Quality of crude protein and crude fibre wafer complete feed based on rice straw fermented with Effective Microorganism 4 (EM-4)

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Abstract. This study aimed to determine the quality crude protein and crude fibre content of complete rations in the form of wafers made from rice straw fermented with EM 4. This study was carried out at the Laboratory of Feed Technology and Industry, Faculty of Animal Husbandry, Hasanuddin University for proximate analysis during two months period. This study was an experimental method and arranged using a completely randomized design (CRD) consisting of four treatments at different composition and three replications. The treatments in the present study were T1 = 0% concentrate + 79% Fermented rice straw + 10% Bran + 10% Molasses + 1% Urea; T2 = 25% concentrate + 75% of T1, T3 = 50% concentrate + 50% of T1; and T4 = 75% concentrate + 25% of T1. The variables measured were dry matter, crude protein, and crude fibre. Data were calculated using analysis of variance and further and continued by Duncan's Multiple Range Test for the differences in the treatments. The results of this study showed that the quality of protein content and crude fibre in the form of complete wafer feed could be improve by using rice straw that fermented with EM-4. The improved quality of the content were to increase the content of crude protein and reduced the content of crude fibre.

1. Introduction
Efforts to increase the availability of feed as well as efforts to reduce feed costs by finding new feed sources that have not been or it is not commonly used by the farmers (non-conventional feed ingredients) are necessary. Some types of residual agricultural and plantation products that are not yet commonly used as feed are widely available in some areas, such as rice straw, soybean skin, cassava peel, cassava stalk, brown skin and coffee skin, but in some other areas they have utilized these materials as feed for livestock [1]. One of the non-conventional feed ingredients that has considerable potential is rice straw. The area of rice harvested in West Sulawesi Province in 2017 was 87,874 ha, with a grain yield of 442,291 tons and has the potential to produce rice straw waste [2]. The use of rice straw as feed has constraints, due to low crude protein content (4.64%) and high crude fiber (33.79%) [3]. Therefore, to increase its quality as feed ingredients rice straw needs to be improved. One of methods is using fermentation process technology. The fermentation process, among others, aims to produce products (feed ingredients) that have better nutritional and biological availability [4]. Efforts to increase the value of the benefits of rice straw as feed has already been reported by several researchers. Processing of rice
straw fermented with starbio® showed that the composition of nutrient of rice straw has improved quality compared to unfermented rice straw. Compared to unfermented rice straw, rice straw fermented with starbio® probiotics has an increase in crude protein content. The fiber composition of unfermented rice straw was significantly higher than that of starbio® fermented rice straw [3].

Aside from the constraints due to the low nutrient content of rice straw, its voluminous nature and fluctuating availability are the main problems facing to feed the animal at all the time continuously. Making complete wafer from fermented straw is one of the solutions so that its use as non-conventional feed ingredients can be optimized. Wafers are dry matter products that in their manufacturing experience compaction and pressure, long shelf life under normal conditions, easy to carry on the way and easily stored [5]. The low nutrient content of rice straw requires the addition of other feed ingredients (concentrates), and arranged in the form of a balanced and harmonious ration (complete ration) to be able to meet the need for animal feed substances. Complete ration wafer is a form of feed that has a compact and concise physical form so that it expected to facilitate handling and transportation, besides having complete nutritional content, and using relatively simple technology so that it is easy to apply [6].

This study aimed to determine the quality of crude protein and crude fiber complete feed in the form of wafers made from rice straw, an effective microorganism-4 (EM-4) fermentation product. The results of this study is expected to provide information on how to improve the quality of rice straw as an alternative feed for quality ruminant animal feed with technology for making fermented straw wafers-based.

2. Study methods

2.1. Experimental design
The study was conducted at the Feed Technology Laboratory and the Laboratory of Feed Nutrition at the Faculty of Animal Science, Hasanuddin University during two months period. The study was an experimental and arranged using a completely randomized design (CRD) consisting of four treatments and three replications with the following composition: T1 = 0% concentrate + 79% fermented rice straw + 10% bran + 10% molasses + 1% Urea; T2 = 25% concentrate + 75% of T1; T3 = 50% concentrate + 50% of T1; and T4 = 75% concentrate + 25% of T1.

2.2. Complete wafer straw production and data collection
A complete wafer feed was made through the fermentation process of dry rice straw. The rice straw that have been chopped into 5 cm in length was mixed with Effective Microorganism-4 (EM-4), rice bran, molasses and urea, then fermented in a silo for 21 days. Proximate analysis was performed according to the AOAC [7]. The parameters observed were dry matter (DM), crude protein (CP) and crude fiber (CF).

2.3. Data analysis
Data were analyzed using analysis of variance (F-test) and Least Significant Difference Test was used as post hoc test [8].

3. Results and discussion

3.1. Dry matter
Average dry matter of complete feed in the form of wafers made from rice straw-Effective Microorganism (EM-4) fermentation products are depicted in table 1.

