Characteristics of Fermented Rice Straw with Several Types of Probiotics and Fermentation Time for Cow Feed

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Abstract. Rice straw has great potential as a feed ingredient for cattle, especially when it is difficult to get forage ingredients in the dry season. To get good quality feed from rice straw, it is necessary to use a fermentation process using probiotics. The purpose of this study was to compare the quality of straw fermented using several types of probiotics and the length of the fermentation process. The method that will be used in achieving these goals is the experimental design method. Completely Randomized Design (CRD) factorial pattern consisting of 2 factors, namely: factor I type of probiotic (P) consisting of EM4 (P1), Bio Bali Tani (P2), and Rumino bacillus (P3), and factor II the length of fermentation time (T), namely: 1 week (T1), 2 weeks (T2), 3 weeks (T3), and 4 weeks (T4), where each treatment combination was carried out repeated 3 times. The results showed that the type of probiotic had a significant effect ($P<0.05$) on the quality of fermented straw, where Bio Bali Tani (P2) showed the best results in crude protein content (CP), water content, and crude fiber. While the fermentation time at week 4 was significantly the best crude protein (CP) ($P<0.05$), but the 1-week fermentation time was significantly the lowest ($P<0.05$) the quality of fermented straw. The interaction between the types of probiotics and the length of time of fermentation only occurred at the highest crude fiber content at P2T2 (the interaction between the Bio Bali Tani probiotics with a fermentation time of 2 weeks), and the lowest at the interaction P1 with T4. From this research, it can be concluded that the type of probiotic and the longer the fermentation process affect the quality of fermented straw, where the probiotic Bio Bali Tani produces the best quality.

Keywords: fermented rice straw; fermentation time; probiotics; quality

1 Introduction

The development of ruminant production in Indonesia is influenced by several aspects, one of which is the difficulty of fulfilling the availability of forage in a sustainable manner both in quality and quantity. Utilization of agricultural waste feed, especially rice straw is one way to meet basic feed needs for livestock. Rice straw production varies, which can reach 12-15 tons

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of fresh straw per ha once harvested, or 4-5 tons of dry straw per ha depending on the location and type of plant variety used (BPTP Jawa Barat).

In general, agricultural waste including rice straw has a high crude fiber content and low protein is a limiting factor in feeding cattle. Entering the dry season, the supply of forage is getting less and less, so the use of agricultural waste, especially rice straw as feed material is quite high in rearing cows in Bali which causes the nutrient content and nutrient fulfillment to be lower (Sudita, 2019). Cattle rations with the composition of natural grass and unfermented straw have lower crude protein and energy content and higher crude fiber (Sudita, at.all., 2015).

The use of high crude fiber, besides being able to reduce easily digestible components, also causes a decrease in the activity of enzymes that break down food substances, such as enzymes that help digest carbohydrates, proteins and fats (Parrakasi, 1991). Therefore, to increase the nutritional value of agricultural waste, a process that can include physical, chemical, and biological processes is needed, among others, by means of fermentation technology. Kompiang et al. (1994), the technology to improve the quality of feed ingredients is by fermentation.

In general, all fermented end products usually contain compounds that are simpler and easier to digest than the original ingredients. Fermentation in straw is largely determined by the type of probiotic (fermenter) and the length of fermentation time. Probiotics of the EM-4 type have been widely used in the community for various purposes in the fermentation process. Currently, various other types of probiotics have been developed, such as Rumino bacillus, and Bio Bali Tani which have the same function, so it is necessary to do research to get the best quality of fermented rice straw with different lengths of time.

2 Research Methods

The design used in this experiment was a completely randomized design (CRD) with a factorial pattern. The first factor is the treatment of 3 types of probiotic ingredients, namely EM-4 (P1), Bio Bali Tani (P2), and Rumino bacillus (P3), while the second factor is the length of fermentation time, namely T1 (1 week), T2 (2 weeks), T3 (3 weeks), and T4 (4 weeks. Each treatment was repeated 3 times so that 36 experimental units were obtained. The dose of probiotic treatment in the fermenter solution was made the same, namely 1 liter of probiotics: 10 liters of water + 1 liter of molasses which was sprayed into 1 ton of rice straw. Rice straw that has been sprayed with a fermenter, then fermented in a tightly closed plastic barrel (in an anaerobic atmosphere) according to the length of fermentation time.

