

# Prepared Milk and Egg Custard with Freeze-Thaw Stability<sup>1</sup>

E. L. THOMAS and S. T. COULTER

Department of Food Science and Industries  
University of Minnesota, St. Paul 55101

## Abstract

The concept of a prepared frozen milk and egg custard which upon thawing would resemble the traditional baked custard was investigated. A basic formula was developed consisting of 73.8% whole milk (3.5% fat), 14.6% whole eggs, 10.0% sucrose, 1.0% nonfat dry milk, and 0.6% 300 Bloom gelatin. Processing involved pasteurization (82 C for 15 min), homogenization, cooling, aging, and freezing in a continuous ice cream freezer followed by storage at -29 C. Syneresis which occurred upon thawing when samples were frozen quiescently was absent when the product was frozen in a continuous freezer with the incorporation of air to yield 10 to 15% overrun. Rate of cooling and time of aging the mix greatly influenced consistency of the thawed product. Results of a small-scale project indicated excellent consumer acceptance. Legal aspects of labeling the product are discussed.

## Introduction

Custard, a cooked mixture of milk, egg, sugar, and flavoring, has been a popular food for many years. Recipes for baked and stirred custards are given in most cookbooks. Although usually considered a dessert, custard is generally recognized as highly nutritious, palatable, and acceptable to all age groups.

Careful attention must be given temperature and time of cooking custard to avoid a curdled appearance and syneresis. This discourages making custard in the traditional manner. Dry egg custard mixes to which only milk must be added before cooking in the conventional manner have been available for several years. These provide some convenience as well as assuring a custard mixture with improved uniformity of performance. A refrigerated ready-to-eat custard has recently appeared on the market.

The concept of a prepared frozen milk and egg custard which upon thawing would closely

to merit investigation. We present the development of a formula and processing procedure for the production of such a custard with satisfactory freeze-thaw properties.

## Development of the Formula

Conventional custard formulas were utilized in several trials to determine the optimum proportions of milk, egg, and sugar. It was assumed that a stabilizer would be necessary to control body characteristics and inhibit syneresis upon thawing. Gelatin was selected as being the type most likely to yield a product possessing typical texture and gel structure. Further experimentation revealed that added nonfat milk solids aided in controlling texture. The following formula was ultimately developed which yielded a custard with excellent stability when processed according to our procedure.

## Milk and Egg Custard Formula

73.8% whole milk, 3.5% fat  
14.6% fresh or frozen whole eggs<sup>a</sup>  
10.0% cane or beet sugar  
1.0% nonfat dry milk<sup>b</sup>  
0.6% gelatin (300 Bloom)

---

100.0% total

Add 28.5 g salt and 7 g liquid cheese color per 45 kg of mix.

An analysis of custard made according to our formula with whole eggs was 4.7% fat, 5.2% protein, and 25.1% total solids.

## Processing Procedure

Processing involved pasteurization, homogenization, cooling, aging, and freezing. It was established that heating at 82 C for 15 minutes yielded a pleasant custard flavor and that increased heating where perceptible thickening of the mixture occurred should be avoided. Excessive heating tended to cause a rough texture

<sup>a</sup> Egg yolk may be substituted for whole egg. If so, use 80.4% whole milk and 8.0% egg yolk and increase gelatin to 0.65-0.70%.

<sup>b</sup> Grade A, low-heat, nonfat dry milk was used in experimental trials.

<sup>1</sup> Paper no. 1374, Miscellaneous Journal Series, Minnesota Agricultural Experiment Station. resemble the traditional baked custard appeared

in the finished custard. The mix was pasteurized and homogenized at 175 and 35 kg/cm<sup>2</sup> and cooled in an ice-water bath to 2 to 4 C. It was necessary to age the cold mix 4 hours or longer to permit gelatin to form a gel structure before freezing. Rapid cooling in a plate or surface cooler resulted in a weaker gel and required increasing gelatin 0.65 to 0.70%.

In preliminary trials, the mix was packaged after aging and then frozen quiescently at -29 C in the ice cream hardening room. Upon thawing, excessive syneresis often appeared and the custard tended to have a grainy appearance. We postulated that freezing in a continuous ice cream freezer with some air would aid in controlling the problem. It was demonstrated that the incorporation of sufficient air to yield an overrun of 10 to 15% resulted in a custard which, after hardening at -29 C, was remarkably resistant to syneresis when thawed. Increasing the overrun resulted in a progressively weaker body. It is possible that small air cells may improve stability of the gel toward freezing by limiting size of ice crystals. Also, visible syneresis may be prevented by retention of free liquid by the air cells through capillary action.

