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Evaluation of Crude Fat, Crude Fiber, and Gross Energy Content of Palm Kernel Meal Fermented with EM-4 (Effective Microorganisms-4) at Different Fermentation Durations

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ABSTRACT

This research aims to determine the effect of fermentation time for palm kernel meal using EM-4 (Effective Microorganism-4) on the crude fat, crude fiber, and gross energy contents. This is clear, but you might add a location like "in Padang, Indonesia" for an international audience. The treatments were as follows: P0 (no fermentation), P1 (fermentation for 7 days), P2 (fermentation for 14 days), and P3 (fermentation for 21 days). The parameters measured included the crude fat, crude fiber, and gross energy contents. Based on the results, it can be concluded that the fermentation time of palm kernel meal using EM-4 significantly affects ($P<0.01$) the crude fiber content but does not significantly affect ($P>0.05$) the crude fat content or the gross energy of the palm kernel cake palm kernel.

Keywords: Palm Kernel Meal, Effective Microorganisms-4, Fermentation, Crude Fiber, Crude Fat, Gross Energy

INTRODUCTION

Factors affecting production include feed usage, which significantly contributes to production costs (Utomo & Widjaja, 2004). Feed accounts for the largest proportion of total production costs, approximately 70-80% (Wahyu, 1997). Improving feed efficiency is expected to reduce production expenses. The optimal utilization of local agricultural feed ingredients or their by-products is anticipated to lower feed costs. Therefore, efforts are needed to identify alternative feed sources that are affordable, readily available, of good quality, and do not compete with human needs. One such alternative is palm kernel meal (PKM), a by-product of palm kernel oil production.

Indonesia is the largest producer of crude palm oil (CPO), followed by Malaysia and Thailand. The area of oil palm plantations in Indonesia was approximately 8,992,824 hectares in 2011, with CPO production amounting to 23,096,541 tons. By 2015, this production increased to 31,070,015 tons (Ditjenbun, 2017). Palm kernel meal (PKM) is considered potentially useful as livestock feed due to its availability and nutritional content. According to Harnentis et al. (2005), PKM contains 7.17% crude fat, 34.10% cellulose, 28.15% hemicellulose, 62.25% neutral

detergent fiber (NDF), and 34.10% acid detergent fiber (ADF). The metabolizable energy content of PKM ranges between 1817-2654 kcal/kg (Ezieshi & Olomu, 2007). PKM can be treated physically, chemically, and biologically (Ramli et al., 2008).

To enhance its quality as animal feed, appropriate processing is required. One alternative for improving PKM is through fermentation, and Effective Microorganisms-4 (EM4) can be used for this purpose. Fermentation is a process where complex chemical compounds are broken down into simpler ones through microbial metabolism (Suprihatin, 2010). The bioconversion of oil palm plantation waste substrates via fermentation offers an attractive and beneficial alternative for developing raw materials for poultry feed. Efforts to improve nutritional quality, reduce or eliminate negative effects of certain feed ingredients can be achieved using microorganisms through the fermentation process, which can also increase digestibility (Saono, 1976; Jay, 2005), enhance taste and aroma, and elevate the content of vitamins and minerals. Additionally, the fermentation process produces hydrolytic enzymes and makes minerals more absorbable by livestock (Esposito et al., 2011). The quality of the fermented product depends on the type of microbes, dosage, fermentation duration, and the medium used.

The fermentation process can minimize anti-nutritional factors and increase the digestibility of high-fiber feed ingredients, such as rice bran, according to Sukaryana et al. (2011). The method to reduce crude fiber in rice bran includes fermentation using EM4 liquid probiotics, which predominantly contain photosynthetic bacteria (Rhodopseumonas spp), lactic acid bacteria (Lactobacillus spp), and yeast (Saccharomyces spp), which are beneficial for livestock growth and production. Effective Microorganisms-4 (EM4) is one of the microbial solutions used for PKM fermentation. EM4 contains various bacteria such as decomposers, Lactobacillus sp., lactic acid bacteria, photosynthetic bacteria, Streptomyces, cellulose-decomposing fungi, and phosphate-solubilizing bacteria that naturally break down organic matter (Akmal, 2004). Mangisah et al. (2009) reported that the fermentation process using EM4 microbes can increase digestibility, enhance taste and aroma, and increase vitamin and mineral content. Santoso and Kurniati (2000) stated that EM4 is capable of reducing crude fiber in fermented laying hen manure.

Based on the aforementioned issues, the problem statement is: How does the composition of crude fat, crude fiber, and gross energy in PKM change when fermented with EM4. The objective of this research is to determine the effect of fermentation duration on the crude fat, crude fiber, and gross energy content of PKM fermented with EM4.

