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The Effect of Differences in the Ratio of Tofu Dregs and Fermented Rice Straw on Fiber Content

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Abstract

This study aims to determine the best fiber content in a mixture of tofu dregs and fermented rice straw. The rice straw mixed with EM-4 and urea then fermented for 21 days. The fermented rice straw then mixed with dried tofu dregs in 5 different concentration that repeated 4 times using completely randomized design method. The mixture treatment as follows: T1 = 100% tofu dregs; T2 = 100% fermented rice straw; T3 = 75% tofu dregs + 25% fermented rice straw; T4 = 50% tofu dregs + 50% fermented rice straw; and T5 = 25% tofu dregs + 75% fermented rice straw. The fiber content observed were the fiber content of lignin, cellulose, hemicellulose, the Neutral Detergent Fiber (NDF), and the Acid Detergent Fiber (ADF). The data obtained were analyzed using ANOVA followed by Duncan's multiple range test. The laboratory analysis showed that the lowest NDF and ADF content resulted from tofu dregs, namely 38.86% and 26.29%, while the lowest hemicellulose content resulted from 50:50 mixture of tofu dregs and fermented rice straw (T4) with a value of 11.94%. The lowest cellulose content resulted from tofu dregs (T1) which was 16.5%, and the lowest lignin content resulted from a mixture of 75% tofu dregs and 25% fermented rice straw (T3) which was 3.41%. Based on the nutrient content, shows that tofu waste and rice straw have the potential to be used as feed ingredients, especially for ruminants or pseudo ruminants which still need fiber in their feed

Keywords: *ADF, fiber, NDF, rice straw, tofu dregs*

1. Introduction

Feed is one of the important factors in livestock raising management. The benefits of feed for livestock life are as a source of nutrition for the animal growth and development. The good feed has a complete nutritional content and can suit the needs of livestock. Feed spends around 65-80% of the total cost of livestock production (Sihombing, 2010). Finding alternative ingredients for animal feed can be considered to reduce feed costs. The source of feed ingredients for livestock must suit several requirements including year-round availability, not compete with human needs and have good nutritional value. The main nutritional content in the feed needed by livestock includes protein, fat, carbohydrates, minerals, vitamins, and crude fiber which are important for ruminants and pseudo-ruminants.

The use of waste as animal feed can reduce feed costs to be more economical. Tofu dregs are waste from the tofu-making industry which still has a high protein content. The protein content in tofu pulp is 23.39% in a dry state (Suningsih et al, 2019). Besides that, tofu pulp also has a low crude fiber content of 3.76% (Anggraini, 2018). Agricultural waste also has the potential to be used as animal feed because it is produced throughout the year and has not been utilized optimally. Rice straw is one of the agricultural wastes that can be used as an alternative feed for livestock but has weaknesses in quality and nutritional content. Rice straw contains nutrient-limiting factors that make it difficult for livestock to digest feed nutrients. The limiting factors for these nutrients are the three components of the fiber fraction, namely cellulose, hemicellulose, and lignin (Yanuartono, 2017). Rice straw has a crude fiber content of 31.99%, 77.00% NDF, 57.91% ADF, 23.05% cellulose, 19.09% hemicellulose, and 22.93% lignin (Suningsih et al, 2019). High crude fiber content can cause disturbances in the absorption of nutrients by the digestion of livestock.

Rabbits can utilize around 10-25% of the lignocellulosic content in forage for growth (Gidenne et al, 2017). The content of feed for broiler rabbits in the growth phase has an average content of 28-46% NDF, 15-23% ADF, 12-18% crude fiber, and 14-19% crude protein (Gidenne, T. 2015). Rice straw can be used as an alternative feed as a source of

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fiber, but further processing is needed to reduce the nutritional limiting factors so that it can be digested properly. Fermentation is an anaerobic process of changing complex compounds such as carbohydrates or starch into acids or alcohols through the activity of microorganisms (Jozala, 2017). Experiments on making feed based on rice straw agricultural waste and industrial waste in the form of fermented tofu dregs need to be studied for their nutritional content as rabbit feed in terms of crude fiber content in the form of lignin, cellulose, and hemicellulose as well as NDF and ADF content to assess their potential as an alternative feed.

