

FUNCTIONAL CHARACTERISTICS OF EXTRUDED PINTO AND NAVY BEAN FLOUR (*PHASEOLUS VULGARIS* L.)

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INTRODUCTION

Dry beans are an important food crop consumed in many countries around the world as a major source of protein. Beans are rich in dietary fiber, vitamins, and essential minerals such as iron, zinc, and calcium. Extruded bean flour has potential to be used for making bakery products, such as cookies and muffins for celiac patients. Celiac disease is a digestive disease that damages the small intestine and interferes with absorption of other nutrients from food. People who have celiac disease cannot tolerate gluten, a protein found in wheat, rye, and barley. The objective of this study was to evaluate a new method of producing navy and pinto bean flours for applications in gluten free bakery products.

MATERIALS AND METHODS

The pinto and navy beans (*Phaseolus vulgaris* L.) used in the study were obtained from Bayside Best Beans, LLC (Sebewiang, MI). Any damaged beans were removed. Raw beans were washed and soaked for 4 hours to reduce flatulence-causing oligosaccharides by leaching into the water. After soaking, the beans were dried in an oven at approximately 65 °C for 12 hours. Pinto and navy beans were ground using a hammer mill model (Model D comminuting Machine, W.J. Fitzpatrick Company, Chicago, USA). Extrusion runs of raw pinto and navy beans were carried out using a laboratory co-rotating twin-screw extruder model JS30A (China by Qitong Chemical Industry Equipment Co, Ltd). The extruder screws are 30 mm in diameter and the barrel has an L/D of 14. Pinto and navy beans were extruded at 85, 100, and 120°C (die end); moisture content was 36 % wet basis; and feed rate was 120 g/min. The bean extrudates were dried overnight (70°C) and then ground to pass a 250 micron screen. The extruded bean flours were compared with the commercial control navy bean and pinto bean flours that were steam cooked at 82°C for overall quality of baked products. Line-spread tests of all the flour/water slurries (sol) were done at different temperatures to find the thickening properties of the flour (Figure 1). Each unit on the line spread scale is equal to 4 mm. Two types of baked products were chosen to compare the functionality of flours: Gluten-Free Cinnamon Sugar Cookies and Gluten-Free Spiced Muffins. These baked products were prepared using recipes for gluten free products and baked at 350 °F (Heartland Finest, Hillman, MI). The total baking time was 14 min and 25 min for the cookies and muffins, respectively. The diameters of the cookies were measured to evaluate the cookie spread. Seed displacement was used to compare baked muffin volumes. Observations of the cookie and muffin appearance, color, and flavor were also used as a basis of comparison.

RESULTS AND DISCUSSION

The experimental pinto and navy flours extruded at 85°C yielded the best results in terms of flour functionality and were most similar to that of the control. The samples had a uniform color distribution in the heat formed sol. At slurry temperatures above 75°C the control navy and pinto bean flours and both of the experimental flours had nearly identical spreads and did not exhibit much thickening. The flours' spread ranged between 8.5 and 10.75 (34mm and 43 mm) on the line spread scale. The control pinto bean flour exhibited more thickening as the temperature approached 100°C and ranged from 5.75 to 10.13 (23mm to 40.5mm) on the same

line spread scale. The control pinto bean flour exhibited the most thickening as the temperature of the sol approached 100°C (Figure 1). The experimental flours that were extruded at 120 and 100°C were inferior to the controls in terms of thickening ability. The 85°C flours also yielded nearly identical products when used in baking of cookies and muffins. Average diameters and heights of the cookies made using the pinto bean flours were identical (2.44 and 0.84 in., respectively). The average diameter and height of the cookies made using the extruded navy bean flour and control navy bean flour (2.24 and 0.9in. vs. 2.5 and 0.73in. [diameter, height], respectively) were very similar. The experimental flours extruded at 120 and 100°C exhibited poor baking performance in cookies and muffins. Muffins made with the experimental flours had an average seed displacement of 115 ml whereas the muffins made with the control flours had an average displacement of 123ml.

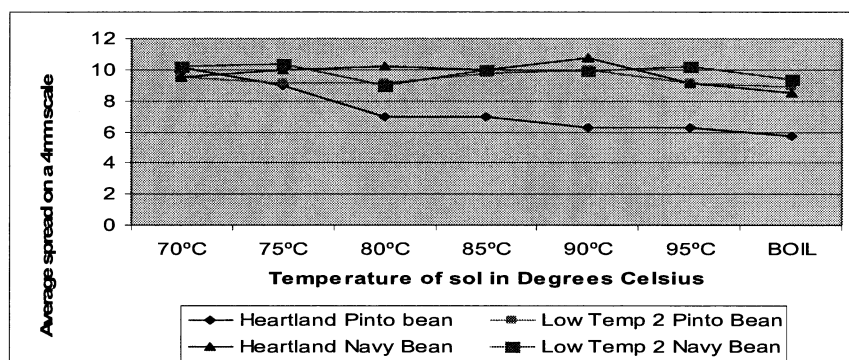


Fig 1: Average Spread of Control and Extruded Navy and Pinto Bean Flour Sols (slurry) during Line-spread test.

CONCLUSION

The experimental flours extruded at 85°C are comparable to the control flours in terms of functional characteristics. The baked cookies and muffins made using the experimental flours were nearly identical in appearance and flavor profile. Batter viscosity was fairly smooth and consistent and comparable to the respective control flours. All had similar baked volume.

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