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Analysis of Crude Fiber and Crude Protein Fermented Corn Cob for Animal Feed

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ABSTRACT

Low productivity of ruminants due to many factors and one of them is lack of feed ingredients in quality and sustainable in quantity. One of sources can be an alternative feed ingredients that containing fibers as a substitute of grass is corn cobs which becoming other earnings of corn farmers. The aim of this research is going to determine the effect of using EM_4 on nutritional (contents of crude protein and crude fiber) fermentation quality of corncobs.

The experimental design used a Completely Randomized Design (CRD) with 4 treatments and 3 times replication, treatment J_0 = corncobs with no fermentation (control); J_1 = fermentation corncobs with EM_4 (500 ml); J_2 = corncobs fermented with EM_4 (700 ml); J_3 = fermentation corncobs with EM_4 (500 ml). Treatment effects was analyzed by analysis of variance (ANOVA) and followed by a test (DUNCAN) if only known there is a significant effect among the treatments.

The results showed that the lowest crude fiber content in treatment J_3 (38.41) and the highest in J0 (46.01) was significantly different with treatment J_1 (42.49) and J_2 (40.81). The Lowest of protein content is in treatment J0 (2.88) and the highest in J_3 (8:02) significantly different with treatment J_1 (3.65) and J_2 (4:27). The best treatment of this research is contained in fermented corn cob with EM_4 with the in 900 ml.

Keywords: *Crude fiber, Corncobs, EM_4 (Effektive Mikroorganisme$_4$), Fermentation, Protein,*

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INTRODUCTION

The introduction is a little different from the short and concise abstract. The reader needs to know the background to your research and, most importantly, why your research is important in this context (Auliani dkk., 2023; Mulyasari dkk., 2023; Wanti dkk., 2023). The purpose of the Introduction is to stimulate the Feed is one factor that is very important and very influential in increasing livestock production. Feed is very important for the success of a livestock business, because the cost of feed ranks first, production costs can reach 60% to 80%. Efforts to minimize feed costs can use alternative local feed ingredients that are non-conventional and do not compete with human needs, are cheap (Al Maarif dkk., 2023; Noer dkk., 2023; Utami dkk., 2023), but have sufficient nutritional content for livestock.

One sector that has not been widely utilized is agricultural waste. Waste is basically a material that is not reused as a result of human activities, or natural processes that do not yet have economic value, even having low economic value. It is said to have low economic value because waste can pollute the environment and its handling requires a large amount of money (Fadiyah dkk., 2023; Otto dkk., 2020). Utilization of waste is one alternative to increase the economic value of the waste. One of the agricultural wastes that can be utilized is corn plants, in the form of stems, leaves and corn cobs. Corn stalks and leaves are commonly used for cattle feed. Corn cobs have the potential to be developed as cattle feed, but this by-product has not been used optimally as a feed ingredient.

The main problem with the use of corn cobs as cattle feed is the high content of hard-to-digest crude fiber in the form of lignin and silica (Fiqih dkk., 2023; Hermansyah dkk., 2023). High lignin and silica levels result in low digestibility of corn cobs and limited consumption by livestock. So it is necessary to find a technology that can increase the nutritional value and digestibility. The development of corn postharvest technology in producing dry shelled corn has been able to produce by-products in the form of corn cobs with smaller particle sizes that allow them to be used as feed components. However, under these conditions, the nutritional value of corn cobs does not change, so another form of processing that can increase its nutritional value still needs to be done (Pamuji & Limei, 2023). One of the processing methods that can be carried out is the utilization of fermentation technology services using several existing microbes.

The research that has been carried out seeks to increase the nutritional value of fiber-sourced feed ingredients for sheep rations such as corn cobs which can be reached through biological processing using commercially available fermented microbes. According to Rachman (1989) fermentation is a process that involves microbial activity to obtain energy through the breakdown of substrates that are useful for metabolic and growth purposes so that it can cause changes in the properties of feed ingredients as a result of breaking down the nutrient content in these feed ingredients. It was further stated by Winarno et al., (1980) that the results of fermentation mainly depend on the substrate, the type of microbes and the surrounding conditions which will affect the

growth and metabolism of these microbes. In the fermentation process, microbes need a certain amount of energy for their growth and reproduction which will be obtained through the overhaul of nutrients in the substrate.

