Rēwena sourdough fermentation with *Propionibacterium freudenreichii*: impacts on structure and texture

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Introduction

Rēwena (*reh–wah–nah*) sourdough is a unique form of bread from Māori cuisine[1].

Rēwena sourdough is produced using a mashed potato based starter culture employing spontaneous fermentation.

Propionibacterium freudenreichii is a Vitamin B_{12} producing probiotic commonly used in food production[2].

P. freudenreichii is also known for its ability to direct affect the structures of foods such as cheese due to CO_2 production.

Aim

To characterise the impacts that *P. freudenreichii* addition has on the structure and physical characteristics of Rēwena sourdough.

Methods

Base Recipe:
The base recipe (Fig 1) used for Rēwena sourdough production was selected based on online sources[3,4].

Starter culture
- Peeled mashed potato (300g), high-grade flour (260g) and cold potato cooking water (360g) were combined and incubated for 48 h at 25℃ to allow for spontaneous fermentation.

Rēwena dough
- Dough was prepared by combining high-grade flour (850g), water (425g), caster sugar (30g), iodised salt (15g), and baking soda (15g) and mixing for up to 10 min in a stand mixer.

Proofing and baking
- Dough underwent primary proofing at 4°C, was spit into loafs and then underwent secondary proofing at room temperature.
- Loafs were baked at 200°C for up to 25 min.

Fig 1: Base recipe for Rēwena sourdough

Recipe optimisation:
Potato variety, primary proofing time, and secondary proofing time were tested (*results not reported*).

- **Potato varieties tested:** Agria, Van Rosa, and Nadine
- **Primary proofing times:** 0h, 24h
- **Secondary proofing times:** 0h 2h, and 4h

The Optimise Recipe used Van Rosa potatoes, and underwent 24h of primary proofing, and 2h of secondary proofing.

Addition of *P. freudenreichii*

The Optimised Recipe was used as a base to prepare bread with or without 0.3 g commercial *P. freudenreichii* (Propionic Culture 0.5u, The Urban Cheese Company, Christchurch, New Zealand) as follows:

Control	• Optimised Recipe
P.F. Starter	• Bacteria added to Starter prior to incubation
P.F. Bread	• Bacteria added to Dough prior to mixing

Analysis:

Bread structure- Image analysis using standardised image acquisition and analysis in Fiji software[5]

Instrumental texture analysis- TPA methiod[6]