#### Recommended Processing Procedure

1. Thoroughly blend all ingredients in pasteurizing vat. Eggs should be beaten slightly to break structure before adding to mixture.
2. Pasteurize at 82 C for 15 minutes.
3. Homogenize at 175 and 35 kg/cm<sup>2</sup>. If homogenization exceeds 15 minutes, the mix should first be cooled to 74 C to avoid excessive thickening.
4. Cool to 2 to 4 C and age at this temperature for 4 hours or longer to permit formation of a firm gel.
5. Add vanilla extract or flavoring equivalent to 114 g of pure double-strength extract per 45 kg of mix.
6. Freeze in continuous freezer to a stiff consistency at as low an overrun as possible, not exceeding 10 to 15%. The mix may be stirred to break gel structure before freezing to facilitate pumping.
7. Package, harden, and store the same as ice cream.

#### Preparation for Serving

When ready to serve, the product should be thawed either by holding in a refrigerator for several hours or at room temperature for about one hour. The time to thaw will obviously depend on the quantity or size of the package. To maintain a firm consistency, the serving temperature should not exceed 7 to 8 C.

#### Observations on Physical and Flavor Stability

No significant changes in physical appearance or syneresis were observed after storage under the following conditions:

1. Held at -29 C for 6 months.
2. Held in open-top ice cream cabinet for one month with temperature fluctuations of -20 to -12 C.
3. Held in a refrigerator at 4 to 7 C for 2 weeks.

Slight flavor deterioration was observed after long-term storage under Conditions 1 and 2. The custard was described as "lacking freshness." Samples packaged in transparent plastic containers exhibited rapid flavor deterioration when exposed to fluorescent lights in an ice cream merchandising cabinet.

#### Consumer Acceptance

Approximately 400, 114-g containers of the custard were dispensed gratis to customers of our dairy products salesroom. Comments were solicited with a self-addressed stamped card with a description of the product and directions for thawing and serving. Seventy-five cards with brief to detailed comments were returned. Some cards included comments from two or more members of the family. Fifty-six, or about 75%, of the responses rated the custard as very good to excellent; five (7%) indicated moderate acceptance; and 14 (19%) indicated a moderate to definite dislike. Following are typical comments from those rating the product high.

"We all liked it very much. Usually do not like regular custard. Ages 45, 38, 16, 14, 11."

"Excellent. Custard is very difficult for our modern homemaker to make, as it often separates or curdles. Your custard had perfect texture, never separated and tasted 'just like mother used to make.' It has none of the 'pudding in a can' or the instant-pudding taste. Delicious!"

"Very tasty and texture perfect—surprised to see little watering since it is frozen."

"Almost as good as homemade—a little more vanilla or nutmeg."

"Preferred it partially frozen—liked it."

"We all liked it very much. It is tasty and convenient to store and use. . . ."

Many suggestions for flavoring were received, including fruits, burnt-sugar sauce, maple syrup, nutmeg, and cinnamon.

Currently the product is being offered for sale to further evaluate consumer acceptance. Sev-

eral food processors have expressed an interest in the product and are investigating marketing possibilities. It is suggested that the custard be considered a convenience item for school and institutional meals and restaurants as well as for the home market.

#### **Labeling**

As with any new product, the question of proper labeling arises. An inquiry regarding labeling was recently directed to the Minnesota Department of Agriculture. Following is the interpretation by the director of the food inspection division: "After reviewing the formula and manufacturing directions for the above-referenced product distributed by Doctors E. L. Thomas and S. T. Coulter, Department of Food Science and Industries, University of Minnesota, St. Paul, which you forwarded to me with your

memorandum dated September 22, 1969, I have concluded that, although a product of which milk is one of the principal ingredients, it is not a frozen food as defined in Minnesota Statutes 1967, Section 32.55, subdivision 2. This conclusion is based principally on the fact that it is neither made in a manner similar to the defined frozen foods nor intended to be eaten in the frozen state. Rather, the product would appear to be a custard frozen to protect it from spoilage and to extend its shelf life.

"Because a standard of identity already exists for a product named 'Frozen Custard,' which is defined by AGR 1551, the name of the product developed by Doctors Thomas and Coulter should not be referred to as a frozen custard, but 'Milk-Egg Custard' or 'Milk Custard' or 'Custard' with label information showing that the product should be stored frozen, thawed in the refrigerator and served cold."