EFFECTS OF *ARTEMISIA ARGYI* ADDITION ON FERMENTATION QUALITY AND GREENHOUSE GAS EMISSIONS OF CORN STOVER SILAGE

Wang, X.[1], Yue, Z.[1], Zhong, Z.[1], Zhang, M.[1], Tan, Z.[1], Wang, Y.[1], Wang, E.[1], Pang, H.[1], Cai, Y.[1]

[1]School of Agriculture and Biomanufacturing, Zhengzhou University

ABSTRACT

Although silage can efficiently utilize forage, its fermentation process produces greenhouse gases, resulting in nutrient loss and environmental pollution. In this study, corn stover was used as the raw material and *Artemisia argyi* (AA) as an additive for mixed silage preparation, and the variations of microbial community, fermentation quality, chemical composition and greenhouse gas emissions during ensiling were analyzed. The results demonstrated that compared with the single corn stover silage, silage mixed with AA could enriched beneficial bacteria such as Lactiplantibacillus and inhibited harmful bacteria including Enterobacter, lowered the pH value, increased lactic acid content, and reduced emissions of greenhouse gas containing CO_2, CH_4, and N_2O more than 65%. This study offers reference for additive development, straw silage optimization, and the realization of the carbon neutralization targets in animal husbandry.

Keywords: forage preservation, delayed ensiling, bacterial strains, aerobic spoilage

INTRODUCTION

Corn stover is characterized by high crude fiber content, low nutritional value, insufficient moisture and soluble carbohydrates, and a low abundance of epiphytic lactic acid bacteria (LAB) on its surface, which makes natural ensiling difficult (Zhou *et al*., 2025). Meanwhile, greenhouse gases (GHGs) are generated during the silage fermentation process. When *Artemisia argyi* (AA) is used as an additive for corn fermentation, it can improve feed quality, reduce mycotoxin levels and enhance aerobic stability. At present, safe Chinese herbal medicines are rarely mentioned in the research on silage additives. In the present study, *Artemisia argyi* (AA) was utilized as a silage additive (Wang *et al*., 2023). This research is expected to provide a reference for the development of novel additives for straw silage, facilitate the efficient utilization of straw resources, and establish technical systems for GHGs emission mitigation in agriculture and animal husbandry

MATERIAL AND METHODS

TCorn stover and whole plant of *Artemisia argyi* (AA) were obtained from Henan, China in Sep., 2024. Four experimental treatments were set up as follows: CS (corn stover), 30% AA (corn stover supplemented with 30% *Artemisia argyi*), 60% AA, and AA (pure *Artemisia argyi* as the control group). Microbial populations were analysed via the dilution plate spreading method. Samples were filtered through four layers of gauze to determine pH values and LA concentrations. Samples were dried at 65 °C for 48 h and weighed to establish dry matter (DM) content. Thereafter, the dried samples were ground and sieved, followed by the determination of water-soluble carbohydrate (WSC), neutral detergent fibre (NDF), acid detergent fibre (ADF), and CP concentrations. The contents and concentrations of CO_2, CH_4 and N_2O were determined by the water displacement method combined with gas chromatography. Determination of microbial community was analyzed by high-throughput sequencing. Metabolic components were measured by liquid chromatography-tandem mass spectrometry (LC-MS/MS).

RESULTS AND DISCUSSION

Sampling and analysis of corn stover silage across different fermentation durations revealed that the groups supplemented with 30% and 60% AA maintained consistently lower pH values and higher CP contents throughout ensiling, while reducing ammonia nitrogen and NDF and ADF concentrations, thereby optimising overall silage quality.

At the phylum level (Figure 1a), the dominant flora shifted from Proteobacteria to Firmicutes on day 3 of fermentation. The relative abundance of Firmicutes in the 60% AA group further increased on day 30 compared with that on day (Figure 1b).

Among all treatments, the 60% supplementation ratio demonstrated the most pronounced improvement in the fermentation quality of corn stover silage. Analysis on the dynamic variations of greenhouse gas emissions (Figure 2) indicated that the 30% and 60% AA groups exhibited a pronounced inhibitory effect on the production of CO_2 and CH_4. AA treatment enriches beneficial microorganisms such as LAB and inhibits the proliferation of harmful bacteria. By regulating pivotal metabolic pathways including amino acid biosynthesis and dicarboxylic acid metabolism, it ultimately suppresses the production of greenhouse gases such as N_2O, CO_2 and CH_4 (Figure 3).

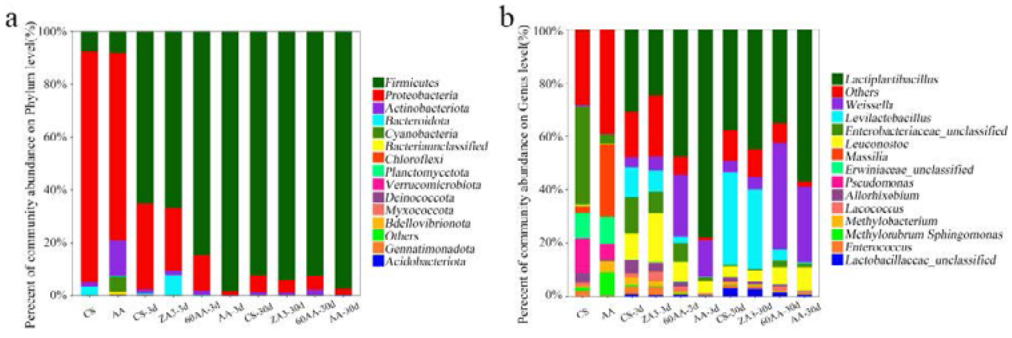

Fig. 1: Microbial community at the phylum level of corn stover silage after 30 days of ensiling

https://doi.org/10.11118/978-80-7701-093-1-0082

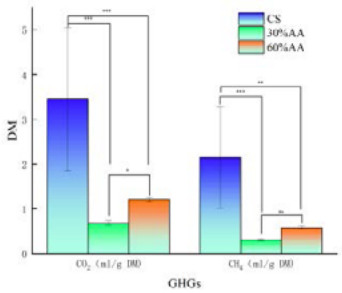

Fig. 2: Greenhouse gas variations

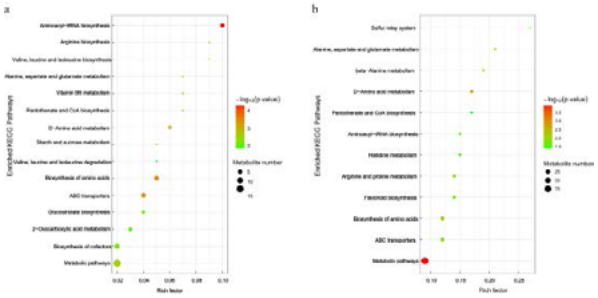

Fig. 3: KEGG functional annotation after 30 days of ensiling

CONCLUSION

Appropriate supplementation of AA reduces greenhouse gas emissions, pH values and crude fiber content of silage, improves the efficiency of lactic acid fermentation, and increases water-soluble carbohydrate levels, thereby enhancing the quality of straw forage. The optimal application ratio is 60% AA addition to corn stover silage.

Acknowledgement

Changjiang Scholars Program of China; National Science Foundation for Young Scientists of China (32201468); Approval of Independent Innovation Projects for Graduate Students at Zhengzhou University (20250423).

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Contact Information

Huili Pang: email: pang@zzu.edu.cn
Yimin Cai: email: caiyimin@zzu.edu.cn