Exploring the potential of exopolysaccharide- and flavour-producing strains to improve texture and flavour of plant-based milk alternatives

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Introduction

In recent years, there has been increasing consumer interest in plant-based milk alternatives (PBMA) due to its health benefits and reduced environmental impact. Although PBMA possesses numerous benefits, the main obstacle to its consumption is the presence of undesirable texture and flavours. Fermentation by a range of lactic acid bacteria (LAB) could potentially improve the textural properties and sensory attributes of PBMA[1-2]. In this study, we explored plant-derived LAB as potential adjunct cultures of PBMA, using soymilk as a model, since soymilk is the most popular PBMA in the world.

Methods

A collection of ~600 LAB isolates from fruits, vegetables and herbs was assessed for their ability of exopolysaccharide (EPS) production on SMRS agar (De Man, Rogosa and Sharpe [MRS] agar supplemented with 5% [w/v] sucrose). Isolates that were forming slimy colonies were picked and re-streaked on fresh soymilk agar (soymilk mixing with agar) for confirmation as being able to produce EPS without extrinsic sugar. The effect of *in situ* EPS-produced by LAB was evaluated by measuring the water holding capacity of fermented soymilk. The Voges-Proskauer test was used to determine the ability of acetoin (desirable buttery and creamy flavour) production in soymilk fermentation. The development of pinkish-red colour indicates acetoin production. The results were qualitatively recorded as negative (-), weak (+), intermediate (++) and strong (+++), corresponding to the intensity levels.

Results

A total of 593 plant-derived LAB isolates were evaluated for their ability of EPS production. Only 13 isolates exhibited a viscous and ropy morphology on SMRS agar, with 3 of these isolates also displaying a similar morphology on soymilk agar (Figures 1B and 1C). These strains were identified as *Weissella confusa*, *Weissella cibaria* and *Leuconostoc mesenteroides* by 16s rRNA sequencing.

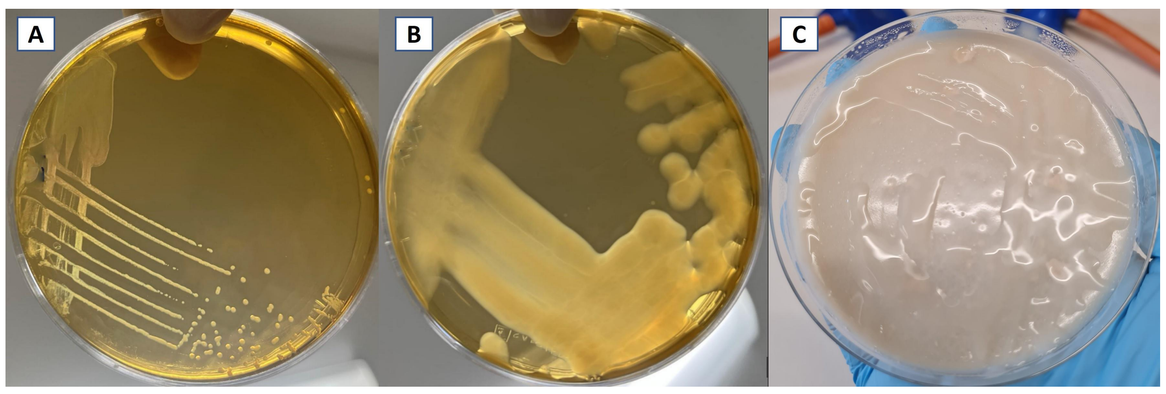

Figure 1. Examples of plant-derived LAB strains with poor EPS-producing (A) and strong EPS-producing ability (B and C) on SMRS and soymilk agar.

Strain possessing strong EPS-producing ability appeared to significantly increase the water holding capacity of fermented soymilk in comparison to that with poor EPS-producing ability (Figure 2).