MATERIALS AND METHODS

This research was conducted at the Livestock Biotechnology Laboratory of Andalas University from June 1, 2021, to August 10, 2021. It is an experimental study using palm kernel meal (PKM) obtained from a poultry shop, with 1600 grams of PKM fermented using Effective Microorganism-4 (EM-4).

The materials used in this study include 1600 grams of PKM obtained from a poultry shop, EM-4, 0.3 N H_2SO_4, 1.5 N NaOH, distilled water, acetone, Buchner funnel pump,

and molasses. The equipment used for this research includes an autoclave, polypropylene plastic bags (15x25 cm), an electric oven, an analytical balance, an incubator, spatulas, cotton, beakers, and a set of laboratory equipment for proximate analysis.

The research method employed is an experimental method using a completely randomized design with 4 treatments and 4 replications. The treatments are as follows:

P0: PKM without fermentation

P1: PKM fermented for 7 days

P2: PKM fermented for 14 days

P3: PKM fermented for 21 days

RESULTS AND DISCUSSION

Effect of Fermentation Duration of Palm Kernel Meal Using Effective Microorganism-4 (EM4) on Crude Fat Content

The average crude fat content of palm kernel meal (PKM) fermented with EM4 for different durations—unfermented, 7 days, 14 days, and 21 days—can be seen in Table 3.

Table 1. The Average content of Crude Fat, Crude Fibre, and Gross Energy of Palm Kernel Meal Fermented Using EM4 (%)

Treatments	Crude Fat	Crude Fiber	Gross Energy (kcal/kg)
P0 = Unfermented	5.94	51.37a	3914.61
P1 = Fermented for 7 days	6.90	37.60b	3489.57
P2 = Fermented for 14 days	6.49	30.37c	3877.59
P3 = Fermented for 21 days	5.78	29.15c	3684.62

Note: Note: Different superscripts in the same column indicate very significant differences (P<0.01).

Base on Table 1, it can be seen that the highest average crude fat content is in P1 = 6.90%, followed by P2 = 6.49%, P0 = 5.94%, and P3 = 5.78%. Variance analysis indicates that PKM fermented with EM-4 shows no significant difference (P>0.01) in crude fat content, suggesting that the duration of fermentation does not affect the crude fat content of PKM. The lack of significant difference is also attributed to the consistent 40 ml dose of EM4 across all treatments, which does not affect the crude fat content in fermented PKM. This implies that EM4 in this study has not been able to optimize nutrient substances, so the bacteria in EM4 cannot digest fat.

Effect of Fermentation Duration of Palm Kernel Meal Using Effective Microorganism-4 (EM4) on Crude Fiber Content.

The average crude fiber content of PKM fermented with EM4 for different durations—unfermented, 7 days, 14 days, and 21 days—can be seen in Table 4.

From Table 1, it can be seen that the highest average crude fiber content is in P0 = 51.37%, followed by P1 = 37.60%, P2 = 30.37%, and P3 = 29.14%. Variance analysis indicates that PKM fermented with EM4 shows very significant differences (P<0.01) in crude fiber content. The significant differences in crude fiber content are due to the varying fermentation durations of PKM—unfermented, 7 days, 14 days, and 21 days. It is suspected that longer fermentation duration increases the growth of microbes that utilize

some feed substances, including crude fiber, as substrates.

Effect of Fermentation Duration of Palm Kernel Meal Using EM4 (Effective Microorganism-4) on Gross Energy Content

The average gross energy content of PKM fermented with EM4 for different durations—unfermented, 7 days, 14 days, and 21 days—can be seen in Table 1.

Base on Table 1, it can be seen that the highest average gross energy content is in P0 = 3914.61 kcal/kg, followed by P2 = 3877.59 kcal/kg, P3 = 3684.62 kcal/kg, and P1 = 3489.57 kcal/kg. Variance analysis indicates that PKM fermented with EM4 shows no significant difference ($P>0.05$) in gross energy content, suggesting that the fermentation duration does not affect the gross energy content of PKM. The lack of significant difference in gross energy content is also attributed to the consistent 40 ml dose of EM4 across all treatments, which does not affect the gross energy content in fermented PKM. This implies that EM4 in this study has not been able to optimize nutrient substances, so the bacteria in EM4 cannot digest fat into simple sugars, i.e., energy, resulting in no significant difference in gross energy content.

CONCLUSION

The results of this study can be concluded that the fermentation duration of palm kernel meal using EM4 significantly affects ($P<0.01$) crude fiber content but shows no significant effect ($P>0.05$) on crude fat and gross energy content.

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