

NOTE ON PERFORMANCE OF LOW-CHOLESTEROL EGG SUBSTITUTES IN LAYER CAKES¹

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Numerous Americans are advised to consume foods low in cholesterol to maintain daily intakes of 300 mg or less (1), thus restricting their consumption of eggs and other animal products. Commercial low-cholesterol egg substitutes generally contain egg white but no yolks. The lipid fraction of the egg yolk has been removed and replaced with vegetable oil to reduce the total cholesterol content of these products.

Kamat and co-workers (2) have described the essential contributions of egg yolk to cake structure. Omitting or defatting yolk to make low-cholesterol egg substitutes may affect the ability of eggs to contribute to structure in baked products. Leutzinger (3) recently reported data on sensory attributes of two low-cholesterol substitutes in scrambled eggs and plain cakes; sponge cakes were also described. The present research note reports data on the function of three commercially available low-cholesterol egg substitutes in a yellow cake.

MATERIALS AND METHODS

Cake Preparation

Yellow layer cakes were prepared using the formula and procedure that Funk *et al.* (4) described, with the following modifications: four sources of eggs were used—fresh whole eggs, Fleishmann's Egg Beaters® (Standard Brands, Inc., New York), Second Nature® (Avoset Food Corp., Oakland, CA), and Eggstra® (Tillie Lewis Foods, Stockton, CA). The ingredients are listed in Table I, and the composition of these low-cholesterol egg substitutes in Table II. The amount of each low-cholesterol egg substitute used was based on the manufacturer's recommendation for the equivalency to one whole egg. All ingredients except the Second Nature® and fluid whole milk were procured as common lots. These were purchased from a retail market on the day before cake preparation and kept refrigerated at 4–5°C until use. Egg Beaters® were thawed at 4–5°C for 18 hr before use. Five replications of each cake were evaluated. The four cakes, comprising one replication, were baked simultaneously at $177 \pm 2^\circ\text{C}$ in an Etco forced convection oven, model 186A, for 20 min. Cake preparation was rotated to equalize the possibility of air loss due to holding the cake batter for a maximum of 25 min before baking.

Cake Evaluation

Batter viscosity, cake volume and symmetry indexes, tenderness, and moisture were determined using the methods that Brockmole and Zabik (5) outlined.

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Color was also determined by their procedure, but the Hunter Color Difference Meter was standardized with the yellow tile (L, 82.8, a_L, 3.5, b_L, 26.2). Batter viscosity was determined while cakes were baking; all other evaluations were conducted approximately 20 hr later.

A trained five-member taste panel subjectively evaluated cakes using the score card that Funk *et al.* (4) described. This score card provides for a two-tailed listing of descriptive terms for each attribute, and places the most desirable description at the center.

The data were analyzed for variance, and Duncan's multiple range test (6) was used to sort out significant differences revealed by the analyses of variance.

RESULTS AND DISCUSSION

Analyses of variance revealed significant differences for the objective measurements for batter viscosity, volume indexes, and percentage moisture (Table III). The batters prepared with fresh eggs or Second Nature[®] were more viscous than those prepared with Egg Beaters[®]. Both of these products contain proteins, gums, and emulsifiers that affect batter viscosity, but proportions may vary. Volume index of the cakes containing Second Nature[®] was significantly less than the control or cake prepared with Eggstra[®]. Cakes prepared with fresh eggs were convex, whereas all the cakes prepared with low-cholesterol substitutes had slightly sunken centers. Protein and stabilizers in these egg substitutes competed for water, so additional water was necessary to optimize cakes prepared with these products. Percentage of moisture was highest for the cake containing Egg Beaters[®]. Color values did not differ significantly among the cakes (Table III). Artificial color was added to all of the egg substitutes to compensate for color that the yolk normally contributes.

Means and standard deviations of the mean for the sensory evaluations are summarized in Table IV. No significant differences were found for any of these sensory attributes. Taste panelists indicated the crust color of cakes with fresh eggs and Eggstra[®] were a deep golden brown, whereas the cakes with Egg

TABLE I
Ingredients Used to Prepare Yellow Layer Cakes

Ingredient	Amount	Flour (%)
Cake flour ^a	168.0 g	100.0
Sugar	225.0 g	134.0
Shortening ^b	70.0 g	42.0
Whole egg ^c	72.0 g	43.0
Whole milk	182.0 g	108.0
Baking powder ^d	6.0 g	3.6
Salt	4.0 g	2.4
Vanilla	4.0 ml	2.4

^aSwans Down, General Foods Corporation, White Plains, NY.

^bCrisco, The Proctor & Gamble Co., Cincinnati, OH.

^cVariables contained 66.0 g Egg Beaters[®], 44.0 g Second Nature[®], or 15.8 g Eggstra[®] reconstituted with 60.0 ml deionized water.

^dCalumet, General Foods.

Beaters® were a light golden brown and those with Second Nature® were even paler. The crust texture of the cakes with fresh eggs was slightly smooth, whereas that of the other cakes was described as slightly pebbly. The color of all cake interiors was depicted as light creamy yellow. The cell size of all cakes except those containing Egg Beaters® was described as slightly small; the last had a slightly large cell size. All cakes had a uniform grain, were tender and velvety, and had a delicate, sweet, evenly blended flavor.

