The fermentation quality of complete feed with FJLB silage additive from tropical grass

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Abstract. Climate change occurs because of the greenhouse gas effect. Methane from livestock accounts for 44% of methane emissions in the air, which comes from fermentation from the rumen and from feces. Many attempts have been made to reduce methane production in the rumen, including feed management. This study aims to improve the quality of complete feed fermentation with the addition of different grass source of FJLB (fermented juice of epiphytic lactic acid bacteria). The treatments consisted of T0 (Control, without FJLB), T2 (FJLB from Napier grass), T3 (FJLB from King grass). Complete feed consists of rice straw, rice bran, soybean meal, pollard and corn. The pH value of the silage with the addition of FJLB was lower than that of the silage without the addition of FJLB. The highest acetic acid production was at T3, 8.76 ppm. Meanwhile, the number of lactic acid bacteria was 5.4; 6.3 and 7.6 CFU/ml, for T0, T1 and T2, respectively. Meanwhile, ammonia production was not significantly different. The conclusion of this study is the addition of FJLB from napier grass and king improves the quality of fermentation compared to without the addition of FJLB. Good fermentation quality will improve digestibility in the rumen and is expected to reduce methane production, which is one of the greenhouse gases that causes climate change.

1. Introduction
The contribution of livestock to greenhouse gases has long been known. Fiber fermentation in the ruminants produces methane which is released into the air. Methane is also produced from manure. Livestock contributes 14.5% of greenhouse gases to total greenhouse gases [1]. Greenhouse gases are known to play a major role in climate change that has occurred in the last few decades. Meanwhile, fermentation in the rumen contributes 39% of the total emissions from livestock. Many studies have been conducted to mitigate methane emissions from ruminants, one of which is feed management. Good quality feed will reduce the production of enteric methane. The provision of feed with different proportions of brewer grain and rice brand to goats produces methane which is still at the level of maintenance [2].

Giving complete feed to ruminants provides great benefits because with complete feed all the nutritional needs of livestock are met. Complete feed is also a solution to improve the quality of agricultural waste. Meanwhile, preservation of feed in dry season, especially in Indonesia, is by silage. Complete feed silage provides a solution for feeding ruminants in the tropics. Silage with additives will provide better fermentation quality. Complete feed with fermented juice of epiphytic lactic acid bacteria (FJLB) from Italian reygras grass produced better quality than without additives [3]. The use of FJLB has been known in the last two decades to be able to improve the quality of silage of napier grass, legumes and complete feed, but FJLB from tropical grasses in complete feed silage from agricultural
waste has not been widely reported. Therefore, this research was conducted with the aim of determining the quality of complete feed fermentation with the addition of additive FJLB from tropical grass.

2. Materials and methods

Complete feed preparation was carried out at the Jatikuwung Experimental Farm, Animal Science Study Program, Faculty of Agriculture, University of Sebelas Maret. Complete feed ingredients used are rice straw, corn, fine bran, pollard and soybean meal. The proportions of feed ingredients are presented in Table 1.

| Material          | Proportion (%) |
|-------------------|----------------|
| Rice straw        | 26             |
| Corn              | 30             |
| Rice bran         | 22             |
| Pollard           | 10             |
| Soybean meal      | 10             |
| Mineral mix       | 2              |

The preparation of the FJLB modified from [4]. FJLB was made from elephant grass (*Pennisetum purpureum Schumach.*) and Kolonjono grass (*Brachiaria mutica*). FJLB treatment was given as much as 1% of fresh weight. Control was given additional water to adjust the moisture content with the treatment. All treatments consisted of 3 replications. The complete feed is then put in a 150 liter plastic drum and closed tightly. Fermented for 21 days.

Sampling was carried out for pH measurement with a pH meter. Then the samples were sent to the Laboratory of Nutritional Chemistry, Faculty of Animal Husbandry, Gadjah Mada University for analysis of VFA, lactic acid, lactic acid bacteria and ammonia nitrogen.

All data obtained were then analyzed using the R (3.6.2) program [5].

3. Result and discussion

The fermentation quality of the complete feed silage for 21 days with different FJLB is presented in Table 2.

| Parameters          | Treatment     | P Value |
|---------------------|---------------|---------|
| pH                  | T1            | 5.96±2.1|         |
|                     | T2            | 3.3±0.2 |         |
|                     | T3            | 3.4±0.3 | 0.09    |
| Acetic acid (ppm)   | T1            | 373.02±106.7 |         |
|                     | T2            | 378.6±104.6 |         |
|                     | T3            | 875.6±85.8 | 0.009   |
| Propionic acid      | T1            | ND      |         |
|                     | T2            | ND      |         |
|                     | T3            | ND      |         |
| Butyric acid        | T1            | ND      |         |
|                     | T2            | ND      |         |
|                     | T3            | ND      |         |
| Lactic acid (mg/100 gr) | T1        | 40.9±17.7 |         |
|                     | T2            | 57.4±36.9 |         |
|                     | T3            | 68.4±44.4 | 0.42    |
| LAB (CFU/ml)        | T1            | 7.6 x 10²±2.5 |         |
|                     | T2            | 6.3 x 10²±1.1 |         |
|                     | T3            | 5.4 x 10²±1.5 |         |
| Nh3-N (mg/100 ml)   | T1            | 29.1±2.1 |         |
|                     | T2            | 31.3±2.0 |         |
|                     | T3            | 30.5±4.1 | 0.65    |

