Honey in Frozen Doughs

Summary of Findings

The use of frozen doughs in wholesale baking is increasing in popularity and it is expected that sales in this sector will exceed $1.5-$2 billion in 1996. Despite progress being made in formulation, processing and freezing technology, frozen doughs often result in products with a lower consumer acceptability due to stability problems.

The objectives of the NHB-sponsored research were to examine the effects of honey on the rheological properties of wheat flour doughs and to formulate honey-based frozen doughs for breads. The evaluation of the quality of the baked products was measured through objective and sensory tests. The study was conducted in 1995 at the University of Kentucky at Lexington.
Materials, methods and a summary of the experimental design are presented in the appendix.
Honey is an important ingredient in baking and cereal-based products. It is used as a humectant, sweetener, browning agent and to improve texture. This study now demonstrates the fact that it is a major ingredient which can positively impact the rheology, stability and overall consumer acceptability of frozen dough baked products.

Results indicate that honey used at a level of 4-6% (flour basis) improves the rheological properties of frozen doughs, protects gluten proteins from damage during freezing, significantly improves dough strength and decreases staling. Honey also has a desirable effect on color development of crust and crumb of frozen doughs and consumers prefer the color of breads made from frozen doughs containing 6-8% honey. An important finding is that consumers like equally breads either fresh or made from frozen doughs to which honey is added at levels of 6-8%.

Manufacturers of frozen doughs will benefit from adding liquid and dry honey to their base formulation when designing new baked frozen goods: this addition improves overall consumer acceptability and can increase the shelf-life of the product.

Baking Studies

A base dough formulation (Table A) was used and the dough mixed, fermented, sheeted and panned. A total of 15 dough pieces were prepared for each type and level of sweetener. Control pieces were proofed and baked immediately. The other pieces were blast frozen immediately after panning, packaged in polyethylene bags and stored at -18°C for 2 weeks. Pieces of dough were then thawed, proofed, baked and cooled. Loaf volumes, bread firmness, crust and crumb colors were determined. Sensory evaluation was conducted with a panel of consumers. The following attributes were measured using a hedonic scale: freshness, mouthfeel, flavor/sweetness and overall acceptability. Data were analyzed statistically by analysis of variance.

Effect of Honey on the Rheological Properties of Frozen Doughs

A common problem with frozen doughs is that gluten proteins are damaged during freezing and that dough strength is weakened by frozen storage.

The effects of different levels of both liquid and dry honey on alveograph rheological properties were measured. The freezing treatment significantly decreased alveograph rheological properties but it was found that the addition of 4% liquid or dry honey increased frozen doughs' resistance to extension. Dough extensibility of frozen doughs containing liquid honey increased significantly over the frozen dough with no added ingredient. This effect was less pronounced when dry honey was used.

These findings show that honey, used at a level of 4%, significantly improves the strength of dough subjected to frozen storage. Honey appears to protect gluten proteins from damage caused by freezing,

possibly because of its hygroscopic properties.

Effect of Honey on Product Quality

- **The addition of liquid and dry honey, at levels ranging from 4 to 12%, improves baking quality of frozen doughs.** Frozen storage typically negatively affects loaf volumes and crumb firmness. However, the addition of liquid and dry honey (at levels of 4,6,8,10 and 12%) improved the baking properties of the breads. When used at levels >6%, liquid honey resulted in proof times and loaf volumes comparable to that of sugar.

- **Liquid and dry honey significantly help reduce staling. Frozen doughs containing dry honey stale the least.** The addition of increasing levels of liquid and dry honey also decreased staling. The hygroscopic nature of honey is a possible explanation of this phenomenon. In fact, the addition of dry honey, which is the most hygroscopic, is the most effective in reducing staling.

- **Increasing levels of honey improve crust and crumb color of frozen doughs.** The addition of sweeteners (sugar or honey) to frozen doughs makes their crust brown better and causes a darkening of the crumb. The study showed that liquid honey is the most effective in developing crust color. This effect may be due to the color of honey itself but also to its fermentable sugars content. Results also indicated that the addition of dry honey results in the most color development for the crumb. Sensory tests indicated consumers preferred the color of breads which contained 6-8% liquid and dry honey.

- **Frozen doughs containing 8-10% honey yield excellent results**. At levels of 8% and above, the addition of honey increased consumer acceptability of frozen doughs. Taste panel evaluations indicated that consumers liked equally frozen and non-frozen doughs when the formulations contained up to 10% liquid honey or up to 8% dry honey.

