NSIEX+RS 2025
NEGERI SEMBILAN INTERNATIONAL EXPOSITION

HARMONY IN PROGRESS:

INTEGRATING SCIENCE, TECHNOLOGY, AND SOCIAL INNOVATION FOR SUSTAINABLE DEVELOPMENT GOALS

e-Book of Extended Abstract
Negeri Sembilan International (NSIEx) & Research Symposium
2025

YST011 - IMPACT OF SOURDOUGH FERMENTATION AND BAKING TEMPERATURE ON CALCIUM-FORTIFIED SOURDOUGH BREAD

Hana Maisarah Mohd Hambal, Nur Aisyah Ismail, and Safiyyah Shahimi*

UiTM Cawangan Negeri Sembilan Kampus Kuala Pilah, Pekan Parit Tinggi, 72000 Kuala Pilah, Negeri Sembilan

*Corresponding author: safiyyahshahimi@uitm.edu.my

ABSTRACT

Sufficient intake of calcium-rich foods is essential for maintaining bone health, particularly among vulnerable populations. In line with this, the current study investigated the impact of sourdough fermentation and baking temperature on the nutritional and physicochemical properties of calcium-fortified sourdough bread. The main objectives were to evaluate changes in calcium content, assess the influence of microbial fermentation on mineral and physicochemical properties and examine the effect of baking temperature. Two bread formulations were involved, which include a control bread with commercial yeast and a sample bread with sourdough starter, both fortified with calcium carbonate. Calcium analysis showed that fortification increased calcium levels in dough, however, baking led to a reduction. The control experienced a 20.5% calcium loss (from 1.05 to 0.84 mg/100 g), while the sourdough sample had a 23.3% loss (from 1.00 to 0.77 mg/100 g). LAB counts increased during fermentation, 2.6×10^8 CFU/g in the starter to 8.9×10^8 CFU/g in the dough, indicating active bacterial growth. Moreover, the protein content was slightly higher in sourdough bread (11.15%) compared to control (10.64%). Gluten content in the control dropped slightly after fermentation (from 25.54 g to 23.50 g), whereas the sourdough sample showed a complete gluten degradation (from 23.03 g to 0.00 g). Texture analysis revealed that sourdough bread had higher firmness (2626.21 g) compared to control (2380.74 g), while springiness was nearly identical (63.70 mm vs. 63.72 mm). Additionally, the pH of sourdough dropped more significantly (from pH 5.85 to pH 4.95) than the control (from pH 5.91 to pH 5.72), affirming strong microbial activity. These findings demonstrate that calcium-fortified sourdough bread can be nutritionally enriched while preserving desirable texture and structure, supporting its potential as a functional food to address nutrient inadequacies.

Keywords – calcium fortification, sourdough fermentation, baking temperature, physicochemical properties, food security

INTRODUCTION

Bread has become one of the main staple foods which is commonly consumed as part of daily meals in many cultures around the world. Sourdough bread is getting more attention today because of its natural fermentation that can improve flavour and digestion (Lau et

al., 2021). However, like most bread, sourdough bread still lacks essential nutrients such as calcium, which are crucial for development and growth (Gahamat et al., 2022). In recent years, gluten-free diets have become popular, especially among individuals with gluten intolerance or celiac disease. Unfortunately, many gluten-free products tend to have lower nutritional quality, including reduced calcium levels, as they are often made from refined flours with poor mineral content. This raises concern, especially for those who rely on such products as dietary staples. Therefore, this study aims to produce a better alternative of sourdough bread with enhanced nutritional value and improved nutrient content. The fortification of micronutrients, namely calcium, into sourdough bread could help address nutritional deficiencies and malnutrition among children and vulnerable populations (Naser et al., 2014).

OBJECTIVE

The objectives of this study are to evaluate the changes of calcium content in fortified sourdough bread, to investigate the effects of microbial fermentation towards calcium content and physicochemical properties of fortified sourdough bread as well as to analyse the effect of baking temperature towards the calcium content in fortified sourdough bread.

