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Fermentation of African Leafy Vegetables to Lower Post-Harvest Losses, Maintain Quality and Increase Product Safety

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Abstract

African leafy vegetables (ALV) are important in securing the food supply and livelihood of small-holder farmers in rural and urban/peri-urban areas. Inadequate postharvest handling, facilities for storage and transport, inappropriate processing methods for product preservation, insufficient hygiene conditions in the markets and poor infrastructure aggravate these problems, causing massive losses. The fermentation of ALVs helps in preparation and extending their shelf life. Cowpea (*Vigna unguiculata*) and African nightshade (*Solanum scabrum*) leaves were fermented in three batches of 20 g, 100 g and 1 kg to test six different lactic acid bacterial starters (inoculum $[10^6]$ cfu ml⁻¹ at different brine concentrations. To determine the role of the starter cultures to inhibit the pathogens *Listeria monocytogenes* and *Salmonella* Enteritidis, 100 g of leaves were fermented in 1 L beakers with starter combinations of *Leuconostoc mesenteroides* ssp. *mesenteroides* and *Lactobacillus plantarum*. The largest fermentation assay was carried out in 5 liters clay pots with *Lactobacillus plantarum* and *Lactobacillus fermentum*. The pH values and microbial counts of total bacteria, lactic acid bacteria, enterobacteria, yeast and molds were determined at 0, 24, 48, 72 and 144 h. The optimal fermentation conditions were achieved with *L. plantarum*, *L. mesenteroides* ssp. *mesenteroides*, *Lactococcus lactis* and *L. fermentum*. A combination of salt and sugar (3% each) as brine led to the quickest and deepest pH-values. The starters reduced the pH below 4 within 24 h, which makes these ideal candidates as starter cultures to inhibit the growth of spoilage and pathogenic microorganisms. In the scaled-up challenge test, the combination of the starter strains *L. plantarum* and *L. mesenteroides* ssp. *mesenteroides* successfully inhibited the growth of *L. monocytogenes* and *Salmonella* Enteritidis by reducing the pH below 4 within 48 h. In the 5 L fermentation assay, the batch with the inoculated lactic acid bacterial starter strains showed a strong decrease of pH value to 3.7 within 24 h in contrast to the control. Enterobacteria were inhibited after 24 h, and no yeast and molds could be detected. Thus, the fermentation of cowpea and nightshade leaves with selected starter cultures showed an improved status of food hygiene and safety.

Keywords: African indigenous vegetables, fermentation, lactic acid bacteria, safety