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The Evaluation of Fiber Fraction Content of Oil Palm Frond Fermented by Local Bio Activators Rumen Content As Ruminant Feed

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ABSTRACT.

This study aims to evaluate the fiber fraction content of oil palm fronds fermented using a local bio activator of rumen content with different incubation times as ruminant feed. The design used in this study was factorial in a 2 x 3 with 3 replications for each treatment. In factor A there was a type of bio activator A1 (Lactic Acid Bacteria) A2 (Crude Enzyme) while in factor B there was an incubation period of 0 days, 7 days, and 14 days. The parameters were the fiber content of oil palm fronds. There were NDF, ADF, Cellulose, and Hemicellulose. The results showed that fermentation based on local bio activators of livestock waste can reduce lignin content so that it will increase nutrient digestibility. The best results were in fermentation with a source of bioactivator in the rumen with an incubation period of 7 days.

Keywords*: palm leaf and midrib, fiber fraction, and local bio activator.*

INTRODUCTION

Oil palm fronds are one of the wastes of oil palm plantations that have the potential to be used as an alternative feed to replace grass. Waste generated from oil palm plantations is abundant in production, does not compete with human needs, and its utilization is not optimal (Azmi and Gunawan, 2005). Each oil palm can be harvested in 22 pieces/year. Oil palm fronds produced each time of harvest are 1-3 fronds per tree, which has a large enough potential to be used as ruminant pieces/year

animal feed, oil palm fronds that are produced can reach 40-50 fronds/tree/year with a frond weight of 4.5 kg dry weight per stem. One hectare of oil palm is estimated to produce 6400-7500 fronds per year (Hanafi, 2004).

Utilizing oil palm fronds as animal feed, it is necessary to find a processing method that is easy to do, inexpensive, does not pose a risk to

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environmental digestion, and is applicable in the field. According to Winarno et al, (1986), fermentation can change materials containing protein, carbohydrates, and fats to be more easily digested, because fermentation aims to improve the quality of food substances by activating the growth and metabolism of remodeled microorganisms to form new products. Anaerobic fermentation can increase lactic acid and enzymes that can increase the digestibility of livestock forage. Nutrients content of oil palm leaves are dry matter 48.78%, crude protein 5.3%, hemicellulose 21.1%, cellulose 27.9%, crude fiber 31.09%, ash 4.48%, BETN 51.87%, lignin 16.9% and silica 0.6% (Imsya, 2007). Oil palm fronds containing ADF 64,03%, NDF 76,44%, Cellulose 45,44%, Hemicellulose 12,41%, and lignin 15,34%, without treatment (Astuti et al, 2019).

The low content of crude protein, high content of fiber, and lignin content of oil palm fronds require treatment of feed technology before being used as forage for animal feed. Fermentation technology using bio activators is widely used to improve the quality of animal feed. Bio activators are materials that contain living compounds, generally beneficial microorganisms, which can affect improving the quality of a material. Bioactivators can be produced from waste materials that are widely available in the surrounding environment with low production effects. Probiotics containing lactic acid bacteria (LAB) have the potential to be developed as animal feed bio activators because they are a group of bacteria capable of converting carbohydrates (glucose) into lactic acid, having antagonistic properties against pathogenic bacteria.

This research is a series of experimental processes to utilize palm fronds as feed ingredients using a rumen content-based bioactator. The contents of the rumen are mixed with several industrial by-products as the expected source of energy and enzymes. Then only lactic acid bacterial species will be isolated from the incubation of the rumen contents to be used as an activator to improve the nutritional quality of the palm fronds.