| Parameters          | Treatment     |
|---------------------|---------------|
| pH                  | T1            |
| Acetic acid (ppm)   | T2            |
| Propionic acid      | T3            |
| Butyric acid        |                |
| Lactic acid (mg/100 gr) |          |
| LAB (CFU/ml)        |                |
| Nh3-N (mg/100 ml)   |                |

T1: no FJLB added, T2: FJLB from Elephant grass, T3: FJLB from Kolonjono grass, ND: not detected

The pH value tended to be higher at T1 than the other two treatments (P < 0.10). The highest acetic acid value was in T3 treatment (P < 0.01). Meanwhile, the values of lactic acid, lactic acid bacteria and ammonia nitrogen were not affected by the treatment. A good pH value for silage is 4.2 or less [6]. In this study, the pH value in the addition of FJLB showed a better pH than without the addition of additives. Factors that affect the pH value include the production of lactic and acetic acids. The amount
of lactic and acetic acid production was lower in the control than the two FJLB treatments so that the pH value was higher. The addition of FJLB was able to reduce the pH value of complete feed silage made from agricultural waste and food waste in this study.

The value of acetic acid is influenced by the dry matter content of silage and lactic acid bacteria [7]. It is further explained that the value of acetic acid is the largest proportion of volatile acid in silage which has anti-microbial properties so that it can be useful when the silage is opened. Acetic acid production in this study was the highest in T3 treatment. This may be due to the change from lactic acid to acetic acid in abundance. Lactic acid production was not affected by treatment. Usually, the addition of silage additives will increase lactic acid. However, in this research, it turns out to produce the same value. This is because the number of lactic acid producing bacteria also has the same number (Table 2). Ammonia content in complete feed silage this time did not differ in all treatments. Ammonia is the result of degradation of nitrogen or protein components in silage. A good silage should have a fixed crude protein content. High ammonia indicates proteolysis by unwanted bacteria [8]. And this can reduce the quality of silage. The propionic acid and butyric acid in this study were not detected, it is suspected that the amount produced was too small. Propionate acid that is not detected usually has a dry matter content of 35-45% [9]. This is consistent with complete feed research this time, which has a dry matter content of 45%.

4. Conclusion
The addition of FJLB from kolonjono grass increased the levels of acetic acid production in complete feed silage with materials from rice straw and food industry waste. Good feed silage will increase livestock productivity. Good feed management on farms is expected to reduce methane emissions so as to reduce the impact of greenhouse gases, or climate change.

References
[1] Grossi G, Goglio P, Vitali A and Williams A G 2019 Livestock and climate change: Impact of live- stock on climate and mitigation strategies Animal Frontiers 9 69–76
[2] Yanti Y, Pamungkas WA, Hermanu F, Putranto S, Widyawati SD and Suprayogi WPS 2021 Effects of different composition of brewer grain and rice bran in the concentrate on methane emission of Kacang goat IOP Conf. Ser.: Earth Environ. Sci. 724 012078
[3] Yanti Y, Kawai S and Yayota M 2019 Effect of total mixed ration silage containing agricultural by-products with the fermented juice of epiphytic lactic acid bacteria on rumen fermentation and nitrogen balance in ewes Trop. Anim. Health Prod 51 (5)
[4] Bureenok S, Sisaath K, Yuangklang C, Vasupen K and Schonewille J T 2016 Ensiling characteristics of silages of stylo legume (Stylosanthes guianensis), guinea grass (Panicum maximum) and their mixture, treated with fermented juice of lactic bacteria, and feed intake and digestibility in goats of rations based on these silages. Small Ruminant Research 134 84–9
[5] R Core Team 2019 R: A language and environment for statistical computing. R Foundation for Statistical Computing [Online] available https://www.R-project.org/
[6] Hosoda K, Eruden B, Matsuyama H and Shioya S 2009 Silage fermentative quality and characteristics of anthocyanin stability in anthocyanin-rich corn (Zea mays L.). Asian-Aust. J. Anim. Sci. 22(4) 528–33
[7] Kung L and Shaver R 2001 Interpretation and Use of Silage Fermentation Analysis Reports Focus on Forage 3(13) 1–5
[8] McDonald P, Henderson A R and Heron, S J E 1991 The Biochemistry of Silage Second Ed. (Marlow, Buckinghamshire: Chalome Publications) 1–340
[9] Kung L, Shaver R D, Grant R J and Schmidt R J 2018 Silage review: Interpretation of chemical, microbial, and organoleptic components of silages J. Dairy Sci. 1014020–33