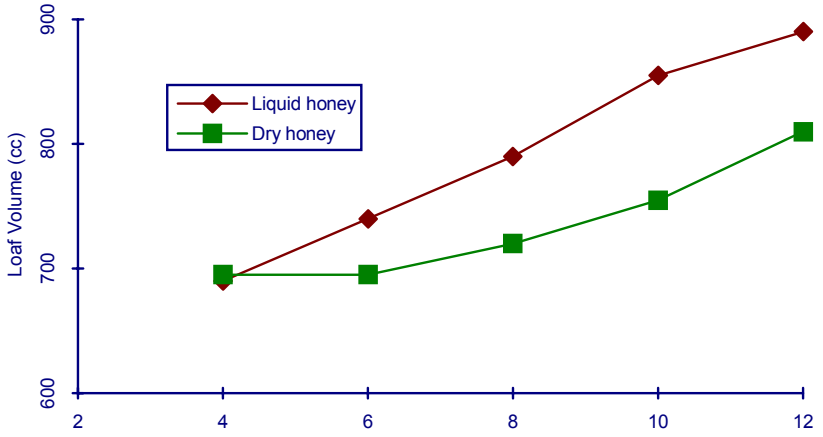
Table 1: Base Formulation Used for Experiments

Ingredients	Flour basis (%)
Flour, 14% mb	100%
Water	optimum
Honey	Tested at 4, 6, 8, 10 and 12%
Yeast, compressed	5.3%
Salt	1.5%
Shortening	3.0%
Ascorbic acid	100 ppm
Potassium sorbate	40 ppm

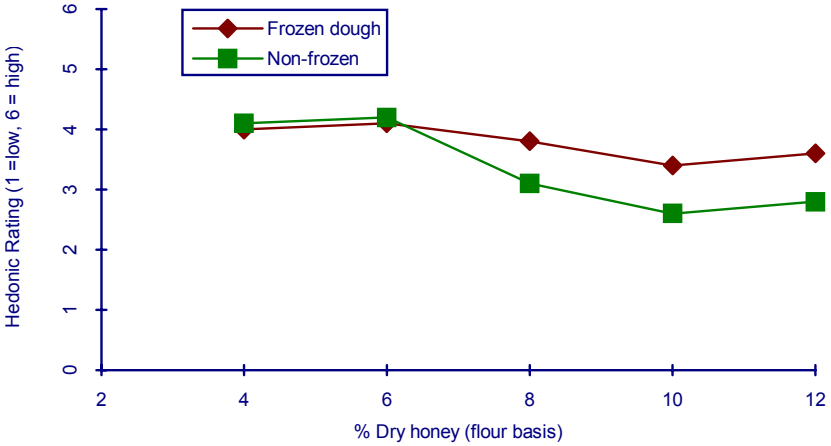
Table 2: Loaf Volume (cc) of Frozen Doughs with Varying Levels of Liquid and Dry Honey Addition

% Honey added	Liquid Honey	Dry Honey
4%	690 cc	695 cc
6%	740 cc	695 cc
8%	790 cc	720 cc
10%	855 cc	755 cc
12%	890 cc	810 cc

Loaf Volume of Frozen Doughs as a Function of Honey Addition (% flour basis)



Consumer Rating of Freshness as a Function of Dry Honey Addition in Frozen and Non-Frozen Doughs



Consumer Rating of Flavor/Sweetness as a Function of Honey Addition

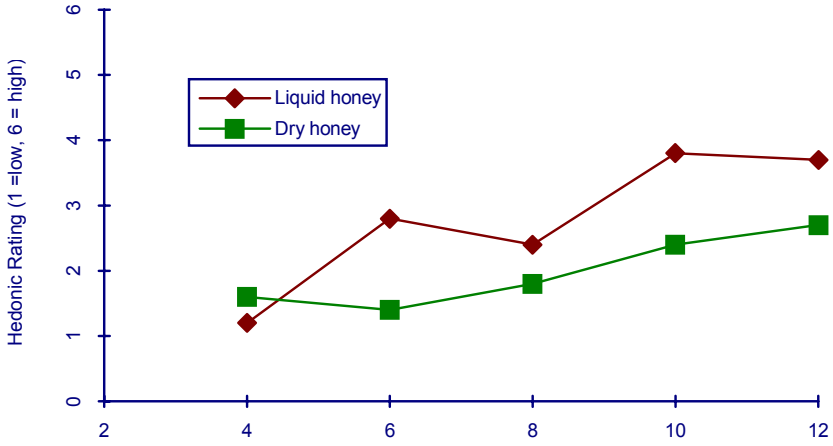
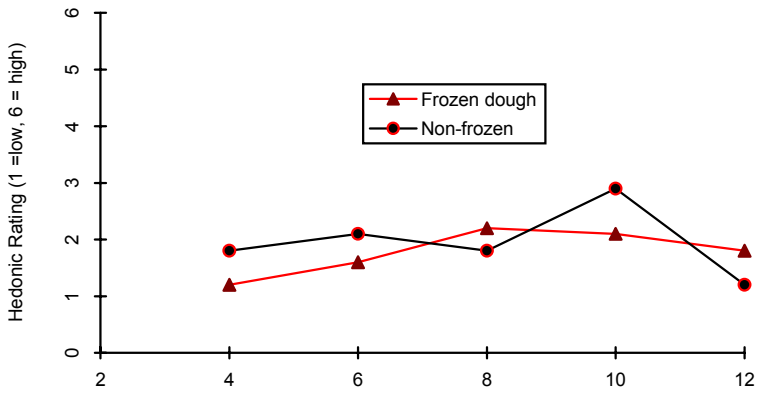


