NOTE

Dry Roasted Pinto Bean (*Phaseolus vulgaris*) Flour in Quick Breads[1]

S. R. ALANI,[2] M. E. ZABIK,[2,3] and M. A. UEBERSAX[2]

Baked products are consumed worldwide. Fortification with high-protein legume flours provides a good opportunity to improve the nutritional quality of cereal protein consumed by many people (Hoover 1979). Considerable interest has been generated in fortifying wheat flour with high-protein, high-lysine material (especially legume and oilseed flours, protein concentrates, and isolates) to increase the protein content and improve the essential amino acid balance of flour-based baked products, especially bread.

Traditional wheat bread doughs and baked breads are adversely affected by the use of composite flours containing 5–10% of various legumes (D'Appolonia 1977, 1978; Deshpande et al 1983). As the legume flour level increased, farinograph dough absorption increased, and dough stability decreased. Loaf volume also decreased. White bread quality depends upon development of a strong gluten matrix; thus dilution and/or interference with gluten development by the legume component of the composite flour results in decreased bread quality.

Chemically leavened baked products traditionally prepared with moderate- or low-protein wheat flours are much less dependent upon development of a strong gluten matrix for production of high-quality products. Sugar-snap cookies prepared with 20% drum-dried navy bean flour were acceptable, although no more than 10% sesame flour could be substituted without adverse flavors being noted (Hoojjat and Zabik 1984). Pumpkin spice muffins and oatmeal cookies prepared with 20 or 35% dry-roasted navy bean flour were successful (Cady et al 1987).

To further the utilization of dry-roasted legume flours, the current study was designed to evaluate high levels of dry-roasted pinto bean flour substitution in a quick bread product.

MATERIALS AND METHODS

Whole pinto bean flour containing 24.6% protein on a dry weight basis (Uebersax and Zabik 1986) was used. The flour was prepared from pinto beans roasted at 270°C temperature, with a 1:15 bean-to-bead ratio and a 2-min residence time. The final bean temperature attained during roasting was 125°C. Processing details are given by Aguilera et al (1982). All other ingredients were obtained from commercial sources. The pumpkin bread formula is given in Table I. Three levels of bean flour substitute were used, i.e., 20, 35, and 50%. Batter samples (300 g) were poured into a greased 8 × 13 cm loaf pan prelined with waxed paper. Four replications of each variable were baked at weekly intervals in an Etco forced-air convection oven at 177 ± 2°C for 45 min. Breads were removed from the pan 30 min after baking for 15 min of further cooling, then weighed to determine the percentage weight loss.

Specific gravity, viscosity (using a Brookfield viscometer, model RVT equipped with a no. 7 spindle and rotating at 10 rpm), and pH measurements were determined for the batter. Bread volume was measured by rapeseed displacement. Loaves were then sliced, 1-cm thick, for further objective and sensory evaluations. Tenderness was determined with the standard shear compression cell of the Allo Kramer shear press using a 136-kg transducer. Moisture of the pumpkin bread was determined according to AACC method 44-40 (1983). Color parameters were determined using a Hunter color difference meter, model D25-2, standardized with a white tile ($L = 91.04$, $a_L = 1.0$, $b_L = 0.9$).

A trained sensory panel of seven members scored each of the samples using a descriptive score card with descriptions ranging from 1 to 10; optimum characteristics were given a score of 10, except for color and moisture for which the optimum score was 5. Sensory evaluation was conducted in individual booths equipped with controlled light to simulate daylight conditions. The data were analyzed for variance, and Duncan's new multiple range test (1957) was used to distinguish significant differences found among variables.

RESULTS AND DISCUSSION

Specific gravities and pH of batters were similar for all levels of pinto bean flour substitution, whereas the batter viscosity increased significantly ($P < 0.05$) with each level of substitution (Table II). Generally, color of the bread was darker (decreased L value) and less yellow (decreased b_L value), with increasing levels of pinto bean flour substitution. Lightness values differed only between the control and the pumpkin bread substituted with 35 and 50% pinto bean flour. The breads became darker as the legume level increased because the reducing sugars present in the pinto bean flour promoted the Maillard browning reaction (Akpapunam and Markakis 1979, Paul 1972).

Moisture contents of the baked products did not differ significantly (Table II). Percentage water loss during baking and bread volume as determined by rapeseed displacement were unaffected by the incorporation of pinto bean flour. The shape of loaves at all levels of substitution was similar, as all loaves had slightly rounded tops.

Texture, tenderness, moisture, odor, and flavor of the pumpkin

TABLE I
Pumpkin Bread Formula[a]

Ingredient	Weight (g)
All-purpose or composite flour[b]	100.65
Baking powder, SAS	0.45
Baking soda	2.00
Salt	3.00
Cinnamon, ground	0.50
Cloves, ground	0.25
Brown sugar, dark	133.35
Vegetable shortening	31.35
Egg, fresh whole	50.00
Pumpkin, canned	123.00
Milk, whole fluid	60.50
Vanilla	1.23

[a]Rombauer and Becker 1978.
[b]Composite flours contained all-purpose/pinto bean flour in 80:20, 65:35, and 50:50 ratios.