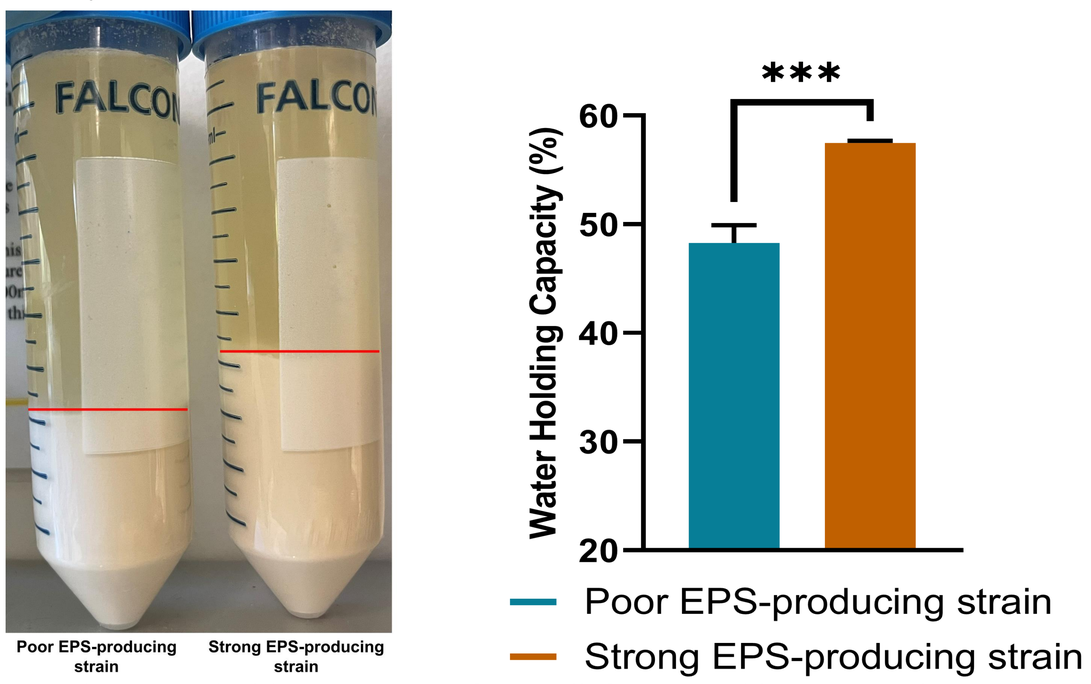

Figure 2. The water holding capacity of soymilk fermented by poor and strong EPS-producing strain.

Results

In terms of acetoin production, three *Lactiplantibacillus plantarum* and one *Latilactobacillus sakei* were able to produce a high level of acetoin (+++) after 24h of growth in soymilk (Figure 3).

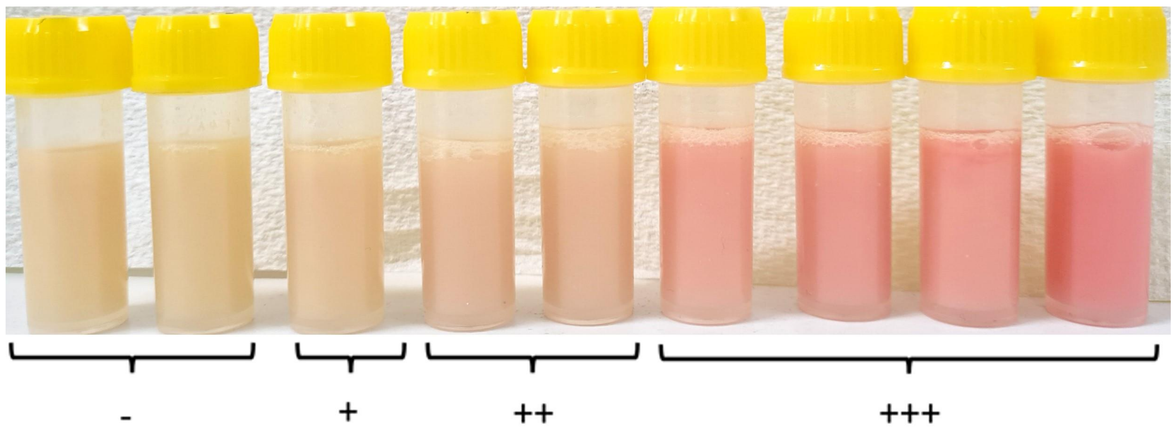

Figure 3. The results of Voges-Proskauer.

Conclusion

In summary, the findings of this study suggest that the use of EPS- and flavour-producing LAB strains can improve the texture and deliver a desirable buttery and creamy flavour in fermented soymilk. The production of EPS by these strains offers a promising approach to enhance mouthfeel and viscosity of the end products, creating a more indulgent sensory experience for consumers. The pleasant flavour imparted by these strains provides an appealing strategy to attract new consumers to explore and enjoy plant-based milk alternatives and their derivatives. As a result, the successful implementation of these strains would address the current issue of most PBMA products, potentially contributing to consumer satisfaction and increasing market demand in the ever-growing plant-based food industry.

Recommendations

Future research such as whole-genome sequencing for molecular basis and gas chromatography-mass spectrometry for volatile compounds analysis is needed to understand the underlying mechanisms of these effects. The safety assessment of LAB strains and sensory analysis of the end products should also be conducted to ensure the highest quality and safety standards.

References

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2. Harper, A. R., Dobson, R. C. J., Morris, V. K., Moggré, G. J. Fermentation of plant-based dairy alternatives by lactic acid bacteria. Microb Biotechnol 15(5):1404-21 (2022).

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