Although no data were presented for the sensory attributes of plain cakes, Leutzinger and co-workers (3) indicated 11 of 17 panelists could differentiate in a triangle test between cakes made with Second Nature® and whole egg. Ten of the 17 also could differentiate between cakes containing Second Nature® and Egg Beaters®, but the differentiations between cakes with whole eggs and Egg

TABLE II
Composition of Low-Cholesterol Egg Substitutes

Egg Beaters®	Second Nature®	Eggstra®
Egg white (82%)	Egg whites	Egg white solids
Liquid corn oil (10%)	Water	Whole egg solids
Nonfat dry milk (7%)	Partially saturated soybean oil	Sweet whey solids
Emulsifiers: vegetable lecithin, mono- diglycerides, propylene glycolmonostearate	Isolated soy protein	Nonfat dried milk
	Dipotassium phosphate	Soy protein
		Cellulose gum
Cellulose and xanthan gums	Carboxymethyl cellulose	Artificial color
Natural flavor	Sodium stearoyl-2-lactylate	Potassium sorbate
Zinc sulfate	Dicalcium phosphate	
Artificial color	Artificial flavor	
Carotene	Magnesium chloride	
Calcium pantothenate	Monoglycerides and diglycerides	
Thiamin	Xanthan gum	
Vitamin B ₆	β carotene	
Riboflavin	Lecithin	
Vitamin D	Ferrous fumarate	
Biotin	Zinc sulfate	
	Calcium pantothenate	
	Vitamin B ₁ (thiamin)	
	Vitamin D	
	Vitamin B ₂ (riboflavin)	
	Vitamin B ₁₂	

TABLE III
Means^a and Standard Deviations of the Mean for Objective Measurements of
Layer Cakes Containing Low-Cholesterol Egg Substitutes

Objective Measurement	Fresh Eggs	Type of Egg Substitute			Level of Significance ^b (%)
		Second Nature®	Egg Beaters®	Eggstra®	
Batter viscosity (poise)	284.2 ± 102.4a	284.4 ± 94.6ab	217.8 ± 44.6c	235.0 ± 95.6bc	5
Volume index (cm)	15.06 ± 1.28a	12.14 ± 0.48c	13.14 ± 0.97bc	14.14 ± 0.43ab	10
Symmetry (cm)	0.32 ± 0.47	-0.46 ± 0.36	-0.06 ± 0.68	-0.04 ± 0.25	NS
Tenderness (lb/g)	1.86 ± 0.53	1.45 ± 0.23	1.66 ± 0.36	1.81 ± 0.42	NS
Moisture (%)	25.3 ± 1.6a	25.6 ± 1.9a	28.4 ± 1.4b	25.5 ± 1.9a	5
Hunter color values ^c					
L	78.1 ± 3.7	78.7 ± 1.5	79.0 ± 3.5	79.3 ± 2.7	NS
a _L	-2.2 ± 1.9	+0.2 ± 0.8	+1.2 ± 1.0	+1.0 ± 0.6	NS
b _L	17.2 ± 2.9	15.1 ± 1.3	18.1 ± 1.9	16.6 ± 0.9	NS

^aBased on five replications.

^bMeans of measurements for which analyses of variance established significant difference that have same letter are not significantly different at $p \leq 0.05$ (6).

^cL = lightness, -a_L = greenness, +a_L = redness, b_L = yellowness.

TABLE IV
Means^a and Standard Deviations of the Mean for Sensory Evaluation of Layer Cakes Containing Low-Cholesterol Egg Substitutes

Sensory Attributes ^b	Type of Egg Substitute			
	Fresh Eggs	Second Nature [®]	Egg Beater [®]	Eggstra [®]
Crust color	4.4 ± 0.5	3.3 ± 0.3	3.8 ± 0.4	3.6 ± 0.9
Crust texture	3.8 ± 0.4	4.0 ± 0.7	3.8 ± 0.8	3.8 ± 0.8
Interior color	4.2 ± 0.4	4.0 ± 0.4	3.8 ± 0.4	3.6 ± 0.9
Cell size	4.0 ± 0.7	3.6 ± 0.7	4.2 ± 0.4	3.4 ± 0.5
Cell distribution	4.4 ± 0.9	4.6 ± 0.5	4.4 ± 0.5	4.2 ± 0.8
Tenderness	4.8 ± 0.4	4.8 ± 0.5	4.6 ± 0.5	4.8 ± 0.4
Mouth-feel	4.2 ± 0.4	4.8 ± 0.4	4.6 ± 0.5	4.0 ± 0.7
Flavor	4.6 ± 0.5	4.0 ± 0.7	4.6 ± 0.5	4.4 ± 0.5

^aBased on five replications. No significant differences among means were established by analyses of variance.

^b5 = Most desirable.

Beaters[®] were not statistically significant. In contrast, the present taste panel scored all cakes similarly for the quality attributes listed in Table IV.

All cakes were deemed acceptable. Water levels should be optimized in cakes containing the egg substitutes to produce maximum quality. Therefore, any of these egg substitutes can be successfully used to prepare cakes for persons who have been advised to restrict their cholesterol intake.

Literature Cited

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