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Evaluation of LAB-Fermented Rice and Maize Sourdoughs as a Biotechnological Approach to Gluten-Free Bread Improvement

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INTRODUCTION & AIM

The growing prevalence of coeliac disease has increased the global demand for gluten-free (GF) bakery products. Despite this, GF breads often exhibit inferior texture, low nutritional value, and poor sensory acceptability compared to wheat-based counterparts.

Sourdough fermentation, driven by lactic acid bacteria (LAB), offers a sustainable biotechnological approach to enhance bread quality. LAB metabolic activity improves dough structure, flavour, and shelf life, while acidification and enzymatic processes increase mineral bioavailability and reduce antinutritional factors such as phytic acid. These functional benefits make sourdough fermentation particularly promising for GF applications.

This study evaluated *Fructilactobacillus sanfranciscensis*, isolated from traditional sourdough, for fermenting rice and maize flours and improving the technological and sensory properties of gluten-free bread.

METHOD

- pH
- Total titratable acidity (TTA)
- LAB count
- Enzymatic activities (amylase, xylanase, protease, phytase activities)
- L(+)- and D(–)-lactic acid

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Selected sourdough (highest phytase)

Gluten-free bread (0-80 % sourdough)

- pH
- TTA
- Porosity
- Specific volume
- Sensory analysis

RESULTS & DISCUSSION

- Fermentation caused stronger acidification in rice sourdough than in maize.
- Rice sourdough showed the highest amylase (0.43 U/g), phytase (46.57 U/g), and xylanase (41.52 U/g) activities.
- Maize sourdough had the highest protease activity (0.093 U/g) and LAB count (8.68 $\log_{10}$ CFU/g).

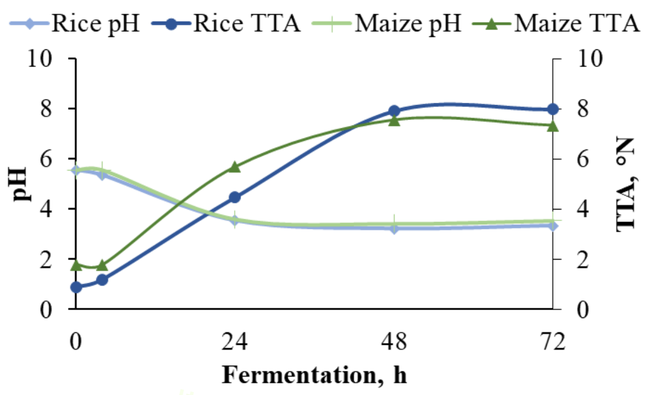

Figure 1. Changes in pH and TTA during sourdough fermentation

Table 1. Characteristics of rice and maize sourdoughs

Sourdough	Rice	Maize
Amylase, U/g	0.42±0.03	0.15±0.04
Protease, U/g	0.09±0.0	0.08±0.05
Xylanase, U/g	41.5±1.0	40.7±0.1
Phytase, U/g	46.6±1.5	43.6±1.3
L-lactic acid, g/100g	0.50±0.04	1.50±0.10
D-lactic acid, g/100g	0.48±0.07	0.62±0.6
LAB count, $\log_{10}$ CFU/g	8.12±0.10	8.68±0.12

- Increasing the proportion of rice sourdough (20–80%) reduced dough and crumb pH and increased TTA, without significantly affecting crumb porosity.
- LAB-fermented sourdough showed strong potential to improve the technological and sensory quality of gluten-free bread.

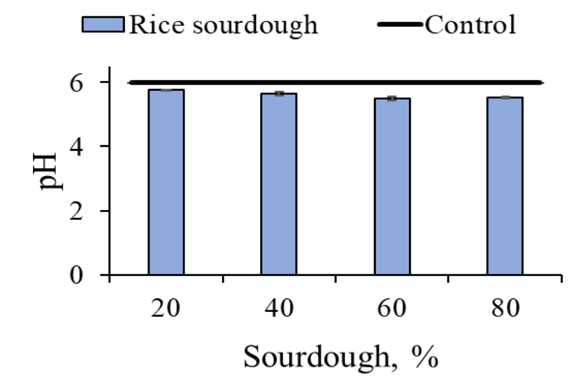

Figure 2. Effect of sourdough on pH of gluten-free bread.