2. Materials and Methods

A. Materials

The materials used in this study were tofu dregs and rice straw waste obtained from the agricultural area of Malang Regency. The rice straw was fermented using a mixture of EM4, molasses, and urea which was sprayed on 5 kg of rice straw with an incubation period of 21 days (Iqbal et al, 2016).

Rice straw fermentation process is described in the following procedure:

1. Shred rice straw 1-2 cm long and weigh as much as 5 kg
2. Homogenize 60 ml EM4 with 1 liter of water and 100 ml of molasses
3. Spray shredded rice straw with homogenized EM4 solution
4. Sow the shredded rice straw with 60 grams of bran and 20 grams of urea then stirred evenly
5. Put the mixture of rice straw in a covered plastic
6. Vacuum the air that is in the plastic
7. Fermented rice straw for 21 days at room temperature
8. After 21 days, erated fermented rice straw
9. Dry in an oven at 60ºC for 12 hours and grinded into powder.
10. The tofu dregs are dried using an oven at 60-70 ºC until dry and then ground using a milling machine into flour. Tofu dregs flour and fermented rice straw flour were then mixed with different concentrations.

B. Experimental Design

The treatment tested was mixtures of tofu dregs and fermented rice straw with different concentrations. The mixture was divided into 5 treatments which repeated 4 times and calculated using a completely randomized design. The treatment given is as follows:

T1: Tofu dregs 100%
T2: Fermented rice straw 100%
T3: 75% tofu dregs and 25% fermented rice straw
T4: 50% tofu dregs and 50% fermented rice straw
T5: 25% tofu dregs and 75% fermented rice straw

C. Variable Observed

After the fermentation and mixing process according to the treatment, Van Soest content was analyzed, including cellulose, hemicellulose, lignin, NDF, and ADF.

D. Statistical Analysis

Data obtained from laboratory analysis results then calculated using analysis of variance (ANOVA) and continued with Duncan's Multiple Range Test (DMRT) if there were significant differences.

3. Results and Discussion

The results of laboratory analysis of tofu dregs and rice straw fermentation on crude fiber, NDF, and ADF content are presented in the following discussion. Statistical analysis showed that there was a significant effect from the different mixture of tofu dregs and fermented rice straw on the crude fiber, NDF, and ADF content.

Table1. The Average Fiber Content from Van Soest Analysis

	T1	T2	T3	T4	T5
Cellulose	16.5^{a}	12.57^{b}	4.87^{c}	38.86^{a}	26.29^{a}
Hemicellulose	32.42^{e}	18.19^{e}	6.88^{e}	75.39^{e}	57.2^{e}
Lignin	25.21^{b}	13.45^{c}	3.41^{a}	46.29^{b}	32.84^{b}
NDF	29.41^{c}	11.94^{a}	4.12^{b}	54.6^{c}	42.66^{c}
ADF	30.84^{d}	15.37^{d}	6.59^{d}	65.09^{d}	49.72^{d}

***Source**: Analysis of Animal Feed and Nutrition Laboratory, Faculty of Animal Husbandry, University of Brawijaya, 2023.*
Superscript letters(a-d) in the same column indicate a very significant difference to the observed variables (P<0.01).

3.1. Effect of Differences in the Ratio of Tofu Dregs Mixture and Fermented Rice Straw on Cellulose Content

Based on the results of laboratory analysis, the lowest average cellulose content was in treatment T1 (tofu dregs without fermented rice straw mixture) of 16.5% while the highest average cellulose content was in treatment T2 (fermented rice straw without tofu pulp mixture) of 32.42%. Tofu pulp is known to have a high protein content of 23.39% and a low crude fiber content of 19.44% in a dry state (Anggraini, 2018) when compared to rice straw which has a high crude fiber content. The cellulose content in rice straw without the fermentation process is around 35.45% (Z. Jie et al, 2019), this indicates that during the fermentation process, the cellulose content undergoes an overhaul into simpler components thereby reducing the cellulose content in rice straw.