The fermentation process was carried out at the experimental station of the Faculty of Agriculture, University of Warmadewa for 1 month in April 2021. Followed by an analysis of the chemical quality of fermented straw in the laboratory of the Faculty of Agriculture, University of Warmadewa. While the crude protein analysis test was carried out in the laboratory of the Faculty of Animal Husbandry, University of Udayana Denpasar.

3 Results and Discussion

Dry matter (DM) has a negative relationship with the water content of a material, where the lower the DM content of the material, the higher the water content. This can be seen in Table 3.1, in treatment P2 the dry matter content was the lowest ($P<0.050$) but the water content was the highest. With a higher water content, it is easier to digest feed ingredients in the digestive tract, especially in the rumen.

Table 1. Quality of Fermented Straw with Probiotics and Different Length of Time

Treatment	Dry Matter / DM (%)	Moisture Content (%)	Ash Content (%)	Crude Fiber /CF (%)	Crude Protein /CP (%)
P1	20.78a	79.22b	26.61a	24.75b	6.38b
P2	18.98b	81.04b	26.34a	27.97c	6.91c
P3	20.84a	79.16a	27.09a	26.23a	5.62a
T1	23.93c	76.07b	26.79a	26.38b	5.92b
T2	23.64b	76.36b	26.88a	26.75a	6.15b
T3	21.65b	78.38b	27.18a	25.61a	6.36ab
T4	21.57a	78.43a	25.87a	26.53a	6.80a
P1T1	25.70a	74.30a	26.53a	25.76df	5.65a
P1T2	23.71a	76.29a	26.56a	25.76f	6.24a
P1T3	22.20a	77.80a	27.08a	23.76g	6.67a
P1T4	21.49a	78.51a	26.27a	23.74h	6.95a
P2T1	22.96a	77.04a	26.77a	27.32bcd	6.67a
P2T2	22.81a	77.19a	27.26a	29.41a	6.62a
P2T3	19.28a	80.80a	26.64a	26.92cde	6.76a
P2T4	20.86a	79.14a	24.72a	28.24b	7.61a
P3T1	23.12a	76.88a	27.08a	26.06e	5.44a
P3T2	24.41a	75.59a	26.82a	25.08f	5.58a
P3T3	23.46a	76.54a	27.83a	26.16de	5.64a
P3T4	22.36a	77.64a	26.63a	27.62bc	5.83a

Explanation : Numbers followed by the same letter on the same factor mean that they are not significantly different (P>0.05) in the 5% BNT test.

P1: Probiotic EM4, P2: Probiotic Bio Bali Tani, P3: Probiotic Rumino bacillus
T1: Fermentation time 1 week, T2: Fermentation time 2 week, T3: Fermentation time 3 week, and
T4: Fermentation time 4 week

Rice straw has a very high dry matter (DM) content (70-80%) and low water content (20-30%) (Kompiang, 1996), so it is still bulky. With the fermentation process the dry matter content (DM) can be reduced to 19-24% and the water content to 76-81% (Table3.1), it will be able to increase the digestibility of feed ingredients in the rumen by microbes. Purnomohadi (2006) stated that the results of straw fermentation research using RCBI (Rumen Cellulolitic Bacterial Incubation 30%) got a decrease in DM from 91.2% to 81.53%.

3.2 Crude Fiber and Ash Content

Crude fiber in the form of cellulose in feed ingredients is very important in the digestive process by microbes for the fermentation process in the rumen to produce free fatty acids (vololetyl fatty acid / VFA) as an energy source for livestock through a mutualistic symbiotic process between microbes and livestock. The use of different probiotics in the fermentation process, the average ash content is the same between P1, P2 and P3, but the longer the fermentation time can reduce the ash content but not significantly different ($P > 0.05$) where T4 (4 weeks fermentation) shows the results the lowest. Ariani (2011) from the results of fermentation research using MOL found that the longer the fermentation time the lower the ash content, but the dry matter and organic matter increased.

