table 3. showed that the energy digestibility of pig rations ranged from 88.48-89.92%. This energy digestibility value is higher than the results obtained Tatuin, (2022) that the use of a combination of moringa leaf flour at the level of 12% and katuk leaf flour at the level of 3% resulted in an energy digestibility value of 66.22-70.26%. Empirically, with the increase in the use of moringa leaves in the ration, the energy digestibility increases, this indicates that the increase in the use of moringa leaves in the ration can increase the energy digestibility value of pig livestock in the Grower. The energy digestibility value is within the recommended value range Tulung et al. (2015) that the normal range of energy digestibility is 70-90%.

Based on the results of the variety analysis, it showed that the treatment had no significant effect (P>0.05) on the energy digestibility of the research pigs. This indicates that the use of moringa leaf meal as a substitute for complete feed at the level of 10-15% has the same effect as without the use of moringa leaf meal, there is no difference in energy digestibility due to the relatively same content of nutrients, the physical form of the ration is relatively the same so that it affects the amount of ration consumption, energy consumption and the same energy digestibility (Sinaga et al., 2011). This is supported by Aome et al. (2024) who reported that the same physical shape or size of the ingredients that make up the ration, the chemical composition of the ration and the rate of food travel in the digestive tract caused relatively the same energy digestibility between pigs. The Duncan's multiple range test showed that the treatment was not real between R3-R2, R3-R1, R3-R0, R2-R1, R2-R0, the absence of an effect on energy digestibility because the energy content, size and shape of the rations given are relatively the same, this statement is in line with Moi, (2019) which reported that relatively similar feed energy content can produce the same energy digestibility value. Another allegation that causes no effect on energy digestibility is that the composition of the ration, especially the content of crude fiber (Table 2), affects the digest rate. This is in line with Jha et al. (2019) who reported that the high level of crude fiber in rations will accelerate the digest rate, the faster the digest rate, the shorter the digestion process in the digestive tract. Furthermore, Sembiring et al. (2020) reported that the high polysaccharides in pig feed will be dissolved in the digestive tract which results in thickening of digesta so that it will inhibit the digestion process of feed ingredients. Energy and protein digestibility is affected by carbohydrate components such as cellulose (Saina et al., 2020).

CONCLUSION

The substitution of commercial complete feed with moringa leaf meal (Moringa oleifera) at the level of 10-20% has the same effect on the consumption and digestibility of protein and energy of pigs in the grower phase. Commercial feed can be substituted with moringa leaf meal up to the level of 20%.

matter can be due to the availability of soluble carbohydrates consumed by bacteria that are in charge of digesting crude fiber (Desnita et al., 2015). The increase in organic matter content is greatly influenced by microbial activity during the fermentation process which facilitates the decomposition of the substrate so as to increase the ability of microorganisms to digest the material more effectively (Astuti et al., 2017). The length of fermentation time affects the degradation process of substrate materials by microbes (Hadisutanto et al., 2020).

CRUDE PROTEIN (PK)

The results of the analysis showed that tofu pulp waste and fermented coconut pulp waste with fermentation time duration had a real effect (P<0.05) on crude protein content. The increase in protein content of tofu pulp waste and fermented coconut pulp waste was 3.28% with a fermentation time duration of 48 hours, when compared to the fermentation time of 24 hours and 12 hours. The length of the duration of fermentation time has been proven to increase the protein content. This is in line with the opinion of Amin et al., (2016) who reported that the increase in protein content is influenced by the length of fermentation time. Microorganisms in the fermentation process need time to decompose complex materials into more conscious materials. Nahariah et al., (2013) reports that the longer the fermentation time, the more opportunities the microorganisms have to adapt. Microbes in the fermentation process are able to convert macromolecules of proteins into micromolecules that are easily digestible (Thaariq, 2018; Bidura, 2007). The ability of microbes to adapt to the substrate to be used as nutrients to grow and develop determines the success of the fermentation process (Astuti et al., 2017; Zakaria et al 2013). Fermentation involves an enzymatic reaction produced by microorganisms that are able to change the physical and chemical form of organic matter into simpler (Moede et al., 2017; Nguru et al., 2024). During the fermentation process, the enzyme amylase is produced to break down carbohydrate components (Suryani et al., 2017). The increase in crude protein is due to the ability of Saccharomyces cerevisiae to secrete extracellular enzymes namely protease, amylase, cellulase, and lipase (Widiarso et al., 2020).

CONCLUSION

The conclusions obtained from this study are

1. The use of baker's yeast as a fermentation medium for tofu and coconut by-products can reduce the content of dry matter, as well as increase the content of organic matter and crude protein
2. The use of fermented tofu pulp and coconut pulp with a fermentation time duration of 48 hours has a real influence on the content of dry matter, organic matter and protein.
3. The use of fermented tofu pulp and coconut pulp significantly increases the nutrient content, so that it can be used as an ingredient in animal feed.

