LACTIC ACID BACTERIA AS A BIOPRESERVATIVE IN FERMENTED FOODS

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Abstract: Public concerns regarding the safety of chemical preservatives in food have led to the use of natural preservatives. Naturally produced antimicrobial compounds tend to promote the substitution of conventional methods and lessen the rigidity of the use of chemical and physical preservatives. In this review, the effects of lactic acid bacteria (LAB) metabolites on the shelf life of fermented foods were investigated. Analysis of the LAB antimicrobial activity against pathogenic bacteria and the effect of LAB on physicochemical properties of the fermented foods were done. Based on the relevant articles, the shelf life of the fermented food was increased with the presence of LAB metabolites including lactic acid, acetic acid, sorbic acid, benzoic acid and bacteriocin. The LAB was found to be able to replace chemical preservatives as the shelf life of food samples was extended. Moreover, no negative effect was reported on the physicochemical properties of fermented food from the addition of LAB. It was shown to inhibit pathogenic bacteria *Listeria monocytogenes*, *Bacillus subtilis*, *Escherichia coli*, *Salmonella typhimurium*, *Staphylococcus aureus* and *Micrococcus luteus* with the most dominant species of *Lactobacillus plantarum* found. Hence, these findings have demonstrated the LAB as an efficient biopreservative in fermented foods.

Keywords: Biopreservative, lactic acid bacteria, lactic acid, natural preservative, bacteriocin

1. Introduction

The food industry is focusing on using natural compounds that are considered safe alternatives and meet consumer preferences for healthier food. According to Mani-López et al. (2018), biopreservation is a food preservation technique that involves the use of antimicrobial substances to extend the shelf life of a product. Biopreservative may come from natural sources or formed in food fermentation. It should be safe and cheap, do not produce any adverse effects, stable, effective at low concentrations and permitted by regulatory agencies. However, only a few biopreservatives achieved or were close to these requirements. Fermented foods are known as food or beverages that are produced from control microbial growth and the components of the food are being converted through enzymatic action which is known as fermentation. The success and safety of the fermentation product are determined by the developed acidity, low pH value, and total sugar elimination (Dimidi et al., 2019). The main microorganism that is involved in the process of fermentation is lactic acid bacteria (LAB) which is predominant in fermented foods. These LAB will ferment carbohydrates into a combination of lactic acid, carbon dioxide, and acetic acid and/or ethanol (heterofermentation), or almost completely lactic acid (homofermentation). It also produces other metabolites such as lactic acid, hydrogen peroxides and diacetyl.

2. Discussion

2.1. Metabolites of LAB and its effect on shelf life of fermented foods

Ebah et al. (2019) analysed cabbage, carrots and tomatoes stored in a tight jar for fermentation for six days. The higher the concentration of LAB, the more lactic acid is produced as a result of LAB breaking down carbohydrates, lowering the pH of the fermented food. As a result, microbial development was suppressed, extending the vegetables' shelf life. Ageni et al. (2017) studied the shelf life of ogi and fufu by extracting the bacteriocin from *Lactobacillus acidophilus* that was isolated from yoghurt and nono. The amount of bacterial load was reduced when the bacteriocin was added into them and the shelf life of ogi and fufu had been extended for 15 and 5 days, respectively compared to 45 and 40 days without bacteriocin. Tumbarski et al. (2021) concluded that the addition of purified bacteriocin can increase the antifungal activity, hence, the shelf life of the yoghurt can be extended. Salleh et al. (2021) did a study on the production of sorbic acid and benzoic acid compounds from lactic acid bacteria. These acids can resist *S. typhimurium* ATCC 14028, *E. coli* ATCC 11795, *E. coli* O157, *S. aureus* ATCC 25923 and *V. cholera* which increase the shelf life of fermented durian flesh.

2.2. Effect of LAB on physicochemical properties of fermented foods

Ravindran and RadhaiSri (2020) did a study on the physicochemical probiotic oats milk drink fermented with microencapsulated *Lactobacillus plantarum*. The addition of *L. plantarum* caused the values of pH to differ significantly ($p < 0.05$) than the non-fermented oats milk. The viscosity in the fermented spice and strawberry flavoured probiotic oat milk increased significantly than the non-fermented sample ($p = 0.03$). Masia et al. (2020) investigated the effect of *Lactobacillus rhamnosus* on the physicochemical properties of fermented plant-based materials such as soy, oat, and coconut. The post-acidification trends of oat samples differed significantly from soy and coconut samples. Kumar et al. (2013) stated that fruit juices with probiotics are useful for developing health-beneficial goods, especially for individuals who are sensitive to dairy products.

2.3. Effect of antimicrobial activity of LAB against pathogenic bacteria

Nizori et al. (2019) did a study on the effect of LAB on the antimicrobial activity in fermented durian paste during four weeks of storage. The result revealed that supernatants from LAB strains inhibited the growth of *S. aureus* and *E. coli* ATCC 25923 strains to varying degrees. Demirbaş et al. (2017) reported that the function of sourdough in terms of the technology primarily depends on the metabolism of LAB that can be originated from flour and other ingredients. Only *L. paraplantarum* N-15 showed antibacterial activity against *S. typhimurium* RSSK 95091. A study by Hamid and Fuzi (2020) on the antimicrobial activity in tapai pulut (fermented glutinous rice) and tapai ubi (fermented cassava) against *Bacillus subtilis*, *E. coli*, *S. typhimurium* and *S. aureus* showed all isolates strongly inhibited all strains except *S. aureus.*

3. Conclusion

LAB was proven to be a biopreservative in fermented foods. Lactic acid and its metabolites, such as sorbic acid, acetic acid, benzoic acid, and bacteriocin, had a significant impact on the shelf life

of fermented food. Furthermore, LAB influenced the physicochemical properties of fermented foods such as pH, water activity, titratable acidity, and viscosity in a positive way. The growth of pathogenic bacteria such as *S. aureus*, *E. coli*., *B. subtilis*, *S. typhimurium* and *M. luteus* can be inhibited by the antimicrobial activity of LAB. Additional research is required to determine the standard approaches to confirm the isolated bacteria's role in increasing the shelf life and preservation efficiency towards selected food products.

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