PREPARATION AND FERMENTATION OF MIXED SILAGE OF COTTON STALK AND CORN STOVER

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ABSTRACT

Cotton is a globally economic crop with an enormous yield of cotton stalk, which are usually difficult to prepare high-quality silage alone. To explore the high-value utilization approach of cotton stalk, this experiment designed corn stover silage mixed with cotton stalk at ratios of 0%, 10%, 25%, 50% and 100%. The inoculant *Lactiplantibacillus plantarum* and cellulase were added for silage preparation. The results showed that corn stover silage was good fermentation quality with pH below 4.0 and lactic acid content higher than 3% of fresh matter, while the cotton stalk silage was poor quality. With the increase in the mixing ratio of cotton stalk, the pH of the silage increased and the lactic acid content decreased. The fermentation quality was lower significantly ($P < 0.05$) when the mixing ratio of cotton stalk exceeded 25%. The combined addition of lactic acid bacteria and cellulase shows a bacteria-enzyme synergistic effect, improving the fermentation quality of mixed silage.

Keywords: cotton stalk, corn stover, mixed silage, fermentation quality, feed utilization technology

INTRODUCTION

Cotton and corn, as important global economic and food crops, generate a large amount of straw resources through large-scale cultivation. Corn stover can be converted into a core roughage source for livestock through high-quality silage fermentation. However, cotton stalk has low nutritional value due to high lignification and anti-nutritional factors such as free gossypol, and it is poorly palatable when fed directly, which is a key bottleneck limiting its use as feed (Wang *et al.*, 2024). For a long time, a large amount of cotton stalk has been discarded or burned, resulting in the waste of biomass resources and increasing environmental burden.

This study focuses on mixed silage of cotton stalk and corn stover, systematically exploring how mixing ratios, microbial inoculants, and other key factors affect fermentation characteristics. The goal is to provide theoretical support and practical references for the high-value utilization of cotton stalk, cost reduction and efficiency improvement in livestock farming, and the development of a green circular agricultural economy.

MATERIALS AND METHODS

Cotton (*Gossypium hirsutum*) stalks were obtained from the Experimental Base of Institute of Cotton Research of Chinese Academy of Agricultural Sciences (Anyang, China), and corn (*Zea mays*) stovers from the Experimental farm of Zhengzhou University (Xingyang, China). Silage additives included L. plantarum FG1 (Zhengzhou University, Zhengzhou, China) and cellulase (CEL, Nanning, China). The mixing ratios of cotton stalk to corn stover were 0, 10, 25, 50, and 100%. Treatments were designed as control, CEL, FG1, and CEL FG1. Silage was prepared with polyethylene plastic bags, vacuum-sealed, and stored at room temperature (20–25°C). After 60 days of fermentation, samples were taken and analyzed for fermentation quality.

RESULTS AND DISCUSSION

Table 1 shows the chemical compositions of the two straw types. Cotton stalk had higher pH, dry matter (DM) and crude protein (CP) but lower neutral detergent fiber (NDF) and acid detergent fiber (ADF) than corn stover.

Fig. 1 illustrates the fermentation quality. Corn stover had 60%–70% moisture (Fig. 1-a) and exhibited favorable fermentation when ensiled alone: pH < 4.0 (Fig. 1-b), lactic acid > 3% in FM (Fig. 1-c), and ammonia nitrogen (NH_3-N) < 0.5% (Fig. 1-d), meeting high-quality silage criteria. In contrast, pure cotton stalk silage had higher pH and lower lactic acid, indicating poor fermentation. Fermentation improved at a 10%–25% cotton stalk mixing ratio, but when the ratio exceeded 25%, pH rose significantly and lactic acid dropped markedly, resulting in inferior quality. Thus, the mixing proportion of cotton stalk should not exceed 25% in silage or fermented total mixed ration (TMR).

