Effect of Bran Reduction on Gluten Secondary Structure in Intermediate Wheatgrass (Thinopyrum Intermedium) Dough

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INTRODUCTION

- Thionylurin intermedium, commonly known as intermediate wheatgrass (IWG), is a novel perennial crop, with both environmental and nutritional benefits (1-2).
- DWG is currently mainly used as a forage but shows great potential to be developed as a grain crop. (3)
- DWG has higher protein, fiber and antioxidant contents than that of common wheat (3).
- DWG is mainly consisting of gliadins and low molecular weight gliadins (LMWG) and deficient in high molecular weight gliadins (HMWG) suggesting a poor gluten forming ability (4-5).
- The difference in protein distribution coupled with higher fiber content negatively affects the gluten network formation in the dough.
- It has been shown that competitive water binding by bran causes partial collapse of the gluten network, which in turn causes conformational changes in gluten and adversely affect its viscoelastic properties (6-7).
- These events can promote partial collapse of the gluten network.
- Protein secondary structure, and its stability, greatly impact gluten mixing and dough development properties.
- Automated Total Reflection Fourier Transform Infrared (ATR-FTIR) spectroscopy is an ideal technique for probing changes in gluten secondary structure by monitoring changes in the amide I region at 1600-1700 cm⁻¹.

MATERIALS AND METHODS

- Materials: DWG (15% protein) were kindly provided by the Land Institute, KS and HRWW (12% protein) grains were from Department of Agronomy Plant Crops, University of Minnesota.
- Milling of Grains: DWG and HRWW-Grains were milled by Schenck Termo Mill (AACC 58-91). Bran was further milled using a cyclone sample mill (UDC, Fort Collins, CO) equipped with a 125 μm screen.
- Preparation of Flour Samples: Bran of DWG was added to refined flour at 100%, 75%, 50%, 25% and 0% of original bran content. HRWW samples were prepared similarly at 100% and 0% bran.
- Dough Preparation: Three flour samples were evaluated for dough strength using farinograph at 30°C and 21°C following the constant flour weight procedure according to AACC method 54-21.02. Dough samples were collected at different time points during mixing: dough development time (DDT), which is the time point when top of the curve leaves the 500 FU line, and over-mixing (i.e. 20 min).
- ATR-FTIR Spectroscopy: The infrared spectra of flour and dough samples were recorded using a Bruker FTIR spectrometer (Bruker T37, Bruker Optics, Inc., Billerica, MA, USA) equipped with a horizontal multi-reflectance zinc selenide crystal accessory.

RESULTS

- Bran reduction in DWG dough during mixing and baking promotes partial collapse of the gluten network.
- It has been shown that competitive water binding by bran cause partial collapse of the gluten network, which in turn causes conformational changes in gluten and adversely affect its viscoelastic properties (6-7).
- The difference in protein distribution coupled with higher fiber content negatively affects the gluten network formation in the dough.
- As the refinement level increases, dough required less water and less time to develop (Figure 2A). At 30°C, bran reduction in DWG did not cause significant structural changes in the dough made at DDT compared to wheat dough. However, the protein distribution is significantly different from that of wheat flour (Figure 2B).
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DISCUSSION

- The higher yield of bran (55%) resulted after milling for IWG than that of HRWW (40%) is due to bran reduction.
- As the refinement level increased, dough required less water and less time to develop (Figure 1 and Table 1). The lower stability could be attributed to the lack of elasticity due to a higher bran content. This information can be used to develop a gluten network with higher elasticity and lower water absorption.

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REFERENCES