Fermented products usually have a higher nutritional value than the original material due to the presence of enzymes produced from the microbes themselves (Nicholas dkk., 2023). Chemical changes that occur in the substrate are caused by the activity of enzymes produced by these microbes which include changing complex molecules such as carbohydrates, proteins, and fats into simpler and easier to digest molecules. Efforts to improve the nutritional quality of corn cobs as animal feed using the fermentation method are expected to increase the crude protein content, reduce crude fiber and increase its digestibility (Azizah dkk., 2022; Putri dkk., 2023). Efforts to increase the nutritional value of corn cobs can be done by fermentation using EM_4.

Livestock EM_4 is an EM_4 culture in a yellowish-brown liquid medium which is beneficial for the growth and production of livestock with the characteristics of a sweet and sour smell. EM_4 livestock is able to improve microorganisms in the digestive tract of livestock so that livestock health will increase, not easily stressed and the smell of manure will decrease (Holly dkk., 2023; Levan's dkk., 2022; Saputra dkk., 2022). Giving livestock EM_4 to livestock feed and drink will increase appetite because of the sweet and sour aroma it creates. EM_4 livestock does not contain chemicals so it is safe for livestock. Corn cobs that have undergone fermentation using Aspergillus niger and Trichoderma viride are expected to increase their nutritional value and can be used as a substitute for conventional forages in complete rations to improve the production performance of fattened rams (Amrina dkk., 2022; Maryati dkk., 2022). In Indonesia, the processing of corn cobs for use as feed has not been done much. Therefore, the purpose of this study was to find the right corncob processing method to increase corncob nutrition, as well as to be used as animal feed.

RESEARCH METHODOLOGY

The research method used in this study was a Completely Randomized Design (CRD), with 4 treatments and 3 replications. The treatment in this study is as follows:

J_0 = Corncobs without fermentation (control).

J_1 = corn cob fermented with EM4 500 ml

J_2 = corn cob fermented with EM4 700 ml

J_3 = Corn cobs fermented with EM4 900 ml

Fermentation is carried out in plastic bags. The steps of the fermentation process are mashing the corn cobs into small pieces, then the corn cobs are weighed as much as 1 kg per experimental unit.

- First treatment of corn cobs without fermentation (control).
- The second treatment uses EM_4 which has been diluted as much as 500ml/kg plus rice bran 5% of the weight of the feed and molasses as much as 3% of the weight of the feed ingredient.

- The third treatment uses EM_4 which has been diluted as much as 700 ml/kg plus rice bran 6% by weight of feed and molasses 3% by weight of feed ingredients.
- The fourth treatment uses EM_4 which has been diluted as much as 900 ml/kg plus 6% rice bran by weight of feed and molasses 3% by weight of feed ingredients.
- Fermented for 2 weeks (14 days) in drums, then closed tightly.

To carry out the fermentation of corn cobs with the addition of EM_4 (Effective Microorganism 4) the method is as follows:

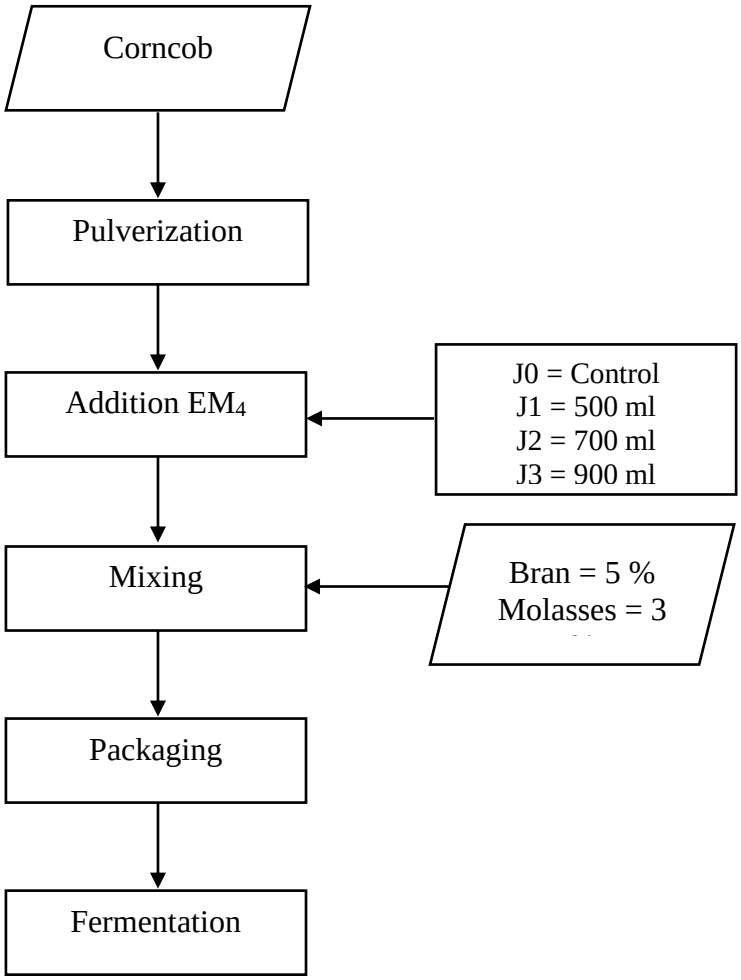

Figure 1. Flowchart

Determination of Crude Fiber (SNI 01-2891-1992)

- Weighing 2-4 grams of sample, freeing the fat by means of soxlet extraction or stirring, pouring the sample in an organic solvent.
- The sample is dried then put into a 500 ml Erlenmeyer.
- Add 50 ml of 1.25% H_2SO_4 solution, and boil for 30 minutes using an upright cooler.
- Add 50 ml of 3.25% NaOH and boil again for 30 minutes.

- The solution is filtered hot using a Buchner funnel containing ashless filter paper which has been dried and the weight is known.
- Washing of the precipitate on the filter paper successively with hot 1.25% H_2SO_4, hot water, and 96% ethanol.
  The filter paper is removed along with its contents, then put into a cup whose weight is known, dried at 105°C and cooled and weighed.

$$\%\ Coarse\ Fiber = \frac{A-B}{gr\ Sample}\ x\ 100\% \qquad (1)$$

Where :

A = cup + sample + filter paper
B = cup + filter paper

Crude Protein Determination

- Destruction stage
  - The sample is mashed, then weighed 2 grams, put into the Kjeldahl flask.
  - Add 2 catalyst tablets or 3.5 grams of catalyst mixture.
  - Add 15 ml of H_2SO_4 and 3 ml of H_2O_2 (let stand 10 minutes).
  - Destruction at 415°C.
  - Chill
- Distillation stage
  - The results of the digestion are added to 50-75 ml of distilled water.
  - Add 50 – 75 ml of NaOH.
  - Distillate, collect the distillate results with an Erlenmeyer containing 25 ml. 4% H3BO3 which has been added with indicator Methyl Red and Bromcresol green.
  - Perform distillation, until the distillate volume reaches 150 ml.
- Titration step
  - Titrate with 0.2 N HCl until the color changes from green to neutral gray
  - Perform blank work

Calculation:

$$Protein\ content = \frac{(VA - VB)HCl\ x\ NHCl\ x\ 14{,}007\ x\ 6{,}25\ x\ 100\%}{W\ x\ 1000} \qquad (2)$$

Where :

VA = milliliters of sample titrated HCl
VB = milliliters of HCl blank titration
N = HCl concentration used
14.007 = Atomic weight of nitrogen
6.25 = protein conversion factor in fish
W = sample weight

RESULT AND DISCUSSION

Coarse Fiber

The results of crude fiber measurements from various treatments can be seen in the following figure:

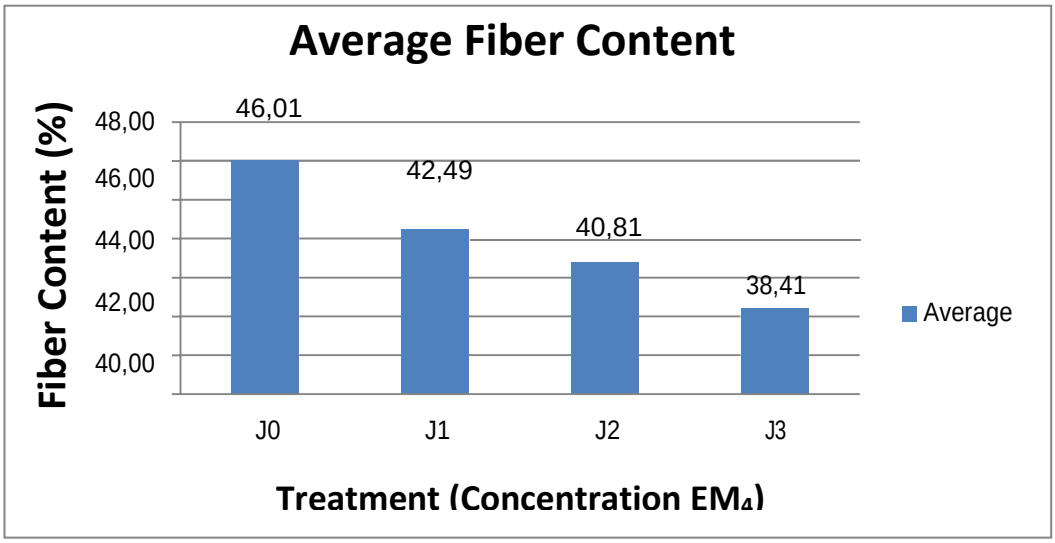

Figure 2. The average result of the corncob crude fiber test

Based on the results of a chemical analysis of the corn cob crude fiber test, the crude fiber from the J_0 (control), J_1, J_2, J_3 treatments had a significant decrease, the J_3 treatment had the lowest crude fiber content. This was influenced by the addition of high EM_4, so the more the higher the amount of EM_4 given, the lower the crude fiber produced. This is because the protein value of corn cobs increases, so indirectly the fiber value from corn cobs will decrease.

Crude fiber is the part of food that cannot be hydrolyzed by chemicals, which are used to determine the crude fiber content, namely sulfuric acid (H_2SO_4 1.25%) and sodium hydroxide (NaOH 1.25%). Crude fiber is food waste that has undergone a heating process with strong acids and strong bases for 30 minutes in the laboratory. With a process like this it can damage several kinds of fiber which cannot be digested by humans and it is impossible to know the chemical composition of each material that forms the cell wall. Therefore crude fiber lowers the estimated total fiber content by 80% for hemicellulose, 50-90% for lignin and 20-50% for cellulose. Measurement of crude fiber aims to determine the value of crude fiber produced from fermentation with several treatments, so that changes can be identified. Crude fiber in corn cobs is very high, resulting in less digestibility. So that the results of research on the nutritional value of crude fiber from corn cobs that have been carried out cannot be used in mixing feed, therefore it is necessary to carry out further research to reduce the nutritional value of crude fiber.

The results of analysis of variance for crude fiber showed that fermented corn cobs showed a direct effect of EM_4 concentration on corncob crude fiber, this can be seen from the F value of 52.874 and sig at F 0.00 (sig <0.05) meaning that the addition

of EM_4 to the cobs corn gave a significant effect on the corn cobs produced in each treatment. In Duncan's follow-up test, it can be seen that the J_0 treatment is very significantly different from the J_1, J_2, and J_3 treatments.