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MATERIALS AND METHODS

Research Material

The materials used in this study were rumen cattle contents, molasses, soybean soaking water, palm fronds, and several chemicals to measure enzymes.

a. Bio activator Production Process

The contents of the beef rumen from the abattoir and put into a jar, then added with tofu soaking water, and molasses, mixed well in a ratio of 1: 1: 8, and 10% of the fronds and palm leaves that have been mashed. All ingredients in jars were incubated for 10 days.

b. Crude Enzyme Production Process

Rumen bioactator that has been incubated for 10 days, then centrifuged for ± 15 minutes at 10,000 RPM to separate the remaining materials that are not needed.

c. Probiotic production process

The rumen contents bioactator that had been previously incubated was then isolated from lactic acid bacteria only on broth media using the plate pouring method.

d. Lactic acid bacteria purification process

e. Rumen contents activator that had been previously incubated was then isolated and with length incubation of 0, 7, and 14 days.

urified by lactic acid bacteria only on broth media, using the pour plate method. Lactic Acid Bacteria Purification Process: Extracts of 100 ml of bioactator were taken, and 10 test tubes were taken, each containing 9 ml of distilled water. 1 ml of the bioactator was taken and put into the 1st test tube (10^{1}), then vortexed to homogenize, then 1 ml of the 10^{1} solution was taken, and transferred to the 2nd test tube. (10^{2}), continued until a dilution of 10^{10}. The 10^{10} dilution solution was pipetted in 1 ml, then put into a sterile petri dish. Add 15 ml Mann Rogose Sharpe (MRS) broth that has been cooked, and has been sterilized. Incubation 1 x 24 hours at 37 ^{o} C in incubator (A). Prepare 500 ml of MRS Broth Media, and sterilize by autoclave for 30 minutes. Scratch the bacteria that grow on dish A, then put it into the MRS Broth media. Incubate for 2x24 hours at 37^{o}C, then observe the formation of a milky white precipitate.

f. Fermentation of palm fronds using lactic acid bacteria and crude enzymes

Research methods

This study used a randomized block design in a 2 x 3 factorial pattern with 3 replications for each treatment used in this study.

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Factor A was the types of bioactivator: A1=Lactic Acid Bacteria dan A2= Crude Enzyme.

Factor B was lenght incubation :

B1 = 0 Days, B2 = 7 Days, and B3 = 14 Days

The parameters observed were the content of fiber fraction, including the content of ADF, NDF, Lignin, cellulose, and hemicellulose. If the results of the study produce a significant difference ($P < 0.05$), then it will be tested further using Duncan's multiple distance test.

RESULTS AND DISCUSSION

Average data from fiber fraction analysis using the van Soest method is shown in table 1.

Table 1. The average content of fiber fraction of fermented oil palm fronds Using by Rumen Content Bio activator

FACTOR B	FACTOR B (Length Incubation) (Days)			Average
	0	5	10	
ADF (%)				
Lactic acid bacteria	46.89 ^{bB}	54.92 ^{aA}	52.12 ^{aA}	51.31
Crude Enzymes	56.73 ^{aA}	40.72 ^{cB}	51.35 ^{bA}	49.60
Average	51.81	47.82	51.74	SE = 1.3
NDF (%)				
Lactic acid bacteria	58.16 ^{cB}	67.44 ^{aA}	66.92 ^{bA}	64.17
Crude Enzymes	67.28 ^{aA}	53.86 ^{bB}	66.27 ^{aA}	62.47
Average	62.72	60.65	66.59	Se=1.4
Cellulose (%)				
Lactic acid bacteria	27.57	30.65	31.15	29.79
Crude Enzymes	27.78	30.22	30.73	29.58
Average	27.68b	30.44a	30.94a	SE=0.29
Hemicellulose (%)				
Lactic acid bacteria	11.26	12.52	14.80	12.86
Crude Enzymes	10.55	13.14	14.92	12.87
Average	10.91 ^{c}	12.83 ^{b}	14.86 ^{a}	
Lignin (%)				
Lactic acid bacteria	13.25	11.43	10.51	11.73
Crude Enzymes	13.14	12.59	10.84	12.19

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Average	13.20 [a]	12.01 [b]	10.68 [b]	SE=0.344

Note: The superscripts (a,b, c) in the same row and (A, B) in the same column showed significantly effects (P<0.05)

Content of Acid Detergent Fiber (ADF)

