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Perspective

Evaluation of Probiotic Potential and Antimicrobial Activity of Lactic Acid Bacteria Isolated from Fermented Vegetables

Ruta Jankauskaite*

Department of Food Science and Technology, University of the Philippines Los Baños, Laguna, Philippines

DESCRIPTION

Lactic Acid Bacteria (LAB) are widely recognized for their probiotic potential and antimicrobial properties, making them vital components of fermented foods. Fermented vegetables, a staple in many traditional diets, serve as rich sources of diverse LAB strains capable of contributing to gut health and inhibiting foodborne pathogens. In Lithuania, homemade and locally produced fermented vegetables such as sauerkraut, cucumbers, and beets remain popular and provide a valuable matrix for isolating native probiotic candidates. This study aimed to isolate and identify LAB strains from various fermented vegetables and evaluate their probiotic attributes, including acid and bile salt tolerance, and their antimicrobial activity against selected pathogenic bacteria.

Samples of naturally fermented vegetables were collected from households and small-scale producers in Vilnius and surrounding rural areas. After homogenization and serial dilution, LAB isolates were cultured on de Man, Rogosa, and Sharpe (MRS) agar and incubated anaerobically at 37°C for 48 hours. Distinct colonies were selected based on morphology and subjected to Gram staining and catalase testing. Only Gram-positive, catalase-negative isolates were considered for further study. The purified LAB strains were preserved in glycerol stocks and analyzed for their physiological and antimicrobial properties.

To assess their probiotic potential, isolates were tested for survival in acidic (pH 2.5) and bile salt (0.3% oxgall) conditions, simulating the human gastrointestinal environment. Approximately 60% of the isolates showed good tolerance to low pH, with survival rates exceeding 70% after 3 hours of exposure. Similarly, a substantial number demonstrated resilience in bile salt, with survival rates ranging from 60% to 85%. These results indicated that a considerable proportion of the LAB strains could potentially survive transit through the human digestive system, a critical criterion for probiotic functionality.

Further characterization involved testing the antimicrobial activity of the LAB isolates against common foodborne pathogens, including *Escherichia coli*, *Salmonella enterica*, *Listeria monocytogenes*, and *Staphylococcus aureus*. The agar well diffusion method was used, where cell-free supernatants of the LAB cultures were applied to wells on pathogen-inoculated nutrient agar plates. Zones of inhibition were measured after 24 hours of incubation. The majority of LAB isolates exhibited clear inhibitory activity against at least two pathogens, with several strains producing broad-spectrum effects. The strongest inhibition was observed against *Listeria monocytogenes* and Staphylococcus aureus, suggesting that certain LAB strains produce bacteriocin-like compounds or organic acids capable of suppressing Gram-positive pathogens.

Additionally, selected LAB strains were evaluated for their auto-aggregation and co-aggregation abilities, which play a role in gut colonization and competitive exclusion of pathogens. High auto-aggregation rates (>50%) and significant co-aggregation with *E. coli* and *S. aureus* were recorded for multiple isolates, indicating strong adherence potential. These properties further reinforce the probiotic suitability of these LAB strains for potential application in functional food development or as starter cultures.

Molecular identification using 16S rRNA gene sequencing revealed that the dominant strains belonged to *Lactobacillus plantarum*, *Lactobacillus brevis*, and *Pediococcus pentosaceus*. These species are already known for their probiotic benefits and are widely studied for food fermentation applications. The identification of locally sourced strains with strong probiotic and antimicrobial attributes highlights the potential for developing region-specific probiotic products using traditional fermentation knowledge.

In conclusion, the fermented vegetable samples from Lithuania proved to be a rich source of lactic acid bacteria with promising probiotic potential and significant antimicrobial activity. Many of the isolated strains demonstrated excellent acid and bile tolerance, broad-spectrum pathogen inhibition, and favorable aggregation characteristics. These findings support the use of fermented vegetables not only as nutritious foods but also as natural reservoirs of beneficial microbes that could be utilized in

Correspondence to: Department of Food Science and Technology, University of the Philippines Los Baños, Laguna, Philippines, E-mail: ruta.jankauskaite@vufermic.lt

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the development of probiotic supplements or starter cultures. Given the global demand for natural and functional foods, the incorporation of these locally isolated LAB strains into food systems could enhance food safety, improve gut health, and preserve traditional fermentation practices in Lithuania and beyond. Further *in vivo* studies and safety evaluations are warranted to confirm their efficacy and viability as commercial probiotics.