NOTE ON LAYER CAKES CONTAINING 30 to 70% WHEAT BRAN[1]

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Epidemiological studies have related Western man's inadequate intake of dietary fiber to the incidence of a wide spectrum of diseases ranging from colonic cancer to certain cardiovascular diseases (1,2). In an attempt to produce acceptable soft wheat products with increased dietary fiber content, small levels of bran and middlings were added to white cakes (3), and to banana, chocolate, nut, and spice cakes (4). This note presents data on incorporation of higher levels of bran in white cakes as well as the effect of the bran's particle size on cake quality.

MATERIALS AND METHODS

A soft red wheat bran and 70% extraction cake flour were procured from Mennel Milling Co., Fostoria, Ohio. Bran contained 12.5% protein, 3.6% lipid (by acid hydrolysis), 12.8% moisture, and 6.7% ash. Bran was ground with a Udy cyclone sample mill, model MS, and mixed with the flour according to the procedure described by Brockmole and Zabik (3). Particle-size distributions of the control and flours containing bran were determined with a Roto-Tap Testing Sieve Shaker Model 4589 according to the procedure of Donelson and Yamazaki (5), and are summarized in Table I.

In order to determine the effect of particle size of bran, a second series of cakes was prepared which included a control and cakes substituted with 30% bran from U.S. Standard Sieves 40 and 50, as well as the bran from U.S. Standard Sieve 40 which was reground until it all passed through the screen. Particle-size distributions of these flours are also included in Table I.

Four replications of each cake were prepared, using the AACC formula and specifications of AACC Method 10-90 (6). Batter viscosity and cake tenderness were determined using the methods described by Brockmole and Zabik (3). Cake volume indexes and sensory characteristics were determined using AACC Methods 10-91 and 10-90, respectively (6).

The data for each series of cakes were analyzed for variance. Duncan's Multiple Range Test (7) was used to pinpoint significant differences established by these analyses of variance.

RESULTS AND DISCUSSION

Substitution of 70% of the flour with bran significantly increased batter viscosity and reduced cake volume (Table II). The volume of the cake with 50% of the flour substituted with bran was also significantly less than that of the

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TABLE I
Percentage of Control and Flour Containing Bran Remaining on Each of the Following Sieves

Sieve Size mesh/in.	Level of Bran Substitution				30% Bran of Varying Particle Size		
	Control %	30%	50%	70%	U.S. Standard sieve 40 35 mesh/in. %	U.S. Standard sieve 50 48 mesh/in. %	Reground %
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	0.0	0.0	0.0	0.0	30.0	0.0	0.1
48	72.0	71.6	71.3	71.0	50.4	80.4	57.5
100	22.8	24.4	25.4	26.5	16.0	16.0	36.2
200	4.5	3.5	2.9	2.3	3.1	3.1	5.6
325	0.7	0.5	0.4	0.2	0.5	0.5	0.6

TABLE II
Means and Standard Deviations of the Mean[a] for Viscosity of the Batter, Volume Indexes, and Sensory Scores for Cakes made with Four Levels of Bran Substitution

Parameter	Level of Bran Substituted for Flour				Level of Significance[b] %
	0%	30%	50%	70%	
Batter viscosity (ps)	265.0 ± 30.0a	547.0 ± 253.7ab	586.8 ± 174.6ab	775.0 ± 119.3b	1
Indexes to volume (cm)	11.5 ± 0.5a	10.6 ± 0.2ab	9.7 ± 0.5bc	9.1 ± 0.7c	0.1
Sensory scores[c]					
Cells (30)					
Uniformity (10)	7.6 ± 0.9	8.4 ± 0.6	8.0 ± 0.4	7.0 ± 1.3	NS
Size (10)	8.4 ± 0.9a	8.6 ± 0.5a	7.8 ± 1.2a	5.7 ± 0.5b	1
Thickness of walls (10)	9.2 ± 0.6a	8.6 ± 1.3a	6.8 ± 0.6a	4.0 ± 0.4b	0.1
Grain (16)	15.1 ± 0.6a	16.0 ± 0.0a	14.8 ± 0.9a	11.4 ± 1.2b	0.1
Texture (34)					
Moistness (10)	9.7 ± 0.3a	9.6 ± 0.3a	8.7 ± 0.5a	6.9 ± 1.1b	0.1
Tenderness (14)	12.5 ± 0.8	13.0 ± 0.9	13.3 ± 0.2	13.0 ± 0.5	NS
Softness (10)	9.6 ± 0.5	9.6 ± 0.8	8.9 ± 0.3	8.6 ± 0.4	NS
Crumb color (10)	10.0 ± 0.0a	9.0 ± 0.8a	8.8 ± 0.5a	4.8 ± 1.0b	0.1
Flavor (10)	9.8 ± 0.5a	5.3 ± 1.0b	3.3 ± 2.2b	2.0 ± 1.2b	0.1
Total score (100)	91.9 ± 5.2a	88.5 ± 4.6ab	80.3 ± 8.8b	63.9 ± 4.7c	0.1

[a]Averages of four replications.
[b]Averages followed by the same letter are not significantly different at the level of probability indicated (7).
[c]Maximum possible points in parentheses after each sensory item.