REFERENCES

1) Aome, Y., I. M. S. Aryanta., T. Dodu., & N. N. S. 2024. Kecernaan Bahan Kering Dan Bahan Organik Babi Grower Yang Diberi Ransum Mengandung Silase Limbah Sawi Putih (Brassica Pekinensia L). Journal Animal Science, 9(1), 20–24.
2) Armayanti, Andi Kurnia., N. Luthfi., S. Nuraliah., S. Faradila., Khaeruddin., A. Prima., H. F. Suryani., N. E. Wati., Ibrahim., A. S. Indah., N. Ali., I. Susanti., & R. N. U. 2023. Nutrisi Ternak Dasar Dinamika Teori Dan Perkembangannya (1st Ed.). Sonpedia Publishing Indonesia.
3) Chassé, É., Guay, F., Bach Knudsen, K. E., Zijlstra, R. T., & Létourneau-Montminy, M.-P. 2021. Toward Precise Nutrient Value Of Feed In Growing Pigs: Effect Of Meal Size, Frequency And Dietary Fibre On Nutrient Utilisation. Animals : An Open Access Journal From Mdpi, 11(9). Https://Doi.Org/10.3390/Ani11092598
4) Chojnacka, K., Mikula, K., Izydorczyk, G., Skrzypczak, D., Witek-Krowiak, A., Gersz, A., Moustakas, K., Iwaniuk, J., Grzędzicki, M., & Korczyński, M. 2021. Innovative High Digestibility Protein Feed Materials Reducing Environmental Impact Through Improved Nitrogen-Use Efficiency In Sustainable Agriculture. Journal Of Environmental Management, 291, 112693.
5) Foidl N, Makkar Hps, B. K. 2017. The Potential Of Moringa Oleifera For Agricultural And Industrial Uses. October 20 Th- November 2nd 2001.
6) Indartono, A. S. 2021. Momentum Pengembangan Bahan Pakan Lokal Indonesia. Majalah Agropustaka. 2021, Edisi 325.
7) Jha, R., Fouhse, J. M., Tiwari, U. P., Li, L., & Willing, B. P. 2019. Dietary Fiber And Intestinal Health Of Monogastric Animals. Frontiers In Veterinary Science, 6(Mar), 1–12. Https://Doi.Org/10.3389/Fvets.2019.00048
8) Kantja, I., Nopriani, U., & Pangli, M. 2022. Uji Kandungan Nutrisi Tepung Daun Kelor (Moringa Oleifera L) Sebagai Pakan Ternak. Jurnal Riset Rumpun Ilmu Hewani, 1, 1–7. Https://Doi.Org/10.55606/Jurrih.V1i1.145
9) Koroh, Veronika., Johanis Ly., & S. S. 2019. Pengaruh Penggunaan Berbagai Jenis Konsentrat Dalam Pakan Berbasis Pollard Terhadap Konsumsi Dan Kecernaan Protein Dan Energi Ternak Babi Fase Starter-Grower. Jurnal Peternakan Lahan Kering, 1(4), 518–529.
10) Kurz, A., & Seifert, J. 2021. Factors Influencing Proteolysis And Protein Utilization In The Intestine Of Pigs: A Review. Animals, 11(12), 1–16.
11) Li, Qingyun., &, & Patience, J. F. 2017. Factors Involved In The Regulation Of Feed And Energy Intake Of Pigs. Animal Feed Science And Technology, 233, 22–33. Https://Doi.Org/Https://Doi.Org/10.1016/J.Anifeedsci.2016.01.001
12) Ly, J., K. N. H. G. 2014. Pengaruh Suplementasi Saccharomyces Cerevisiae Sebagai Probiotik Dalam Pakan Berbasis Pakan Lokal Terhadap Performan Dan Kecernaan Nutrisi Pada Babi Lokal Fase Starter. Jurnal Kajian Veteriner, Vol. 2 No., 111–118.
13) Ly, J., Sjofjan, O., Djunaidi, I., & Suyadi, S. 2017. Effect Of Supplementing Saccharomyces Cerevisiae Into Low Quality Local-Based Feeds On Performance And Nutrient Digestibility Of Late Starter Local Pigs. Journal Of Agricultural Science And Technology A, 7. Https://Doi.Org/10.17265/2161-6256/2017.05.006
14) Moi, M. A. 2019. Pengaruh Penggunaan Konsentrat Sierad Dalam Pakan Lokal Terhadap Konsumsi Dan Kecernaan Protein Dan Energi Pada Ternak Babi Pernakan Landrace. Thesis.Universitas Nusa Cendana.
15) Moyo, B., Masika, P. J., Hugo, A., & Muchenje, V. 2016. Nutritional Characterization Of Moringa (Moringa Oleifera Lam.) Leaves. African Journal Of Biotechnology, 10(60), 12925–12933. Https://Doi.Org/10.5897/Ajb10.1599
16) Ndolu, D. J., Sabarta, Sembiring., N. N. Suryani., & D. A. Nguru. 2024. Ternak Babi Grower The Effect Of Using Chinese Cabbage Waste Silage (Brassica Pekinensia L) On The Comsumption And Digestibility Of Energy And Protein In Grower Pigs. 10(April), 55–64.
17) Nggadas, Leonardus Rizaldus., N. N. Suryani., & W. M. Nalley. 2023. Pengaruh Penggunaan Campuran Tepung Daun Kelor (Moringa Oleifera) Dan Tepung Daun Katuk (Sauropus Androgynus L . Merr) Dalam Ransum Terhadap Konsumsi Dan Kecernaan Protein Kasar Dan Energi Ternak Babi Fase Starter - Grower. Jurnal Peternakan Lahan Kering, 5(3), 359–367.
18) Nguru, A. D., S. M. F. Telupere., & E. D. W. Lawa. 2022. Effects Of The Use Of Fermented Gamal Leaf Flour As A Concentrate Substitute On Performance Of The Landrace Breeding Pigs. Jurnal Sain Peternakan Indonesia, 17(2), 91–96. H
19) Nouman, W., Basra, S. M. A., Siddiqui, M. T., Yasmee, A., Gull, T., & C. A. M. A. 2015. Potential Of Moringa Oleifera