Adding lactic acid bacteria and cellulase did not significantly improve fermentation, and no obvious synergistic effect was observed. A significant increase in ammonia nitrogen occurred only in the 10% cotton stalk mixed silage group, and the mechanism remains unclear. Future research will focus on the effects of cotton stalk chemical composition on silage fermentation and the associated protein metabolic pathways and regulatory mechanisms.

Tab. 1: Chemical composition of cotton stalk and corn stover

Item	Cotton stalk	Corn stover
pH	7.12	6.18
Dry matter (DM, %)	79.10	27.78
CP (% DM)	14.65	9.17
NDF (% DM)	40.80	42.77
ADF (% DM)	32.77	32.23

DM, dry matter; CP, crude protein; NDF, neutral detergent fiber;ADF, acid detergent fiber.

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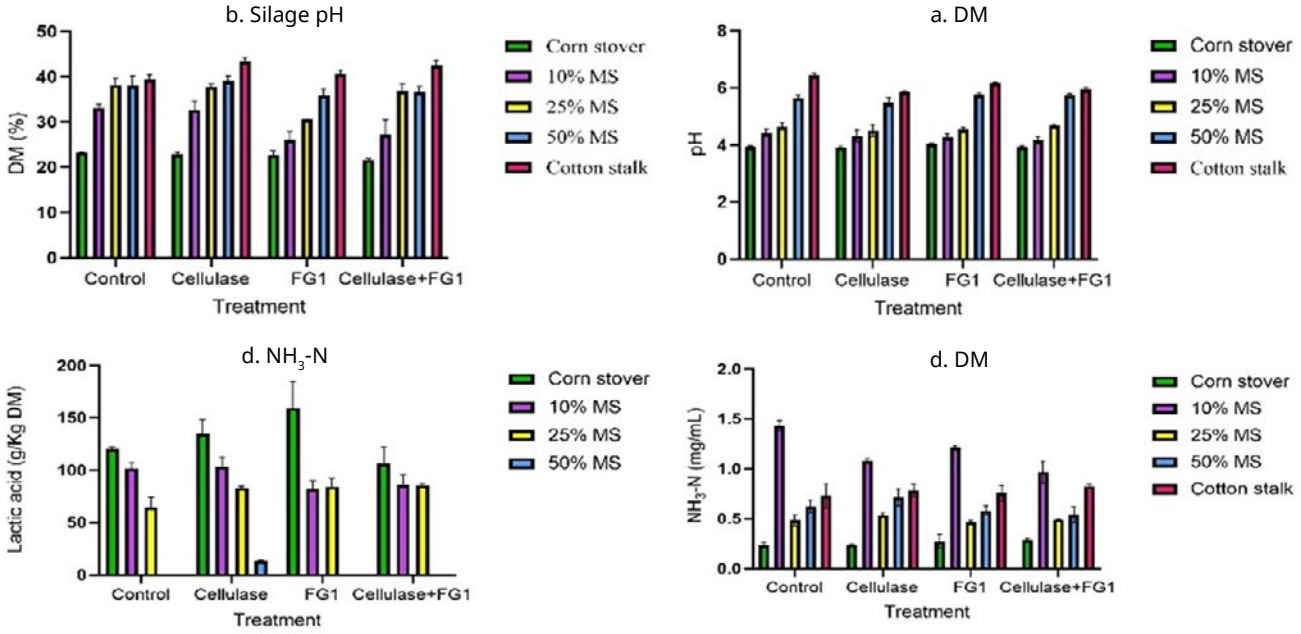

Fig. 1: Fermentation quality of mixed silage prepared with cotton stalk and corn stover

CONCLUSION

This study confirms that ensiling cotton stalks alone often leads to poor fermentation quality, whereas mixing them with corn stalks can effectively improve fermentation performance. When the proportion of cotton stalks exceeds 25%, the fermentation quality of the mixed silage significantly decreases. Therefore, when preparing silage or fermented total mixed rations, the mixing ratio of cotton stalks should not exceed 25%. This study can provide baseline data support for the high-value utilization of cotton stalks.

REFERENCES

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