Table 3: Sensory Evaluation of Frozen Doughs with Honey		
Attribute: **Freshness**		
% Honey added	**Liquid Honey**	**Dry Honey**
4%	4.4bc	4.0c
6%	4.2ab	4.1b
8%	4.9a	3.8c
10%	4.7a	3.4b
12%	4.7a	3.6b
Attribute: **Mouthfeel**		
% Honey added	**Liquid Honey**	**Dry Honey**
4%	2.8d	3.3d
6%	3.8b	2.0c
8%	4.3bc	4.0c
10%	3.3d	4.0c
12%	4.0b	4.1b
Attribute: **Flavor/Sweetness**		
% Honey added	**Liquid Honey**	**Dry Honey**
4%	1.2c	1.6bc
6%	2.8a	1.4b
8%	2.4bc	1.8d
10%	3.8a	2.4cd
12%	3.7a	2.7b
Attribute: **Color**		
% Honey added	**Liquid Honey**	**Dry Honey**
4%	3.2c	4.6a
6%	3.9c	4.3bc
8%	4.8b	4.7c
10%	4.7a	5.3a
12%	4.2a	4.1a
Overall Acceptability		
% Honey added	**Liquid Honey**	**Dry Honey**
4%	2.3c	1.2d
6%	3.6b	1.6c
8%	4.1b	2.2c
10%	4.9ab	2.1d
12%	3.8b	1.8c

a,b,c,: Data in a row which are not followed by the same letter are statistically different.

Overall Acceptability - Frozen vs. Non-Frozen Doughs Made with Dry Honey



Appendix

Materials and Methods

- Honey. A U.S. Grade A amber liquid honey (industrial type, blended) and a dry honey product made from pure liquid honey converted to a free flowing powder were used in this study.
- Wheat flour. A commercial high gluten, malted flour was used for this study.

Rheological Properties

The rheological properties were determined using the alveograph. Measurements were performed under conditions of constant dough water content and mixing times by a modification of the standard AACC method 54-30. Dough was frozen at -50°C for 15 minutes, then transferred into a polyethylene bag and stored at -18°C for two weeks. After two weeks, the dough was thawed in a retarder at -2°C for approximately 12 hours and at room temperature for 30 minutes The dough was then placed in the alveograph and mixed for 2 minutes, followed by extrusion, relaxation and bubble formation by the standard methods. The following alveograph parameters were automatically recorded by a computer software program: maximum overpressure needed to blow the dough bubble -- an index of resistance to extension, average abscissa at bubble rupture -- an index of dough extensibility, and the deformation energy -- an index of dough strength.

Baking Studies

Doughs were mixed to optimum consistency in a mixer. Mixed doughs were divided into 170 g. pieces, rounded and rested for fermentation. Doughs were sheeted, molded and panned. Control doughs (not frozen) were baked at 400°F for 25 minutes. After 30 minutes of cooling, loaf volume was determined by rapeseed displacement. Breads were sliced and grouped in separate sets for objective and sensory tests. Other doughs were placed in a blast freezer for 15 minutes at -50°C immediately after panning. They were then stored in

polyethylene bags at -18°C for 2 weeks. Doughs were thawed in a retarder and proofed, baked and cooled. Loaf volumes, bread firmness, crust and crumb color were measured.

- Bread firmness was determined with Universal Testing Machine, Model 4301 with 10 kg. cell load using the approved AACC Method 74-09.
- Crust and crumb color were determined using a Minolta CM-2002 spectrophotometer. The CIE-Lab L value indicates darkness.

Consumer Panel Sensory Evaluation
Two-day old bread slices were served to semi-trained consumer panelists for sensory evaluation using the approved AACC Method 74-30. Panelists used a hedonic scale of 1 to 6 to judge the following sensory attributes: freshness, mouthfeel, flavor/sweetness and overall acceptability.

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