TABLE III
Means and Standard Deviations of the Mean[a] for Viscosity of the Batter and Sensory Scores of Cakes made with 30% Bran of Different Particle Sizes and a Control Cake

Parameter	Control Cake	Bran Particle Size: U.S. Standard sieve 40 35 mesh/in.	U.S. Standard sieve 50 48 mesh/in.	Reground	Level of Significance[b] %
Batter viscosity (ps)	121.0 ± 11.9a	252.0 ± 87.8a	412.0 ± 111.8b	330.0 ± 66.9ab	1
Sensory scores[c]					
Cells (30)					
Uniformity (10)	8.3 ± 1.5a	6.0 ± 0.8b	7.0 ± 0.8ab	6.0 ± 0.8b	5
Size (10)	8.6 ± 0.3a	6.9 ± 0.8b	7.9 ± 0.8ab	8.0 ± 0.9ab	5
Thickness of walls (10)	8.8 ± 1.0a	6.5 ± 1.0b	8.5 ± 0.6a	8.8 ± 0.5a	1
Grain (16)	14.9 ± 1.4a	10.1 ± 0.8b	11.9 ± 0.8ab	11.5 ± 1.6ab	0.1
Texture (34)					
Moistness (10)	8.9 ± 0.6	8.0 ± 0.7	8.4 ± 0.5	8.3 ± 0.6	NS
Tenderness (14)	12.3 ± 0.6	11.3 ± 0.5	11.4 ± 0.6	11.9 ± 0.5	NS
Softness (10)	9.5 ± 0.6a	7.0 ± 0.7b	8.9 ± 0.6a	9.1 ± 0.5a	0.1
Crumb color (10)	10.0 ± 0.0a	6.6 ± 1.6b	8.8 ± 1.0ab	7.2 ± 0.6b	1
Flavor (10)	9.7 ± 0.6a	4.7 ± 0.6b	5.6 ± 0.7b	5.0 ± 1.0b	0.1
Total score (100)	90.8 ± 3.8a	67.0 ± 3.3c	79.5 ± 2.5ab	77.3 ± 5.2bc	0.1

[a]Averages of four replications.
[b]Averages followed by the same letter are not significantly different at the level of probability indicated (7).
[c]Maximum possible points in parentheses after each sensory item.

control cake. Increased water-holding capacity of the bran components may have contributed to the higher batter viscosity, and if these components competed with the starch for water, incomplete gelatinization of the starch could have resulted in reduction of cake volume.

Analyses of variance failed to reveal any differences among the tenderness data for these cakes. Tenderness values ranged from 1.21 to 1.73 lb/g. Thus, substituting levels as high as 70% of the flour with bran had little effect on this parameter.

Bran substitution for flour in white layer cakes significantly reduced total sensory scores (Table II). All components of the total score except uniformity of cells and the tenderness and softness subdivisions of texture were affected by bran incorporation. However, cakes made with 50% of the flour substituted with bran did not score significantly lower than the control cake for thickness of cell walls, grain, moistness, or crumb color. Flavor was adversely affected by bran substitution. Since the bran used in this study had been stored for 6 months at about 21°C prior to its use, oxidation of bran lipids may have contributed to these reduced scores. The precise compounds responsible for the off-flavor found in these cakes need to be determined. The type of bran used may also have affected flavor, as it may be speculated that use of soft white wheat bran would have a less adverse effect while use of hard red wheat bran may have a more adverse effect.

The effect of particle size on the physical and sensory characteristics of cakes substituted with 30% bran was also studied to see if the grinding done in the first series of cakes was really necessary, and to see if the components which resisted grinding had any different effect on cake characteristics once this material had been reground sufficiently to pass through the U.S. Standard Sieve 50. The finer particle size of bran produced most viscous batter (Table III). Regrinding the bran also resulted in more viscous batters but these were intermediate in viscosity compared to that of batters prepared with bran from the other two sieve sizes. Cake volume indexes which ranged from 10.3 to 10.8 cm were not affected by the particle size of the bran used.

The particle size of the bran used significantly affected several of the sensory characteristics of the cakes (Table III). Cakes with bran of the largest particle size scored significantly lower than the control for cell uniformity, cell size, thickness of cell walls, grain, softness, and crumb color, whereas cakes prepared using bran of a finer particle size often scored slightly lower but were not significantly different from the control cake. Regrinding the bran significantly improved scores for thickness of cell and softness (Table III).

Thus it appears that fineness of grind is important to successful incorporation of bran in cakes. Cakes with 30% of the flour substituted with bran were found to be acceptable, but further work would be needed to optimize formulas to facilitate substituting flour with bran levels as high as 50%.

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