Silage preparation and fermentation characteristics of pearl millet stover treated with microbial additive in West Africa

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Introduction

Generally, the crop by-products are the main roughage sources for ruminants in tropical developing countries including Africa. The most important limiting factor for cows in the tropics is shortage of feed in the aspect of quantity and quality, especially in the dry season. Pearl millet (PM, Pennisetum glaucum L.) is indigenous African cereals that unlike maize and wheat, are well adapted to African semi-arid and sub-tropical agronomic conditions. The PM stover could be used for livestock feed. However, some stovers were generally discarded in the field and burned used as fertilizer. Previously, interest has shifted toward natural grass silage as a main feed source for ruminant animals. Recent year, lactic acid bacteria (LAB) inoculant and cellulase enzyme are widely used for silage production in the world. However, a limited information are available on PM silage preparation. The purpose of this work to study the silage preparation and fermentation characteristics of PM stover treated with microbial additive in West Africa.

Material and method

The PM that is widely cultivated in West Africa was selected for this experiment. PM stover including stems and leaves were harvested at maturity stage in an field of local farm, Koudougou, Burkina Faso in October 27, 2018. The PM was used for silage making by using laboratory-scale fermentation system. The commercial LAB inoculant Chikusou-1 (LP, Lactobacillus plantarum, Snow Brand Seed Co., Ltd, Sapporo, Japan) and cellulase enzyme (AC, Acremonium cellulase, Meiji Seika Pharma Co., Ltd, Tokyo, Japan) were used as silage additives based on the guidelines of a commercial manufacturer. Silage treatments were designed as control; LP and AC. After harvest, fresh PM stover (about 80 kg) were immediately cut into approximately 1 to 2 cm lengths by a chopper, and then approximately 8 kg were packed into 20 L used polyethylene drum silos. The silos with triplicates for each treatment were kept at an ambient temperature (25–38°C). After 120 days of fermentation, these silos were opened for analysis of microbial population, chemical composition, and fermentation quality.

Result and discussion

The dry matter (DM) of PM stover was 43.15%. The organic matter, crude protein, ether extract, neutral detergent fiber, and acid detergent fiber contents were 93.37, 4.18, 0.75, 77.10, and 48.30% on a DM basis, respectively. The aerobic bacteria dominated PM stover with $10^5$, while the LAB was below $10^2$ colony-forming unit (cfu)/g on a fresh matter (FM) basis. After 120 days of fermentation, the chemical composition did not show marked differences among the control, LP, and AC-treated silages. In the control silages, aerobic bacteria ($10^5$ cfu/g of FM) was the dominant species, but the LAB of the LP and AC-treated silages were the dominant population with $10^5$ cfu/g of FM (Fig. 2). The counts of coliform bacteria and molds in the PM stover silages were below detectable levels (< $10^2$ cfu/g of FM). During ensiling, LAB can use sugars to produce lactic acid, thereby reducing the pH and inhibiting the growth of harmful bacteria, in turn resulting in good-quality silage. The control silage was of poor quality, with low lactic acid content (0.40% of FM), and a relatively high pH (4.64) and ammonia nitrogen values (0.48 g/kg of FM). When silage inoculated with additives, their fermentation quality were improved (Fig. 3). These results suggest that the PM can be prepared as silage and the LAB inoculant and cellulase enzyme can improve the fermentation quality.