3.2. Effect of Differences in the Ratio of Tofu Dregs Mixture and Fermented Rice Straw on Hemicellulose Content

The highest average hemicellulose content was in T2 treatment of 18.19% accordance with the previous statement that rice straw has a high crude fiber content where the crude fiber is composed of fiber fractions, one of which is hemicellulose. It is known that the average hemicellulose content in unfermented rice straw was 24.42% (Z. Jie et al, 2019). The results showed a lower number of hemicellulose content indicated that the fermentation process could reduce hemicellulose levels in rice straw. The lowest hemicellulose content was from the T4 treatment of 11.94%. The highest

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crude fiber component in tofu dregs is hemicellulose which consists of pentose sugars, hexoses bound to methyl uronic acid (Z. Jie et al, 2019) so that from laboratory results the T1 treatment has a fairly high hemicellulose content of 12.57%.

3.3. Effect of Differences in the Ratio of Tofu Dregs Mixture and Fermented Rice Straw on Lignin Content

The highest lignin content was in treatment T2, which was 6.88%, namely in the treatment of fermented rice straw without addition of tofu dregs, followed by treatment T5, which was 6.59%, which was a mixture of 25% tofu dregs and 75% fermented rice straw. Whereas in treatment T3 it had a lignin content of 3.41% with a mixed of tofu dregs of 75% and 25% fermented rice straw, followed by a T4 treatment which had a lignin content of 4.12% from a mixture of 50% tofu dregs and 50% fermented rice straw, and the treatment T5 with a mixed of 25% tofu dregs and 75% fermented rice straw had a fairly high lignin content compared to other mixed treatments, namely 6.59%. The results showed that the higher the addition of rice straw, the lignin content in the material would increase. Rice straw without the fermentation process is known to have 16.62% lignin content (Masrullita et al, 2021), while the lignin content of fermented rice straw decreased by 9.74% to 6.88%. This means that the fermentation process in rice straw has an effect on breaking down lignin polymer bonds so that it can reduce its levels.

3.4. Effect of Differences in the Ratio of Tofu Dregs Mixture and Fermented Rice Straw on NDF Content

NDF (Neutral Detergent Fiber) is the part of the plant cell wall that is insoluble in neutral detergents and is an indicator for measuring fiber clumps in feed ingredients. The NDF value were used to measure the ability of livestock to consume feed before their stomach are full. The NDF value obtained from the results of laboratory analysis showed that the highest value was obtained from T2 treatment which was the fermented rice straw treatment without the addition of tofu dregs, which was 75.39% of NDF content. On average, rice straw has a high NDF content of around 70.6% (M. Yulin et al, 2020) to 79.5% before it is fermented (N. T. Huyen et al, 2019).

3.5. Effect of Differences in the Ratio of Tofu Dregs Mixture and Fermented Rice Straw on ADF Content

ADF (Acid Detergent Fiber) is a substance in the feed that does not dissolve in an acidic detergent solution, the substance consists of cellulose and lignin. Based on the results of the study, the highest ADF value was found in treatment T2, namely the treatment of fermented rice straw without tofu dregs mixture, amounting to 57.2%. This value is not much different from research on rice straw fermentation with probiotics which has an average ADF value of 54% (M. Amin et al, 2016). The ADF value in the tofu dregs treatment without rice straw mixture (T1) was low at 26.29% because tofu dregs had a lower fiber content compared to rice straw. The low ADF value is directly proportional to the results of the cellulose and lignin content of tofu dregs which is also low.

4. Conclusion

Based on the results of the study, it can be concluded that mixing tofu dregs with fermented rice straw can affect the fiber content in the feed, and the higher the mixture of rice straw can increase the fiber content in the feed. 25% fermented rice straw mixture has a high enough NDF and ADF content for rabbit feed so consideration is needed before being given as feed, especially for livestock that require fiber in feed such as rabbits.

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