Results and Discussion

Bread Structure

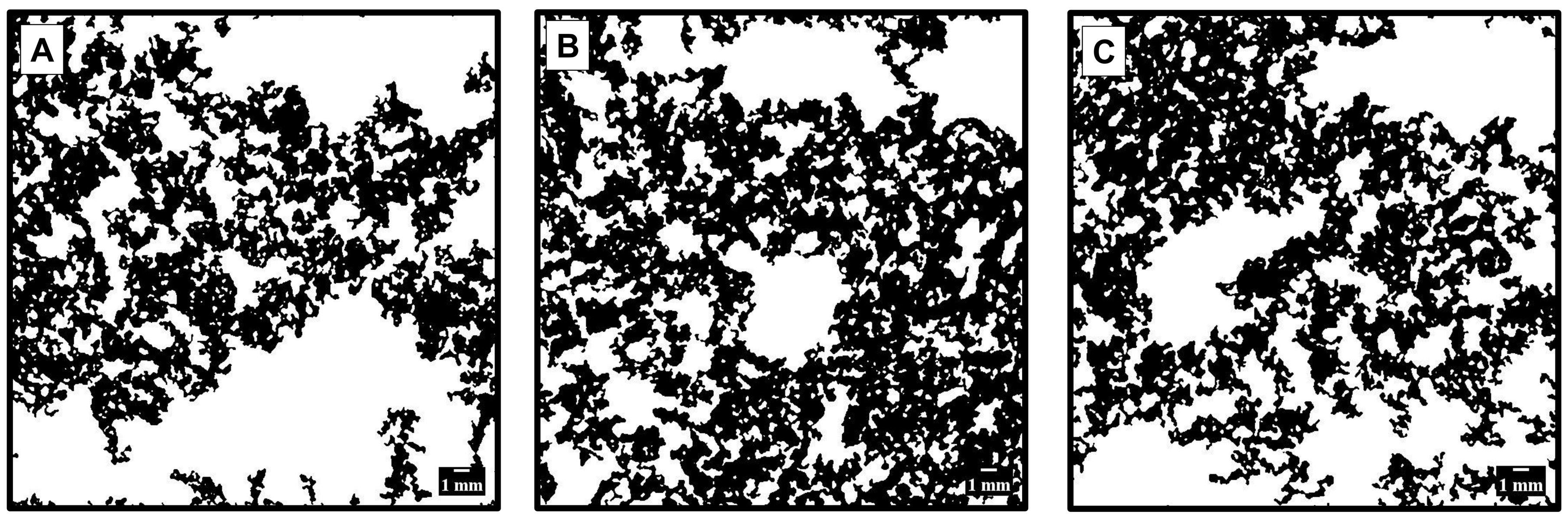
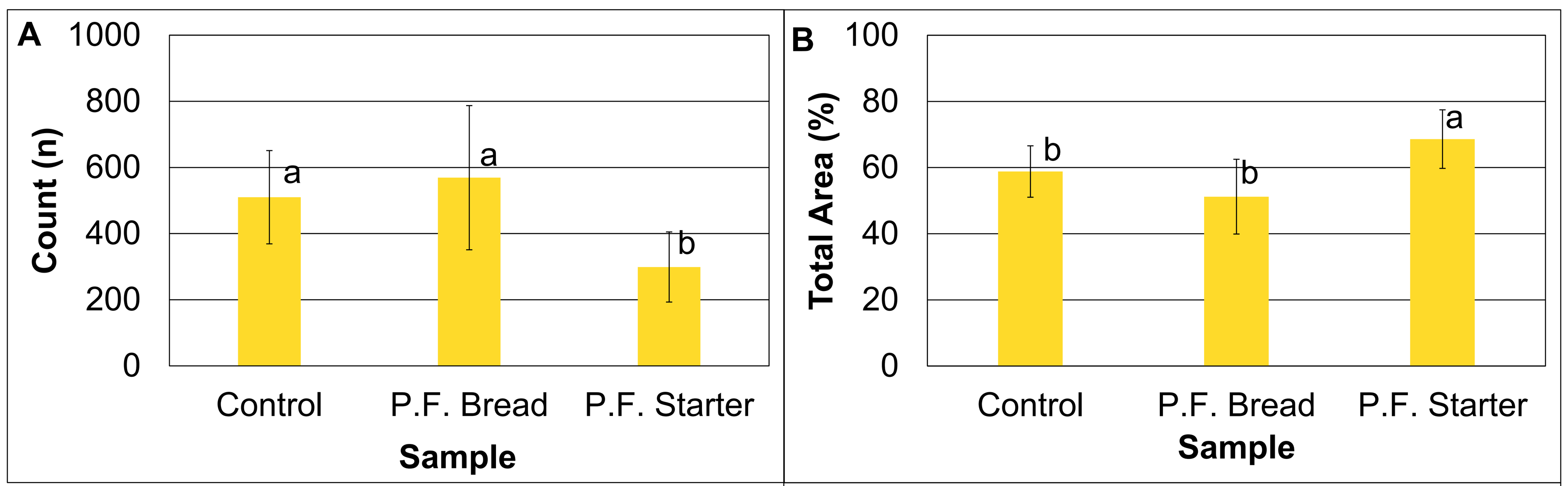
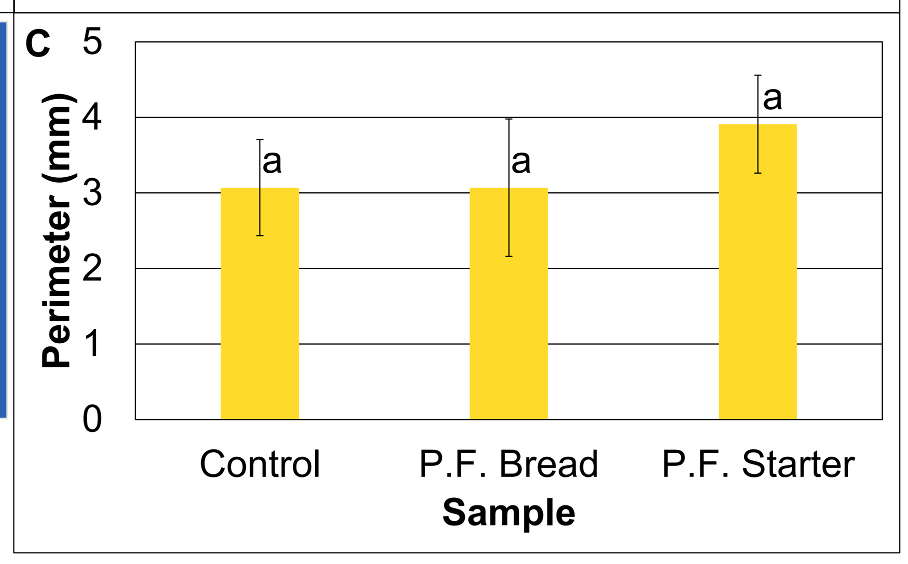