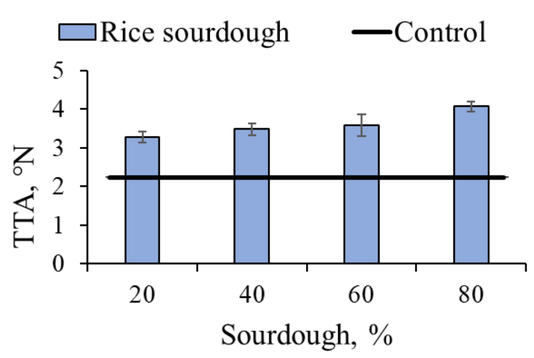

Figure 3. Effect of sourdough on TTA of gluten-free bread.

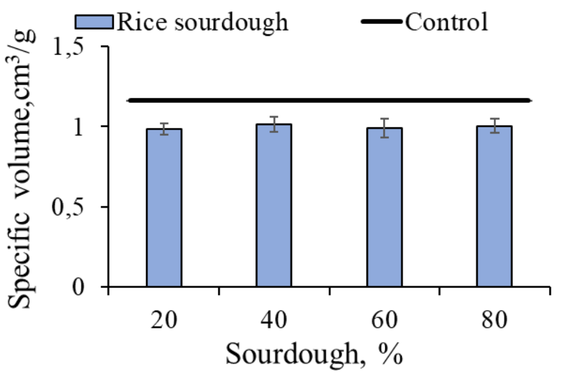

Figure 4. Effect of sourdough on specific volume of gluten-free bread

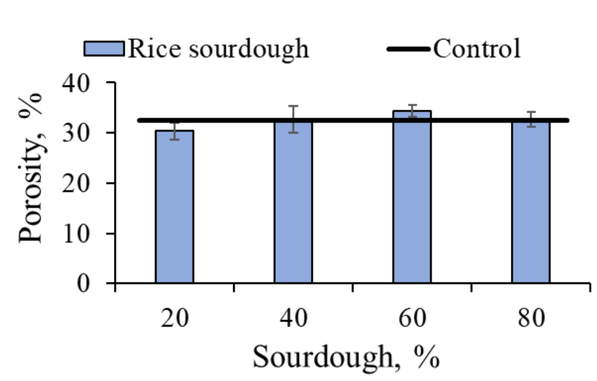

Figure 5. Effect of sourdough on crumb porosity of gluten-free bread.

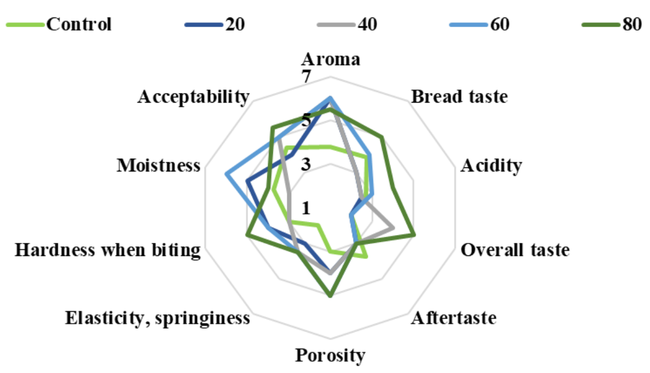

Figure 6. Effect of sourdough on sensory evaluation of gluten-free bread

CONCLUSION

- The LAB *Fructilactobacillus sanfranciscensis*, isolated from traditional wheat sourdough, effectively fermented rice and maize flours.
- Sourdough fermentation improved the technological and sensory properties of gluten-free bread.
- Rice sourdough showed strong potential as a functional ingredient for developing high-quality gluten-free products.