The results of the analysis of variance showed that all treatments had a significant influence on the dry matter content of complete feed in the form of wafers made from fermented rice straw. In this study, there was a difference in the increase of dry matter with differences in the composition of ingredients contained in each treatment. The highest achievement in dry matter occurred at T4 treatment and it was significantly higher than T1, T2 and T3 treatments. This shows that complete feed wafers made from fermented straw with 75% and 25% of fermented straw is the ideal ratio.
Table 1. Average content of dry matter in complete feed in the form of wafers made from rice straw-fermented products Effective Microorganism 4 (EM4).

| Treatment | Replication | Total | Average |
|-----------|-------------|-------|---------|
|           | 1           | 2     | 3       |          |
| T1        | 84.08       | 84.11 | 85.00   | 253.19   | 84.39<sup>b</sup> |
| T2        | 82.92       | 82.45 | 83.03   | 248.40   | 82.80<sup>a</sup> |
| T3        | 84.60       | 83.90 | 83.67   | 252.17   | 84.05<sup>b</sup> |
| T4        | 85.05       | 85.00 | 85.56   | 255.61   | 85.20<sup>c</sup> |

<sup>abc</sup> different superscripts in the same column show a significant difference (P<0.05).

The highest dry matter content of complete wafer was in T4 treatment because in the complete feed wafer, the use of fermented straw was the highest level compared to other treatments. The previous study [9] supports this study, which stated that fermentation is one of the efforts in improving the quality of feed ingredients. In this study, the fermentation process has advantages including: it has no negative side effects, is easy to do, relatively does not require special equipment and is relatively inexpensive. The fermentation process is simply can be carried out by adding a microbial starter (mold or bacteria) that is suitable for the substrate and the purpose of the fermentation process. A high increase in dry matter provides information on the effective decomposition of dry matter in the ingredients of the complete feed wafer [10].

3.2. Crude protein

Average content of crude protein in complete feed ration in the form of wafers made from rice straw Effective Microorganism (EM 4) fermentation products are shown in table 2.

Table 2. Average content of crude protein in complete feed ration in the form of wafers made from rice straw fermented product Effective Microorganism 4 (EM 4).

| Treatment | Replication | Total | Average |
|-----------|-------------|-------|---------|
|           | 1           | 2     | 3       |          |
| T1        | 11.37       | 10.96 | 11.46   | 33.79    | 11.26<sup>a</sup> |
| T2        | 13.27       | 13.12 | 13.53   | 39.92    | 13.30<sup>b</sup> |
| T3        | 14.38       | 13.87 | 14.33   | 42.58    | 14.90<sup>c</sup> |
| T4        | 14.02       | 14.00 | 14.09   | 42.41    | 14.11<sup>c</sup> |

<sup>abc</sup> different superscripts in the same column show a significant difference (P<0.05).

The wafer crude protein content was significantly increased (P<0.05) as the amount of fermented straw used in the complete feed wafer increased. The highest crude protein content occurs in wafers with the use of 50% and 75% fermented straw. Increased levels of crude protein is closely related to the changes in levels of other proximate components, especially crude fiber. A decrease in crude fiber content and in the fermentation process results in a proportional increase in crude protein content. The increase occurred because in the microbial fermentation process produces microbial cells in the form of single cell protein, microbial enzymes and the results of microbial metabolism, namely amino acids, nucleotides, and proteins. This is in line with the opinion of Bachruddin [11], which in the fermentation process there will be an increase the amount of cell mass that will later increase the protein content in the substrate.

3.3. Crude fibre

Table 3 shows the average content of crude fibre in complete feed ration in the form of wafers made from rice straw Effective Microorganism (EM-4) fermentation products.
Table 3. Average content of crude fibre in complete feed in the form of wafers made from raw rice straw fermented Effective Microorganism 4 (EM-4).

| Treatment | Replication | Total | Average |
|-----------|-------------|-------|---------|
| T1        | 32.62       | 32.40 | 33.15   | 98.17   | 32.72<sup>a</sup> |
| T2        | 30.82       | 31.03 | 30.35   | 92.20   | 30.73<sup>b</sup> |
| T3        | 29.46       | 29.31 | 29.00   | 87.71   | 29.25<sup>c</sup> |
| T4        | 27.47       | 26.66 | 27.21   | 81.34   | 27.11<sup>d</sup> |

<sup>abc</sup> different superscripts in the same column show a significant difference (P<0.05).

Data on wafer crude fibre content decreased significantly (P<0.05) by increased of fermented rice straw in complete feed wafers (table 3). The lowest crude fibre content of complete feed wafers was in treatment T4. This might be due to the cellulolytic material or substrate such as rice straw which is hygroscopic when mixed with EM4 solution, water, swelling and swelling and enlarging the substrate cells making it easier for microbes contained in EM4 solution enter the substrate to develop, grow and work in accordance with the functions of each organism. Cellulolytic microbes use cellulose as a source of energy and carbon by producing cellulose enzymes that can break down and degrade cellulose components and their long derivatives into glucose [12,13] and further stated that cellulolytic microbes are capable of using fibrous substrates because they are able to produce cellulose enzymes and their long derivatives into glucose. Therefore, that it is able to break down cellulose into glucose.

The addition of probiotics can increase levels of crude protein, dry matter and organic matter, reduce levels of crude fiber [14]. [The length of time of fermentation can increase levels of crude protein and in vitro digestibility of dry matter and organic matter; reduce levels of crude fiber, NDF, ADF, cellulose and ammoniated rice straw lignin plus probiotics 15].

4. Conclusion
The results of this study concluded that the quality of the complete proximate wafer ration content could be improve by using rice straw- Effective Microorganism-4 fermented product. The improved quality of proximate content were dry matter, crude protein and reduction in crude fibre content.

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