Note on the Use of Modified Salt in Doughs Containing Antimycotic Agents[1]

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Sorbic acid at levels of 0.025 to 0.10% is an excellent preservative for cakes, pies, and ice fillings. Sorbic acid is effective against bacteria and especially molds and yeasts. The effect on yeast is deleterious in yeast-leavened products, and cannot be overcome by increasing fermentation time as can be done when one is adding propionate salts (1). Melnick et al. (2) suggested incorporating sorbic acid into fat with a melting point of 140° to 160°F., and spray-chilling the fat to form small beads. Adding beads equivalent to 0.1% sorbic acid (on white-wheat-flour basis) has a limited effect during fermentation. During baking, the fungistat is released from the melted fat and protects the final product. Diemair and Schulz (3) reported that adding up to 0.4% sorboylpalmitate had no deleterious effect on fermentation or over-all quality of dark and mixed rye bread. The compound is stable during fermentation, but is completely hydrolyzed into palmitic and sorbic acids during baking. Bread baked with the sorbic acid derivative showed no mold attack after 20 days' storage at 25° to 30°C. and relative humidity of 90 to 94%. Control loaves were moldy in 5 to 10 days.

Fortmann and Welcker (4) described use of sodium chloride coated in a way to prevent dissolution of the salt until the late stages of the baking process. Moline and Fried (5) recently reported that reducing the concentration of salt in dough eliminates the inhibitory effect of sorbic acid on yeast fermentation. This Note compares the effects of regular and coated salt on fermentation and loaf volume of bread baked with sorbic acid, calcium propionate, and mixtures of the two antimycotic agents. For comparison, experiments with coated sorbic acid were included.

MATERIALS AND METHODS

The flour, designated as Regional Baking Standard (RBS), was milled from a composite of samples of many hard winter wheat varieties that were harvested at numerous locations throughout the Southern, Central, and Northern Great Plains in

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1968. The flour (14% moisture basis) had a protein content of 12.7% (N X 5.7), ash content of 0.42%, good loaf-volume potential, and medium mixing time. The regular (control) sodium chloride was chemically pure. The coated (X-modified) sodium chloride was from Wallace & Tiernan, Inc., Cedar Knolls, N.J. (1.65 g. contained 1.5 g. salt). Another more heavily coated (H-modified) product contained 1.5 g. sodium chloride per 1.76-g. sample. Calcium propionate ("Guard") was from Anheuser Busch, St. Louis, Mo. Chemically pure sorbic acid was from Nutritional Biochemicals Corp., Cleveland, Ohio, and the coated sorbic acid (77% sorbic acid) was from Union Carbide Corp., Tarrytown, N.Y.

The breadmaking formula included 100 g. flour, 1.5 g. sodium chloride, 2 g. compressed baker's yeast, 4 g. nonfat dry milk, 6 g. sucrose, 0.50 g. 60°L. malt syrup, 3 g. shortening, water as needed, and optimum potassium bromate. An optimum mixing time with the straight-dough procedure and a 3-hr. fermentation time at 30°C. were employed. Panning and punching were done mechanically. Proof time was 55 min. at 30°C.; baking time was 24 min. at 218°C. Baking tests were replicated at least twice. Immediately after the bread was taken from the oven, loaf volumes were determined by dwarf-rapeseed displacement. Average-of-replicate differences of 25 cc. were significant at the 5% level. After cooling, the loaves were cut, and their crumb grains and textures evaluated as satisfactory (S), questionable (Q), or unsatisfactory (U).

RESULTS AND DISCUSSION

The effects of X-modified (coated) salt on proof height, loaf volume, and crumb grain of bread baked with various levels of sorbic acid, calcium propionate, or combinations of the two antimycotic agents are summarized in Table I. In no-salt doughs, loaf volume increased and crumb grain improved with increasing calcium propionate. In the presence of chemically pure or X-modified sodium chloride, calcium propionate had essentially no effect on proof height, loaf volume, or crumb

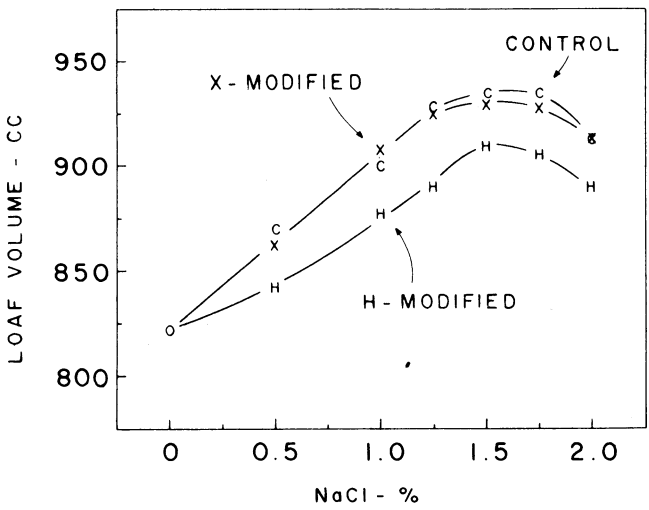

Fig. 1. Effect on loaf volume of various levels of chemically pure sodium chloride and each of two modified salt samples.