The variance analysis showed the interaction of a significant effect (P < 0.05) between length incubation and the type of rumen content bio activator on ADF content oil palm fronds fermented. This shows that the metabolic process carried out by microorganisms is influenced by the length of incubation on the oil palm fronds as a substrate in this study. Microorganisms need optimal time to degrade fiber content. Further test using Duncan's Multiple Range Test. Oil palm frond fermentation using lactic acid bacteria had significantly higher ADF content at 5 and 10 days of incubation compared to no incubation (0 days), and 5 days of incubation was significantly different from 10 days of incubation (47.82 Vs 51.74%), it is suspected that this is due to an increase in lignocellulose activity by enzymes produced by microbes that leave a lignin fraction so that ADF levels are high. The content of ADF describes the quality of the cell wall of a material, which consists of cellulose and lignin.

Content of Neutral Detergent Fiber (NDF)

NDF is a food substance that insoluble in neutral detergents and NDF the largest part of the cell wall plants. The results of the variance analysis show the interaction effect was significantly different (p<0.05) between the types of bio activator rumen content and the length of incubation on the NDF content of fermented oil palm fronds. This is because microorganisms in degrading fiber require an appropriate length of incubation based on the type of host substrate. Further test with DNMRT showed that fermented oil palm fronds using lactic acid bacteria at an incubation period of 5 days had a different affected on NDF content at an incubation period of 0 days (without incubation) and incubation for 10 days. Meanwhile, the fermentation of palm fronds using crude enzymes was able to reduce the NDF content of the oil palm fronds as much as 19.95% at 5 days incubation, and when increased the lenght incubation up 10 days, the NDF content of the palm fronds increased again as much as 23.04%. Table 1 shows that incubation of oil palm fronds using crude enzymes had

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NDF content which was not significantly different between 0 and 10 days incubation. This shows that each type of microbe has a different optimal growth time, so that if it has passed the optimal growth time, it will give fermentation results that are not expected anymore. Van Soest (1994) stated that microbial enzymes besides being able to reduce NDF levels can also crack the remaining structure so that the structure can be fermented more quickly. Crampton and Haris (1969) stated that decreased levels of NDF is caused by an increase in lignin in plants causing decrease in hemicellulose.

Content of Cellulose, Hemicellulose, and Lignin

The analysis of diversity showed that the interaction between the types of rumen content bio activators, lactic acid bacteria, and crude enzymes showed no significant interaction effect on the incubation dose ($p>0.05$) on the cellulose, hemicellulose, and lignin content, but the effect was significant ($p<0$ 0.05) on the incubation period of the palm fronds. Further tests using DNMRT showed that the cellulose and hemicellulose contents were significantly different between 0 days incubation (without incubation) and 5 and 10 days incubation. The highest content of cellulose and hemicellulose was at an incubation period of ten days. According to Said (1996), cellulose is rarely found in a pure state in nature but binds to other materials, namely lignin and hemicellulose. The cellulose content is also influenced by the ADF content of a material. The higher the ADF content, the higher the cellulose content. The average cellulose content of palm fronds in this study was 29.79 % (using lactic acid bacteria) and 29.58 % (using crude enzymes) which was higher than the study by Imsya and Palupi (2008) which fermented palm fronds with liquid substrate media with content cellulose by 23.21%. Lignin is a part of indigestible plants and is closely related to cellulose and hemicellulose with lignocellulose bonds. Lignin is not a carbohydrate. But often related to cellulose and hemicellulose.

Table 1 shows that the longer the incubation time, the lower the lignin content. It is suspected that in this local bio-activator solution, there are types of bacteria that produce ligninase enzymes that are able to break lignocellulosic bonds, causing the lignin content in the palm fronds to be lowered. Astuti et al (2022) rumen contents bio activator containing the enzyme laccase 15.91 U/ml, LiP 4.11 U/ml, and MnP 7.06 U/ml.

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CONCLUSION

Based on the results of this study, it can be concluded that the source of microbes or bio activator of livestock waste can be used as an inoculum to ferment palm fronds as ruminant animal feed, with an incubation period of 5 days. The best results were found in the fermented treatment of palm fronds and leaves using lactic acid bacteria isolated from the rumen contents with an incubation period of 5 days.