Fig 2 A (Control), B (P.F. Bread), and, C (P.F. Starter): Example processed images used for the determination of Rēwena sourdough structure (White= Air pockets).



The addition of *P. freudenreichii* to Rēwena sourdough starter cultures significantly affected (P<0.05) bread structure.



The addition of *P. freudenreichii* to Rēwena sourdough bread prior to mixing had no significant effect (P>0.05) on bread structure.

Fig 3 A, B, and, C: Rēwena sourdough structural changes (Mean ± S.D.) due to the addition of *P. freudenreichii;* Superscript letters indicate a significant difference between samples (P<0.05) by ANOVA and Tuley's test.

Instrumental Texture Analysis

No significant changes (P>0.05) in the texture of Rēwena sourdough textural occurred due to the addition of *P. freudenreichii*. Implying that changes in structure did not affect key textural parameters

Table 1: Rēwena sourdough textural changes (Mean ± S.D.) due to the addition of *P. freudenreichii;* No significant differences between samples (P>0.05) by ANOVA and Tuley's test.

Samples	Control	P.F Bread	P.F Starter
Hardness (g)	2,609 ± 483	2,575 ± 335	2,880 ± 224
Springiness (%)	0.826 ± 0.022	0.811 ± 0.039	0.840 ± 0.020
Gumminess (g)	1,664 ± 362	1,562 ± 157	1,671 ± 167

Conclusion

***P. freudenreichii* is a potential tool as a bio-fortification tool in foods however, its method of addition may affect food structures.**

References

[1] Sun, J., Silander, O., Rutherfurd-Markwick, K. … (2022). Phenotypic and genotypic characterisation of Lactobacillus and yeast isolates from a traditional New Zealand Māori potato starter culture. *Current Research in Food Science*, 5, 1287-1294; [2] Zhang, Y., Momoisea, P., Lin, Q. … (2023). Evaluation of Sensory and Physicochemical Characteristics of Vitamin B_{12} Enriched Whole-Meal Sourdough Bread Fermented with *Propionibacterium freudenreichii*. *Sustainability*, 15(10), 8157; [3]Sowmya. (2020). *Rewena Paraoa.* Bread Therapy. Https://breadanddreams.in/rewena-paraoa/; [4] Pantry, T. S. (2020). *Rēwena (Maori bread) recipe*. Https://totspantry.co.nz/blogs/recipe/rewena-maori-bread-recipe; [5] Demirkesen, I., Sumnu, G., & Sahin, S. (2013). Image Analysis of Gluten-free Breads Prepared with Chestnut and Rice Flour and Baked in Different Ovens. *Food and bioprocess technology*, 6(7), 1749-1758; 6 Gambaro, A., Fiszman, S., Gimenez, A. … (2004). Consumer acceptability compared with sensory and instrumental measures of white pan bread: sensory shelf-life estimation by survival analysis. *Journal of food science*, 69(9), S401-S405.

Acknowledgments

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