TABLE I. EFFECTS OF C.P. AND MODIFIED SALT ON PROOF HEIGHT, LOAF VOLUME, AND CRUMB GRAIN OF BREAD BAKED WITH SORBIC ACID AND CALCIUM PROPIONATE

Sodium Chloride		Calcium	Sorbic Acid				
Control g.	X-Modified g.	Propionate g.	Control g.	Capsulated g.	Proof Height cm.	Loaf Volume cc.	Crumb Grain[a]
...	...	...	...	...	7.3	823	Q to S
1.5	...	...	...	...	7.5	936	S
...	1.5	...	...	...	7.5	930	S
...	...	0.1	...	...	7.7	865	Q to S
...	...	0.2	...	...	7.8	875	Q to S
...	...	0.3	...	...	7.8	893	S
1.5	...	0.1	...	...	7.5	928	S
1.5	...	0.2	...	...	7.5	928	S
1.5	...	0.3	...	...	7.5	923	S
...	1.5	0.1	...	...	7.4	934	S
...	1.5	0.2	...	...	7.5	928	S
...	1.5	0.3	...	...	7.4	925	S
...	...	...	0.05	...	7.7	868	S
...	...	...	0.10	...	7.8	860	S
...	...	...	0.15	...	6.7	760	Q
1.5	...	...	0.05	...	7.5	898	Q to S
1.5	...	...	0.10	...	6.5	790	Q
1.5	...	...	0.15	...	5.3	643	U
...	1.5	...	0.05	...	7.6	912	Q to S
...	1.5	...	0.10	...	6.5	795	Q
...	1.5	...	0.15	...	5.5	653	U
1.5	...	0.1	0.05	...	7.3	875	S
1.5	...	0.2	0.05	...	7.0	843	Q to S
1.5	...	0.1	0.10	...	5.9	725	Q to U
...	1.5	0.1	0.05	...	7.3	885	Q to S
...	1.5	0.2	0.05	...	7.1	848	Q to S
...	1.5	0.1	0.10	...	5.9	708	Q to U
1.5	...	...	...	0.05	7.6	943	S
1.5	...	...	...	0.10	7.5	930	S
1.5	...	...	...	0.15	7.4	887	Q to S
1.5	...	0.1	...	0.05	7.6	928	S
1.5	...	0.2	...	0.05	7.3	890	S
1.5	...	0.1	...	0.10	7.1	868	S

[a]Q, questionable; S, satisfactory; U, unsatisfactory.

grain. Of course, loaves containing salt were superior to those without salt.

In no-salt doughs, 0.05 or 0.10% chemically pure sorbic acid significantly increased and 0.15% significantly decreased proof height and loaf volume. In the presence of chemically pure salt, loaf volume and crumb grain were impaired somewhat by 0.05% sorbic acid, but 0.10 or 0.15% sorbic acid materially decreased proof height and loaf volume, and significantly impaired crumb grain of the loaf. Deleterious effects were almost entirely eliminated by using capsulated sorbic acid.

However, X-modified (coated) salt did not prevent chemically pure sorbic acid from depressing proof height and loaf volume.

Combinations of calcium propionate and sorbic acid, in the presence of sodium chloride, were more deleterious, in general, than any antimycotic agent alone, except for the combination of 0.1% calcium propionate and 0.05% capsulated sorbic acid.

Loaf volume data for various levels of sodium chloride (Fig. 1) show that the X-modified salt was essentially identical in function to the chemically pure salt, and thus apparently was not as effectively coated as the capsulated sorbic acid. Data for the heavily coated (H-modified) salt strongly indicate that the coating material depressed loaf volume.

The results of this study indicate that, in a rich-formula, straight dough, the deleterious effects of as much as 0.10% sorbic acid on fermentation and bread quality can be eliminated by capsulating sorbic acid. Reducing the concentration of sodium chloride below optimum also will reduce its beneficial effect on loaf volume and bread crumb grain.

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