REFFERENCES

Alimon, AR 2005. The nutritive value of palm kernel cake for animal feeds. Palm Oil Developments, vol. 40. Malaysian Palm Oil Board, Kuala Lumpur, Malaysia, pp. 12–14.

Astuti, T. 2015. The effect of fermented oil palm fronds with local microorganisms based on waste of livestock on the content of fiber fraction as ruminant feeding). Proceeding: Seminar Nasional LPPM University of Jambi hal 218-223

Astuti, T., Rofiq, M.N., Nurhaita, Santoso, U., 2019. Analysis of fiber fraction of palm oil frond fermented with different microbes and soluble carbohydrates addition as ruminant feeding. IOP Conf. Ser. Earth Environ. Sci. 347 (1). https://doi.org/10.1088/1755-1315/347/1/012059.

Astuti T, Syahro A. Akbar , Muhammad Nasir R , Novirman Jamarun , Nurul Huda , Ahmad Fudholi . 2022. Activity of cellulase and ligninase enzymes in a local bioactivator from cattle and buffalo rumen contents. Journal. Volume 45, October 2022, 102497.

Azmi and Gunawan. 2005. Utilization of Palm Oil Midrib and Solid for Beef Cattle Feed. Proceedings of the National Seminar on Animal and Veterinary Technology. Center for Livestock Research and Development, Bogor.

Blanchette RA, KR Cease and AR Abad. 1991. An evaluation of different forms of deterioration found in archaeological wood. Int Biodeter. 28:3–22

Bonnarme. P and TW Jeffries. 1990. Mn(II) regulation of lignin peroxidases and manganese-dependent peroxidases from lignin-degrading white rot

fungi. Environ Microbiol App. 56(1):210–217.

Hanafi, D. N. 2004. Keragaman Pastura Campuran pada Berbagai Tingkat Naungan dan Aplikasinya pada LahanPerkebunan Kelapa Sawit. Disertasi Pasca

Ishida, M and OB Hassan. 1997. Utilization of oil palm frond as cattle feed. JARQ 31 (1) : 41 – 47.

Kung Jr, L., CC Taylor, MP Lynch, and JM . nylon. 2003. The effect of treating alfalfa with Lactobacillus buchneri 40788 on silage fermentation, aerobic stability, and nutritive value for lactating dairy cows. J. Dairy Sci. 86: 336 – 343.

Purba, A., SP Ginting, Z. Poeloengan, K. Simanihuruk and Junjungan. 1997. Nutritional value and benefits of oil oil palm fronds as animal feed. . J. Oil Palm Research. 5(3): 161 – 170.

Said, EG 1996. Handling and Utilization of Palm Oil Waste. Trubus Agriwidya. cet. 1 Ungaran

Simanihuruk. K, Junjungan and Ginting SP 2008. Utilization of oil oil palm fronds silage as basal feed for peanut goats in the growth phase. National Seminar on Animal Husbandry and Veterinary Technology. pp. 446-455.

Steel, RGD and JH Torrie, Principles and Procedures of Statistics, McGraw-Hill Book Co. Inc. New York. 1991.

Taherzadeh, MJ, 1999. “Ethanol from Lignocellulose: Physiological Effects of Inhibitors and Fermentation Strategies”.

Weinberg, ZG, O. Shatz, Y. Chen, E. Yosef, M. Nikbahat, D. Ben-Ghedalia, and J. Miron, 2007. Effect of Lactic Acid Bacteria Inoculants on In Vitro Digestibility of Wheat and Corn Silages. J. Dairy Sci. 90:4754–4762.

Winarno FG, S. Fardiaz and D. Fardiaz. 1986. Introduction to Food Technology. PT. Gramedia, Jakarta.

Zheng. L., Du Y. and Zhang J. 2003. Degumming of ramie fiber by alkalophilic bacteria and their polysacaride-degrading enzyme. Bioresour Technology 78 (l): 89-94.