Fermentation and Phytic Acid in Ancient Wheat

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ABSTRACT

Introduction: Sourdough bread made with ancient wheats is a nutritional gold medal. During the fermentation process, the combination of wild yeast and lactobacilli release nutrients that would otherwise be bound to phytate in yeast-only fermentations. This study aims to determine whether the type of wheat influences the breakdown of phytic acid in both sourdough and yeast bread. **Methods:** Five grain samples (hard white wheat, hard red wheat, einkorn, emmer, spelt) were analyzed through the stages of fermentation (freshly milled whole grain flour, sourdough starter on 3 consecutive days, dough and bread). The sourdough starter was fed 50g flour and 50ml distilled water, once per day. All samples remained at a stable temperature of 20-25°C. The sourdough was mixed using 250g flour, 25g starter and 200ml water, whereas the yeast loaf was mixed using 2.5g dry active yeast as opposed to sourdough starter. The Megazyme Phytic Acid Assay Kit, procedure and reagents, was used for data collection; values were calculated using the Mega-calc excel document. **Results:** Phytic acid is substantially lower after the fermentation process in all varietals (average decrease of 51% between flour and bread) except for einkorn. The yeast loaf lowered phytic acid (1.0713g/100g to 0.1763g/100g), however, there was a further decrease seen after 24 & 48 hours of fermentation, (0.1551g/100g, 0.0373g/100g), respectively. There was a large variability in phytic acid levels among wheats (0.1045g/100g – 1.6662g/100g). **Conclusion:** Wheat varietals showed a similar decrease of phytic acid between flour and bread, except for einkorn. Future research should look at the kinetics of both phytic acid and nutrient availability during the fermentation process.

INTRODUCTION

- Sourdough bread has many beneficial characteristics[1]:
  - Increased shelf life
  - Lower glycemic-index
  - Higher nutritional profile
- Whole intact wheats are well known for their high levels of protein, fiber, vitamins, minerals, and phenolic compounds lost when refined[3].
- Phytic acid resides in the aleurone layer of the grain[4].
- Phytase breaks down phytic acid and frees valuable nutrients bound to it[1].
- Phytase is naturally occurring in whole grains and is also present in yeasts and lactic acid bacteria[4].
- Phytase has been shown to reduce the level of phytate by approximately 70% if there is a moderate decrease in pH[5].
- Fermentation lowers the pH, creating a favorable environment for phytase (4.0-5.5 pH)[3].

PURPOSE

- The goal of this study was to determine how phytic acid levels differ between a classic yeast loaf and a fermented loaf. An array of ancient and locally adapted wheats were compared to see how wheat varietal affects phytic acid breakdown during the fermentation process.

METHODS

- The Megazyme Phytic Acid Assay Kit[2] (Wicklow, Ireland) procedure and reagents were used for data collection; values were calculated using the Mega-calc excel document.
- Testing took place in the UCCS Microbiology Lab.
- Whole grain flour was milled fresh at the beginning of each grain trial and tested immediately after milling.
- Samples included: hard red wheat, hard white wheat, emmer, einkorn and spelt
- The sourdough starter was created using 50g flour and 50 g distilled water, for each grain variety.
- A 1-gram sample was taken each day prior to feeding the starter.
- The starter was kept at room temperature (20-25°C)

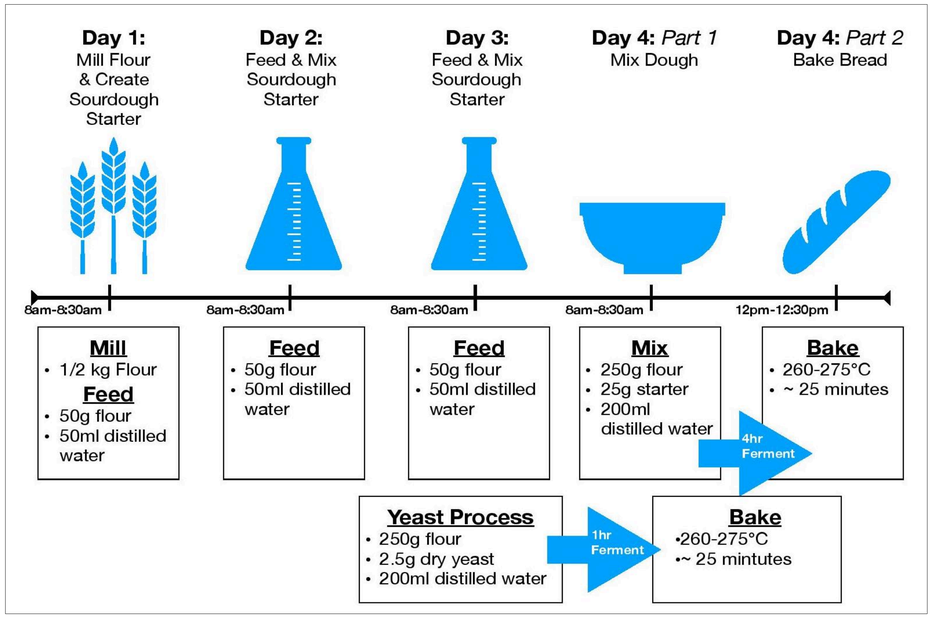

Diagram 1. Timeline of fermentation process

RESULTS

Flour Sample	Phytic Acid (g/100g)
Hard Red Wheat- Locally Adapted (CO)	1.0713
Hard White Wheat- Locally Adapted (CO)	1.0601
Einkorn (ID)	0.1045
Emmer (AZ)	1.6662
Spelt (CO)	0.7767