L. As Livestock Fodder Crop: A Review. Turk. J. Agric, 38 (1): 1-.

20) Parisi, G., Tulli, F., Fortina, R., Marino, R., Bani, P., Dalle Zotte, A., De Angelis, A., Piccolo, G., Pinotti, L., Schiavone, A., Terova, G., Prandini, A., Gasco, L., Roncarati, A., & Danieli, P. P. 2020. Protein Hunger Of The Feed Sector: The Alternatives Offered By The Plant World. Italian Journal Of Animal Science, 19(1), 1204–1225.
21) Pexas, G., Doherty, B., & Kyriazakis, I. 2023. The Future Of Protein Sources In Livestock Feeds: Implications For Sustainability And Food Safety. Frontiers In Sustainable Food Systems, 7(September), 1–13. Https://Doi.Org/10.3389/Fsufs.2023.1188467
22) Poluan, Wenny R., Petrus R.R. I. Montong., Jantje F. Paath., & V. R. R. 2016. Pertambahan Berat Badan, Jumlah Konsumsi Dan Efisiensi Penggunaan Pakan Babi Fase Grower Sampai Finisher Yang Diberi Gula Aren (Arenga Pinnata Merr) Dalam Air Minum. Zootec, 37(1), 50. Https://Doi.Org/10.35792/Zot.37.1.2017.14213
23) Prawitasari, R. H., V. D. Y. B. Ismadi., & I. E. 2018. Digestivity Of Crude Protein And Fiber And Digesta Rate In Arabic Chicken Feeded With Various Levels Azolla Microphylla. Animal Agriculture, 1(1), 471–483.
24) Rengo, A. F. 2021. Pengaruh Pemberian Ekstrak Daun Kelor (Moringa Oleifera Lam) Difermentasi Dengan Em-4 Pada Liquid Feeding Terhadap Kecernaan Energi Dan Protein Pada Babi Starter Peranakan Duroc. Thesis. Universitas Nusa Cendana.
25) Rumlaklak, Eklo Helmyana., Sabarta, Sembiring., & T. D. 2023. Pengaruh Suplementasi Jenis Dedaunan Terfermentasi Terhadap Kecernaan Protein Dan Energi Ternak Babi Fase Starter-Grower. Jurnal Peternakan Lahan Kering, 5(2),194–201.
26) Saina, Yohana Monita., Johanis Ly., Tagu Dodu., & I. M. S. Aryanta. 2020. Pengaruh Penggunaan Tepung Krokot (Portulaca Oleracea L.) Dalam Ransum Terhadap Konsumsi Dan Kecernaan Protein Dan Energi Ternak Babi Peranakan Landrace Fase Grower – Finisher. Jurnal Peternakan Lahan Kering, 2(2), 812–818.
27) Sembiring, Sabarta., P. Trisunuwati., O. Sjofjan., & I. D. 2020. Pemberian Tepung Bonggol Pisang Kepok Fermentasi Dalam Pakan Ternak Babi Fase Grower Dan Efeknya Terhadap Kecernaan Nutrien. Jurnal Nukleus Peternakan, 7(1), 6–13.
28) Sijung, M. D., I M. S. Aryanta., N. N. Suryani., & T. Dodu. 2020. "Pengaruh Suplementasi Larutan Daun Kelor (Moringa Oleifera L.) Dalam Liquid Feeding Terhadap Kecernaan Energi Dan Protein Ternak Babi Fase Grower-Finisher." Jurnal Peternakan Lahan Kering, 2(3), 910–918.
29) Sinaga, S. Dan S. M. 2011. Pengaruh Pemberian Berbagai Dosis Curcurminoid Pada Peranakan Babi Landrace. Jurnal Ilmu Ternak, 10(2), 95–110.