[1]Michigan Agricultural Experiment Station Journal Article no. 12,738.
[2]Department of Food Science and Human Nutrition, Michigan State University.
[3]Address correspondence to Dr. M. E. Zabik, Associate Dean for Academic Affairs, College of Human Ecology, Michigan State University, East Lansing 48824.

TABLE II
Physical Characteristics of Pumpkin Breads Prepared with from 0 to 50% of the Wheat Flour Substituted with Pinto Bean Flour[a]

Characteristics	Pinto Bean Flour Substitution (%)			
	0	20	35	50
Batter				
Viscosity (poise)	575 ± 44 a	683 ± 56 b	915 ± 55 c	1,078 ± 43 d
Specific gravity	0.95 ± 0.05 a	0.94 ± 0.08 a	0.95 ± 0.06 a	0.94 ± 0.05 a
pH	7.20	7.28	7.29	7.25
Bread				
Moisture (%) loss	11.80 ± 1.40 a	11.00 ± 0.70 a	11.80 ± 3.70 a	10.50 ± 0.90 a
Volume (cm^3)	612 ± 24 a	601 ± 30 a	628 ± 17 a	581 ± 33 a
Tenderness (kg/g)	0.62 ± 0.10 a	0.56 ± 0.10 a	0.54 ± 0.06 a	0.52 ± 0.06 a
Hunter color difference				
L (lightness)	39.43 ± 1.66 a	38.70 ± 0.73 a	37.28 ± 1.25 b	35.88 ± 1.10 c
a_L (redness)	6.28 ± 0.20 a	6.20 ± 0.40 a	6.38 ± 0.25 a	6.20 ± 0.08 a
b_L (yellowness)	9.28 ± 1.20 a	7.70 ± 0.54 b	6.23 ± 0.90 c	4.60 ± 0.58 d
Moisture (%)	34.60 ± 2.40 a	36.20 ± 2.40 a	34.80 ± 2.50 a	35.50 ± 1.30 a

[a]Means and standard deviation of the means for four replications; means within a row followed by same letter were not different at $P < 0.01$ (Duncan 1957).

TABLE III
Sensory Scores of Pumpkin Bread Prepared with from 0 to 50% Pinto Bean Flour Substitution[a]

Characteristics	Pinto Bean Flour Substitution (%)			
	0	20	35	50
Color	4.5 ± 0.1 d	5.2 ± 0.2 c	5.8 ± 0.4 b	6.6 ± 0.5 a
Texture	4.6 ± 0.6 a	4.1 ± 0.5 a	4.5 ± 0.6 a	4.1 ± 0.5 a
Tenderness	7.4 ± 0.6 a	7.1 ± 0.4 a	7.5 ± 0.3 a	7.3 ± 0.8 a
Moisture	6.9 ± 0.6 a	6.7 ± 0.7 a	6.7 ± 0.7 a	7.1 ± 1.0 a
Odor	6.5 ± 0.4 a	6.9 ± 0.5 a	6.3 ± 0.6 a	6.5 ± 0.5 a
Flavor	6.5 ± 0.2 a	6.4 ± 0.4 a	5.8 ± 0.7 a	6.0 ± 0.8 a

[a]Means and standard deviation of the means based on four replications. Ten-point scale for texture, tenderness, odor, and flavor: 10 = optimum, 1 = undesirable quality. For color and moisture a two-tailed scale was used: 5 = optimum, 1 being too light or too dry and 10 being too dark or too moist, respectively. Means followed by the same letter are not different at $P < 0.05$ (Duncan 1957).

breads were not affected by pinto bean flour substitution (Table III). The color of the bread was scored as being significantly closer to optimum ($P < 0.05$) with each increasing level of pinto bean flour substitution. Thus, the panelists did not find the slightly darker color of the pumpkin breads with higher levels of pinto bean flour objectionable.

Quick breads are unique baked products in that they encompass some of the functional qualities of both bread and cake. The products are baked as breads, yet they lack the requirement for a strong gluten development required for yeast breads and contain a high ratio of sugar to flour, as in the cake system.

CONCLUSION

A high-quality pumpkin bread was produced with pinto bean flour substituted for 20, 35, and 50% of the wheat flour. For all blends, most of the quality parameters measured were close to those of the control pumpkin bread.

As had been shown for muffins and cookies (Cady et al 1987, Hoojjat and Zabik 1984), these chemically leavened quick breads have greater potential for inclusion of legume flours than do yeast breads (D'Appolonia 1977, 1978; Deshpande et al 1983). Moreover, the dry-roasted pinto bean flour in the pumpkin spice breads functioned as well as the dry-roasted navy bean flour in the pumpkin spice muffins of the previous study (Cady et al 1987).

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