DESCRIPTION OF THE PROJECT

This project involved the development of sourdough bread that was fortified with calcium by using calcium carbonate. Two different types of bread were made, one made using commercial yeast (control) and another made using a sourdough starter. Both of the breads were baked in a breadmaker. The study focused on some of the properties of the bread, which included levels of calcium, protein and gluten content, texture (firmness and springiness), pH and microbial number. The product is useful as a healthier alternative to regular bread, especially for those who need more calcium in their diet. The technique used is practical and can be done on a small scale or even at home. This study offers a potential solution to help reduce the risk of calcium deficiency while providing a reduced-gluten bread option with acceptable texture and taste, making it suitable for individuals seeking lower-gluten alternatives in their diet.

Table 1: Calcium content in bread samples before and after baking

Sample Type	Dough (mg/100 g)	Bread (mg/100 g)	Calcium Loss (%)
Control Bread	1.05	0.84	20.5%
Sourdough Bread	1.00	0.77	23.3%

NOVELTY

This project introduces the development of sourdough bread that is fortified with calcium while maintaining its texture, flavour and overall bread quality. The novelty lies in combining microbial fermentation with mineral fortification and studying how baking temperature affects calcium retention. While calcium fortification is not new, applying it

specifically to sourdough bread and evaluating it in terms of both physicochemical and nutritional aspects adds originality. This approach also promotes a functional food that supports better dietary intake, especially for vulnerable populations.

CONCLUSION

This study found that fortifying sourdough bread with calcium can enhance its nutritional value while maintaining acceptable quality. Although calcium content increased in the dough stage, a reduction occurred after baking due to heat exposure. According to the Recommended Nutrient Intake (RNI) for calcium in Malaysia, which ranges from 1000 to 1200 mg/day for adults, the fortified bread still contributes positively despite the loss which were 20.5% in control bread (from 1.05 to 0.84 mg/100 g) and 23.3% in sourdough bread (from 1.00 to 0.77 mg/100 g). The lactic acid bacteria (LAB) count increased significantly from 2.6×10^8 CFU/g in the starter to 8.9×10^8 CFU/g in the sourdough, indicating successful fermentation, further supported by the drop in pH from 5.85 to 4.95. Furthermore, protein content increased slightly in sourdough (11.15%) compared to control (10.64%) and gluten content dropped drastically in the sample, from 23.03 g before fermentation to 0.00 g after, suggesting gluten breakdown during fermentation. For texture, sourdough bread showed slightly higher firmness (2626.21 g) than the control (2380.74 g), with similar springiness between both (63.70 mm for sourdough and 63.72 mm for control). These findings suggest that calcium-fortified sourdough bread could support dietary calcium intake and offer a lower-gluten alternative, beneficial for individuals seeking improved nutrition without compromising texture or quality.

REFERENCES

Gahamat, M. F., Rahman, M. M., and Daud, M. S. (2022). Nutritional Status of Under-Five Children and The Relationship with Household Food Wastage and Food Security in Samarahan, Malaysia. IIUM Medical Journal Malaysia, 21(4). https://doi.org/10.31436/imjm.v21i4.2052

Lau, S. W., Chong, A. Q., Chin, N. L., Talib, R. A., and Basha, R. K. (2021). Sourdough microbiome comparison and benefits. *Microorganisms,* *9*(7), 1355. https://doi.org/10.3390/microorganisms9071355

Naser, I. A., Jalil, R., Muda, W. M. W., Nik, W. S. W., Shariff, Z. M., and Abdullah, M. R. (2014). Association between household food insecurity and nutritional outcomes among children in Northeastern of Peninsular Malaysia. Nutrition Research and Practice, 8(3), 304. https://doi.org/10.4162/nrp.2014.8.3.304