WHEAT
DIGESTIBILITY

Agricultural Utilization Research Institute

Fermentation Technologies for Improved Nutritional Quality and Digestibility of Wheat Products: A Summary by Dr. Michael Gänzle, University of Alberta

Consumers avoid wheat products because of real or perceived non-celiac wheat intolerance, which is also termed "gluten sensitivity". Measures to restore wheat consumption are hampered by the lack of knowledge of etiological agents of non-celiac gluten intolerance. Fermentable oligosaccharides, disaccharides, monosaccharide and polyols (FODMAPs) were demonstrated to contribute to adverse reactions to wheat consumption in sensitive individuals; immune reactive proteins in wheat including amylase-trypsin inhibitors (ATI) and wheat germ agglutinins (WGA) were additionally suggested to contribute to intolerance of wheat in sensitive individuals.

Fermentation of bread with lactic acid bacteria, sourdough fermentation, has become a major tool for bread production in Europe, and is rapidly increasing in North America. The use of lactic acid bacteria in industrial applications aims to reduce ingredient cost and to achieve "clean label" solutions by replacement of additives, and to improve the nutritional and sensory quality and the storage life of the products. Large scale fermentations are carried out at the bakery or by specialized ingredient suppliers. Sourdough also has the potential to degrade FODMAPs immune reactive proteins during fermentation. This project aimed to develop fermentation technologies to reduce levels of adverse components in wheat.

Specifically, the project aimed to meet the following objectives:

- Reduction of FODMAPs in wheat and wheat bread by fermentation with lactobacilli.
- Quantification of trypsin amylase inhibitors (ATI) and wheat agglutinins (WGA) in wheat and wheat bread fermented with addition of enzyme-active malt and lactobacilli.

Results demonstrated that a conventional sourdough fermentation reduces the levels of fructans, the major component of FODMAPs in wheat and rye, during bread-making to a level that likely improves tolerance of wheat and rye bread even by sensitive individuals. The use of a strain of *Lactobacillus crispatus* that expresses an extracellular enzyme degrading fructans resulted in reduced wheat and rye fructans by more than 90%.

The fate of immune-active proteins in wheat sourdoughs and wheat bread was assessed by quantification with LC-MS/MS (ATI) or enzyme-linked immune-sorbent assays (WGA). Sourdough fermentation decreased the level of both proteins; for ATI, the reduction was mainly attributable to acidification of the sourdough; for WGA, the effect was attributed to thiol-exchange reactions. Both proteins denatured during baking, however, and differences between sourdough bread and control bread produced with baker's yeast only were not detected.

Overall, this project makes an important contribution to understand the impact of sourdough fermentations on wheat constituents that are known or suggested to contribute to non-celiac wheat intolerance. Project results informed communication strategies of the wheat industry to restore the confidence of consumers in the wholesomeness of wheat and wheat products and thus to maintain its market share, and to maintain the farmers' flexibility to include wheat in their cropping systems.

FODMAP (fructans and mannitol) content of bread and sourdough bread

Based on the analysis of the FODMAP concentration in model breads made with yeast only or with specific sourdoughs, the images depict how much bread can be eaten to meet the threshold of 0.3 g FODMAPs per serving.

Straight dough Conventional sourdough **FruA-sourdough**

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