Table 1. Phytic acid content in flour samples

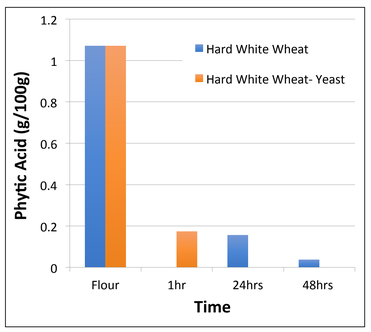

Figure 1. Sourdough vs. Yeast

RESULTS CONT'D.

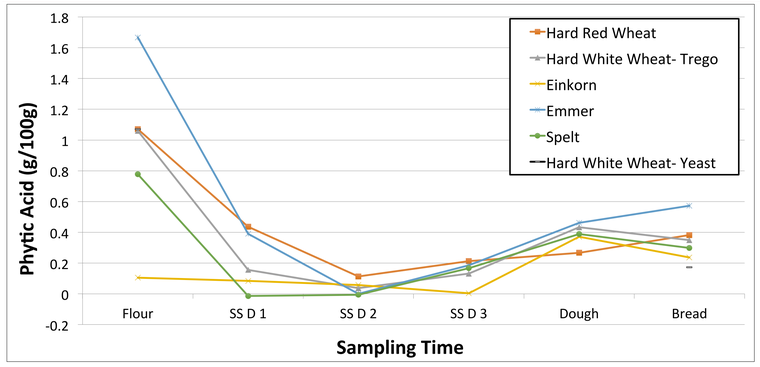

Figure 2. Phytic acid levels throughout the fermentation process

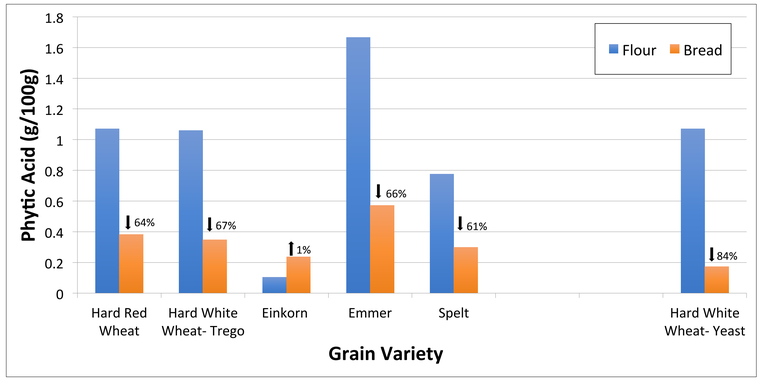

Figure 3. Phytic acid levels from flour to bread

DISCUSSION & CONCLUSION

- Phytic acid is substantially lower after the fermentation process in all wheat varietals except einkorn.
  - Average decrease of 51% between flour and bread
- The yeast loaf lowered phytic acid, but there was a larger decrease seen after 48 hours of sourdough fermentation
  - 1 hour: 0.1736 g/100g (yeast loaf)
  - 24 hours: 0.1551 g/100g (fermentation)
  - 48 hours: 0.0373 g/100g (fermentation)
- Future research should assess the kinetics of phytic acid and nutrient availability during fermentation to identify a possible threshold at which optimal nutrient availability occurs compared to a classic yeast loaf.

REFERENCES

1. Gobbetti M, Angelis M, Cagno R, Calasso M, Archetti G, Rizzello C. Novel insights on the functional/nutritional features of the sourdough fermentation. *Int J Food Microbiol*. 2018;1-11.
2. Megazyme Phytic Acid Assay Kit. Wicklow, Ireland: Megazyme; 2018.
3. Kililea, D. The nutrition of grains a wealth of health. *Grain Gathering*. 2017.
4. Poutanen K, Flounder L, Katina K. Sourdough and cereal fermentation in a nutritional perspective. *Food Microbiol*. 2009;693-699.
5. Leenhardt F, Levrat-Verny M.-A, Chanliaud E, Remesy C. Moderate decrease of pH by sourdough fermentation is sufficient to reduce phytate content of whole wheat flour through endogenous phytase activity. *J Agric Food Chem*. 2005;53,98–102..