When viewed from the crude fiber content, the use of probiotics Bio Bali Tani (P2) was significantly ($P<0.05$) the highest compared to treatments P1 (EM-4) and P3 (Rumino bacillus). Higher crude fiber will also increase organic matter in feed ingredients, so the digestibility of feed ingredients also increases (Winedar, 2006 and Kusuma Dewi, et.all., 2012). With the longer fermentation time, the more concentrated crude fiber, the cruder fiber content increased (Fajarudin et.all., 2014), as shown in Table 3.1 treatment T1 showed significantly lower results ($P<0.05$) than T2, T3, and T4.

The interaction between types of probiotics and the length of time of fermentation on crude fiber shows that each factor influences each other, where P2 (Bio Bali Tani) and 2 weeks of fermentation (T2) the crude fiber content is significantly higher ($P<0.05$) compared to the combination treatment. others, while the lowest was at P1T4. Crude fiber content will be related to the physical properties of feed (Reksohadiprodjo, 1996) and physical properties are closely related to the level of degradability and fermentability in the rumen (Sutardi, 1997).

3.3 Crude Protein (CP)

Although cattle are able to synthesize protein in the body, the source of N present in the protein in feed ingredients is still needed for the formation of microbial bodies in the rumen as a source of protein for livestock. From the results of the study in Table 3.1, in general, fermentation of straw can increase protein in all probiotic treatments (P1, P2, and P3) and the longer the fermentation time, the higher the protein content. The increase in the amount of protein in the straw was influenced by the type of probiotic used, such as Purnomohadi's (2006) study using Rumen Cellullolitic Bacterial Incubation (RCBI) 30% was able to increase protein from 4.1% to 9.01%. Aminah (2005) stated that straw fermentation using cassava was only able to increase protein to 5.54%. Several other researchers (Ariani, 2011., Fajarudin et.all., 2014) confirmed that straw fermentation was able to increase organic matter and digestibility.

In this study, it was seen that the difference in probiotics in the rice straw fermentation process had a significant effect ($P<0.05$) where P2 treatment was significantly higher than other treatments, while the lowest was in P3 treatment. This is because the type of bacteria of each probiotic is different, so the ability to ferment and reproduce is also different. With more bacteria growing in the P2 treatment, the amount of protein is also higher which comes from the microbial body itself. When compared with the statement of Purnomohadi (2006), the highest amount of crude protein in the P2 treatment (6.91%) was still lower, but when compared to Ariani's (2011) study which only reached 5.54% it was still higher. Thus, it can be said that the level of crude protein content in fermented straw is largely determined by the type of probiotic used.

When viewed from the length of the fermentation time, it is also very influential on the crude protein content where the longer the fermentation time, the higher the average total crude protein in the straw. At week 4 (T4) the highest and significantly different ($P<0.05$) compared to T1 and T2 (Table 3.1). This is in accordance with the statements of Karlina (2008) and Sukaryani (2016) which state that the length of fermentation time affects the amount of protein, ADF and NDF content. Mustofa, et.all., (2020) stated that the production of VFA and NH3 in fermented ammonium cobs increased at a 2% commercial starter level with four weeks of curing time. The longer the fermentation time in rice straw, the number of microbes that breed is also increasing, as a result the protein content in fermented straw is also higher which comes from the body of dead bacteria. Thus, the higher the protein content, the higher the amino acid content in the straw feed ingredients, especially the amino acids methionine and lysine.

Although the type of probiotic and the length of time of fermentation in rice straw had a significant effect ($P<0.05$), but the results of statistical analysis of treatment combinations did not occur interaction. However, the interaction of P2T4 treatment (Probiotic Bio Bali Tani with 4 weeks fermentation time) showed the highest protein content, which was 7.61%.

4 Conclusion

From this research it can be concluded that: The quality of rice straw can be improved by performing fermentation using various types of probiotics/ fermenters with a certain length of time. Types of probiotics affect the high and low quality of fermented rice straw, especially the content of dry matter (DM), crude fiber, and crude protein. The best results of rice straw fermentation using Bio Bali Tani probiotics reached 6.91% crude protein content. The length of time of fermentation also affects the quality of fermented rice straw, with a fermentation period of 4 weeks the highest protein content reaches 6.80%. The interaction between the treatment of probiotic types and the length of time only occurred in the crude fiber content, while the dry matter, ash content, and crude protein content did not occur.

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