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Effects of Previously Fermented Juice on Nutritive Value and Fermentative Quality of Rice Straw Silage

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Abstract: The effects of Previously Fermented Juice (PFJ) on the fermentative quality and changes in chemical composition during fermentation of rice straw silage were investigated. The results showed that the PFJ and diluted the PFJ (dPFJ) treated silages had significantly (p<0.05) lower pH and ammonia-nitrogen content, while significantly higher lactic acid content compared with treatments. This study confirmed that the applying of the PFJ and the dPFJ improved fermentation quality of silage.

Key words: rice straw, Previously Fermented Juice (PFJ) silage, nutritive value, fermentative quality

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Introduction

Previously Fermented Juice (PFJ) is a new type of silage additive. In addition to having the effects of preparation and lactic acid bacteria similar outside, there are the following advantages of the PFJ: ① the PFJ production process is simple and economic, the operation will be environmentally friendly. And it can avoid acid corrosion to instruments and machinery in the process of silage produced; ② the lactic acid bacteria in the PFJ are natural lactic acid bacteria, which have many kinds and large quantity, and been adapted to environment. Therefore, as a kind of silage additives, it can demonstrate a higher stability of fermentation, which improve silage fermentation quality and better to improve the fermentation quality of silage (Ohshima *et al*., 1997). The objective of the present study was to investigate the effect of diluted the PFJ (dPFJ) on the fermentation quality of rice straw silage, which was supposed to contain a number of species of domestic LAB, as a silage additive using rice straw silage.

Materials and Methods

Rice straw and additives

Rice straw was obtained from Tangchi in Anhui Province, the rice straw was harvested at full-ripening stage while the stems had high moisture content (60%-75%) and were still green.

Additives: 50 g of growth alfalfa was harvested by hand at the vegetative stage, macerated with 250 mL of a 2 g·l00 mL^{-1} glucose solution and filtered through double cheese cloth (PFJ). One of the PFJ solution was prepared by making up 5 mL to 100 mL with 2 g·l00 mL^{-1} glucose solution (dPFJ). They were preserved anaerobically for 2 days at 30℃. After fermentation both the PFJ and the dPFJ solutions were diluted 5 mL to 100 mL with 2 g·l00 mL^{-1} glucose solution (the PFJ20 and the dPFJ20), respectively. These treatments were also preserved anaerobically for 2 days at 30℃. All the treatments consisted of the three replicates (Ohshima *et al*., 1997) .

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Ensiling

Rice straw was ensiled whole to a theoretical length of 6-cm using a rice harvester. Whole rice straw was treated with five different additives. i) No additive, ii) PFJ, iii) dPFJ, iv) PFJ20, v) dPFJ20. Additives were dissolved in deionized water and sprayed uniformly on the rice straw constantly and thoroughly. Approximately 5 kg of rice straw was then packed and sealed in plastic bags and stored at ambient temperature (20 to 25℃) in an enclosed barn for 45 days. All the treatments consisted of three replicate silos. After completion of ensiling time, silos were opened; the RS silages were randomly sampled by drawing vertical cores from three different positions, and then mixed thoroughly to get a composite sample. Samples were stored on ice until taken back to the laboratory for chemical analyses.

Laboratory analyses

Silage samples were analyzed for DM, CP (AOAC, 1997), NDF and ADF (Van Soest *et al*., 1991).

According to the method of Nishino and Uchida (1999), 20 g silage sample was homogenized with 180 mL of distilled water and stored overnight at 4℃ in a refrigerator. Then the mixture was filtered through Whatman 54 filter paper and the filtrate was used for pH, ammonia-N, lactic acid and the VFA determination. The pH was directly measured by pH meter (Thermo Orion, USA). The NH_3-N concentration was measured by ammonia-sensing electrode (Expandable Ion Analyzer EA940, Orion, USA). Lactic acid concentration was analyzed using high performance liquid chromatography (Waters 600E, USA). Samples for the VFA analysis were prepared as described by Li and Meng (2006), and the VFA concentrations were determined using gas chromatography (GC-2010, Shimadzu, Japan) with a 30 m the FFAP capillary column (0.25 mm i.d. and 0.30 μm film thickness). Each analysis was performed in triplicate.

Statistical analyses

Data was subjected to statistical analysis using the general linear model (GLM) procedure of the SAS (1999) for a completely randomized design to test the main effects of the PFJ addition on nutritive value of ensiled rice straw. Significance was declared at $p<0.05$ unless otherwise noted.

Results

Fermentation quality of rice straw silage

The data on silage fermentation quality of different PFJ additions in rice straw silage is shown in Table 1.

Table 1 Effects of different PFJ additions on fermentation quality of rice straw silages

Item	Control	PFJ	PFJ20	dPFJ	dPFJ20
pH	4.54±0.13a	3.70±0.01c	3.83±0.02b	3.69±0.01c	3.80 ±0.01b
NH_3-N (g·kg^{-1} TN)	5.73±0.29a	3.34±0.71b	3.76±0.30b	3.43±0.69b	3.64±0.45b
Organic acids (% DM)					
Lactic acid	1.06±0.09c	1.82±0.12a	1.14±0.11b	1.30±0.11b	1.09±0.13b
Acetic acid	0.34a±0.11	0.26±0.06b	0.26±0.11 b	0.22±0.07b	0.28±0.08b
Butyric acid	0.07±0.03	0.05±0.02	0.07±0.03	0.04±0.01	0.05±0.01
L∶A	3.11b	7.00a	4.38b	5.90a	3.89b

TN=Total nitrogen; L∶A=Lactic acid∶acetic acid. a, b, and c mean different letters within the same row differ from each other ($p<0.05$). The same as below.

The results demonstrated that pH differed between the control and the PFJ treatments ($p<0.05$), while pH did not differ between the PFJ and the dPFJ ($p>0.05$) , and the same results were obtained between the PFJ20