Proteins

The results of crude protein measurements from various treatments can be seen in the following figure:

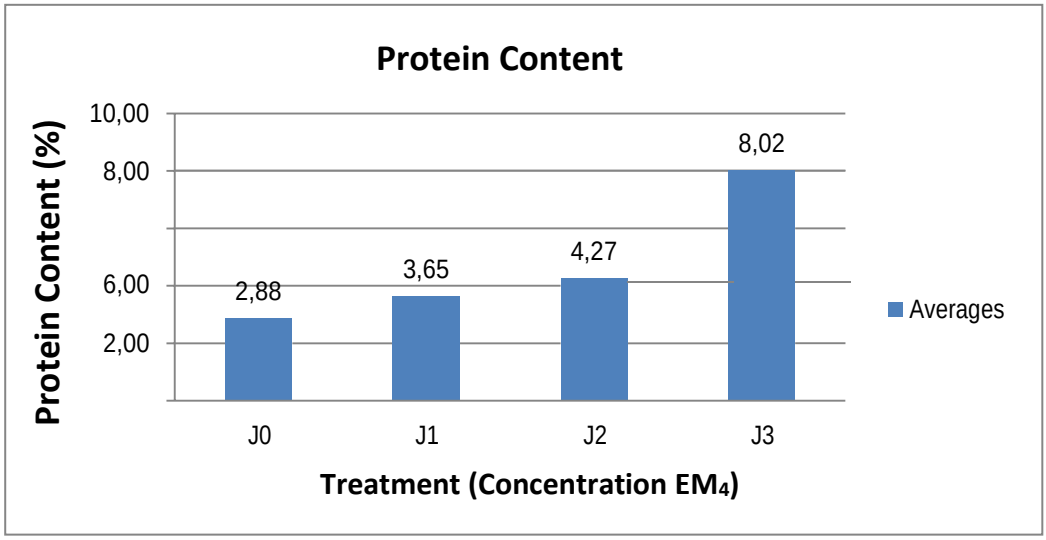

Figure 3. The average results of the corncob crude protein test

Measurement of crude protein aims to determine the value of crude protein produced from fermentation with several treatments, so that changes can be identified. Crude protein in corncobs is very low, resulting in very little protein requirement. So that the alternative that can be applied is that the results obtained can only be used as a mixed ingredient in animal feed (Fathia dkk., 2022; Saskia dkk., 2023, 2023). So that the need for protein for cattle feed can be in accordance with predetermined standards. Based on the results of chemical analysis of the corn cob protein test, it showed that crude protein from treatments J_0 (control), J_1, J_2, J_3 experienced a significant increase, treatment J_3 had the highest crude fiber content. This was influenced by the addition of high EM_4, so the higher the amount of EM_4 given, the higher the crude protein produced.

According to Fathul (1997) that the new form of protein in the preservation of animal feed by fermentation is composed of a combination of free N from bacterial carcasses and residual volatile fatty acid compounds (a mixture of acetic, propionic and butyric acids) which have lost O, N and H ions. The O, N and H ions are caused by an increase in temperature during the fermentation process. The results of analysis of variance for crude fiber showed that fermented corn cobs showed a direct effect of EM_4 concentration on corncob crude fiber, this could be seen from the F value of 4.463 and sig at F 0.00 (sig <0.05) meaning that the addition of EM_4 to the cobs corn had a

significant effect on the corncobs produced. In Duncan's follow-up test, it can be seen that the J_0 treatment was very significantly different from the J_1, J_2, and J_3 treatments.

From the results of the analysis of the nutritional value of crude fiber and crude protein that has been carried out by testing corn cobs, the best nutritional value for crude fiber is 38.41% and crude protein is 8.02%, where for the nutritional value of the feed needed by ruminants for crude fiber i.e. less than 18% and crude protein i.e. 20% of dry matter, cell wall <35% in dry matter. Class 4 includes energy sources that have undergone a fermentation process (silage).

CONCLUSION

Based on the results of the research that has been done, it can be concluded that the best treatment is the treatment J_3 (EM_4 900 ml) with a crude fiber value of 38.41% and crude protein of 8.02%, of all treatments carried out from J_0 (control), J_1 (EM_4 500 ml)), and J_2 (EM_4 700 ml). Produces significant changes in both crude fiber and crude protein. This is due to the administration of EM_4 concentrations, the higher the concentration of EM_4 the lower the fiber produced, while the protein produced is higher. The best chemical characteristics of fermented corn cobs were the J_3 treatment with 900 ml of EM_4.

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