30) Sjofjan, Osfar., M. H. Natsir., Siti Chuzaemi., & H. 2019. Ilmu Nutrisi Ternak Dasar. Ub Press, Malang. Ub Press.
31) Sudradjat., & Lilis, R. 2019. Nutrisi Dan Pakan Ternak. In Buku Ajar. Kementerian Pertanian.
32) Sukria, H. A., Nugraha I., & S. D. M. 2018. Pengaruh Proses Steampada Daun Kelor (Moringa Oleifera) Dan Asam Sulfat Terhadap Performa Ayam Broiler. Jurnal Ilmu Nutrisi Dan Teknologi Pakan, 16(2), 1–9.
33) Suryana, I. K. A., Mastika, I. M., Dan Puger, A. W. 2014. Pengaruh Tingkat Protein Ransum Terhadap Penampilan Ayam Kampung Umur 22-23 Minggu. Jurnal Peternakan Tropika, 2(2), 287–296.
34) Suryani, Ni Nengah., I Made S. Aryanta., & T. D. 2021. Efisiensi Pakan Dan Kualitas Karkas Babi Yang Mendapat Suplementasi Larutan Daun Kelor (Moringa Oleifera Lam) Dalam "Liquid Feeding." Jurnal Nukleus Peternakan, 8(1), 6–13.
35) Tamawiwy, Alfred., M. Najoan., J. S. Mandey., & F. N. S. 2015. Pengaruh Penggunaan Virgin Coconut Oil (Vco) Dalam Ransum Terhadap Performans Ternak Babi Fase Starter. Zootec, 35(2), 86. Https://Doi.Org/10.35792/Zot.36.1.2016.9986
36) Tatuin, Krisantus Efren., S. Sembiring., & N. N. S. 2022. Pengaruh Penggunaan Campuran Tepung Daun Kelor (Moringa Oleifera) Dan Tepung Daun Katuk (Sauropus Androgynus L. Merr) Dalam Ransum Terhadap Konsumsi Dan Kecernaan Protein Dan Energi Ternak Babi Fase Grower. Jurnal Peternakan Lahan Kering.
37) Tillman, A. D., Hari Hartadi., Soedomo Reksohadiprodjo., Soeharto Prawirokusumo., A. S. L. 1. 1998. Ilmu Makanan Ternak Dasar. Gadjah Mada University Press.
38) Tulung, C., J. F. Umboh., F. N Sompie., & C. J. P. 2015. Pengaruh Penggunaan Virgin Coconut Oil (Vco) Dalam Ransum Terhadap Kecernaan Energi Dan Protein Ternak Babi Fase Grower. Jurnal Zootek, Vol. 35 No, 319 – 327.
39) Tulung, L. R Yohannis., A. F. Pendong., J. J. M. Londok., C. A. Rahasia., & S. A. E. M. 2022. Ilmu Nutrisi Ternak Dan Pengetahuan Bahan Pakan (1st Ed.). Patra Media Grafindo.
40) Umboh, J. F., Pontoh, C. J., & Rahasia, C. A. 2017. Pengaruh Substitusi Dedak Halus Dengan Tepung Kulit Buah Kopi Dalam Ransum Terhadap Kecernaan Energi Dan Protein Pada Ternak Babi Fase Grower. Zootec Journal, 37(2),199–206.
41) Usfinit Tolanta Desly., Sabarta Sembiring., & I. M. S. A. 2019. Pengaruh Penggunaan Konsentrat Sierad Dengan Pakan Lokal Terhadap Performan Dan Income Over Feed Cost Ternak Babi Peranakan Landrace. Peternakan Lahan Kering, 1(3), 355–364.
42) Wenda, D., M. Hubeis., & N. H. P. 2019. Strategi Pengembangan Pasar Usahatani Pembesaran. Manajemen Ikm, 14(2), 160–168.