



FROZEN CUSTARD APPLICATION RESEARCH

COMPARING THE FUNCTIONALITY OF EGGS TO EGG REPLACERS IN FROZEN CUSTARD FORMULATIONS

FROZEN CUSTARD RESEARCH EXECUTIVE SUMMARY

For this study, eggs were reduced and/or removed from frozen custard formulas and replaced with commercial egg replacer products at the manufacturers' suggested rates. Both the frozen custard base and the prepared frozen custard were evaluated using industry standard analytical and qualitative tests. The successful reduction of eggs in frozen custard may be possible, however products made with less than the required egg solids content may not be marketed as such to consumers, according to the FDA mandated standard of identity for frozen custard. Not a single replacer product performed as well as or better than real eggs in all attributes assessed, with color and flavor targets being the most difficult attributes to match.

Frozen custard with reduced egg content generally had less custard-like flavor, with a more dairy-forward profile. The best and worst performing egg replacers were both whey-based products, showing that generalizations about egg replacers may be difficult to make. Overall, changes in product quality from the reduction or removal of egg products in frozen custard are slight, but noticeable. Manufacturers must test egg replacing ingredients and spend time optimizing formulas for best results.



OBJECTIVE

The purpose of the study was to provide food manufacturers research-based formulation and application information on the use of egg replacers in frozen custard. Due to the known performance characteristics of real egg yolks in frozen custard, it was hypothesized that no single ingredient would be able to replace the multiple functions provided by eggs in frozen custard without affecting product quality.

EGG REPLACING INGREDIENTS

After researching available egg replacers, seven egg replacer ingredient companies were selected, based on dollars spent on marketing and advertising in industry publications. A variety of egg replacing ingredients was selected based on their recommended use to reduce or replace egg yolks in frozen custard. Ingredient specifications, nutritionals, starting formulations and recommended usage rates were requested and compiled from the manufacturers and used to create test formulas. Egg replacers not recommended for this application were excluded from testing.

The recommended egg yolk replacement ranged from 50 to 100 percent and almost all companies recommended keeping the ratio of wet to dry ingredients the same (when removing some or all of the sugared egg yolks from a formula, moisture is also removed, and needs to be added back in the form of water to balance the formula). Five of the seven products selected were recommended to replace 100 percent of the sugared egg yolks from frozen custard formulas.

FORMULAS

Control/Gold Standard Formulas

The Control formula consisted of whole milk, heavy cream, granulated sugar, sugared egg yolk, and vanilla extract.

Negative Control

A Test formula was conducted with the absence of egg yolks or egg replacers to demonstrate the need for the functionality of these ingredients.

Test Formulas

Seven egg replacer ingredients were tested in frozen custard formulas. Egg replacers tested were:

- Starch-based blend
- Whey protein concentrate
- Blends of various ingredients, including starches, proteins, emulsifiers, leaveners, enzymes and hydrocolloids
- Algae-based blend

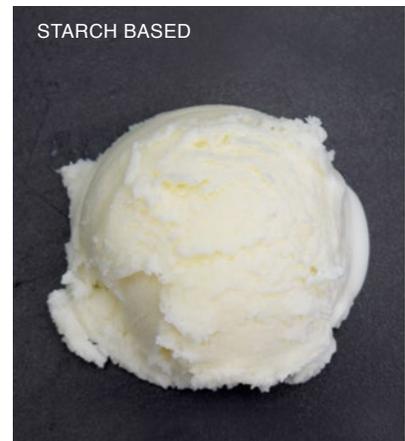
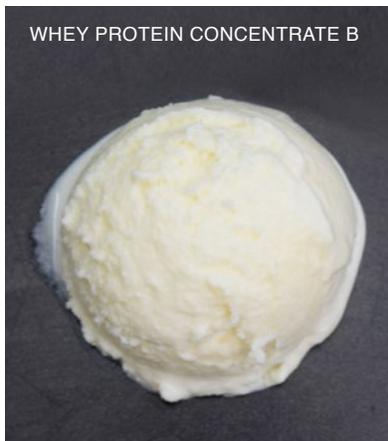
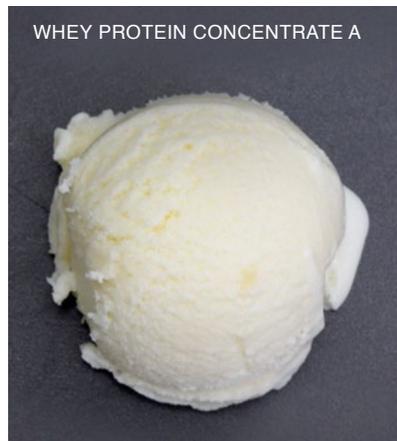
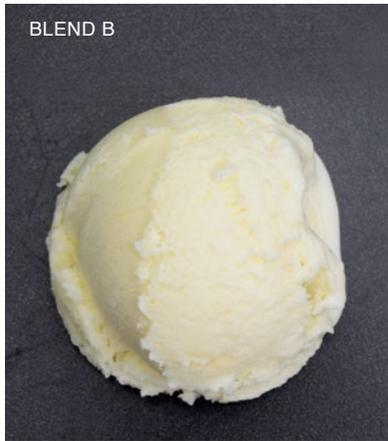
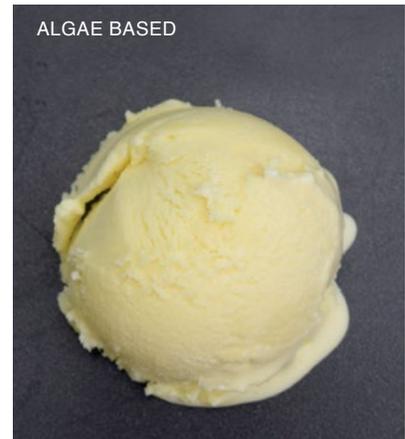
Frozen custard test formulas were created using the Control gold standard formula, with the addition of egg replacer ingredients. Formulations were based on the ingredient manufacturer's recommended usage rate in application and percentage of egg yolk replacement, which varied widely among products.

TESTS

Both the frozen custard base and the prepared frozen custard were analyzed, using industry standard, category-specific tests. Frozen custards were all produced in the same conditions, on the same equipment, on the same day. Consistent batching, portioning and churning procedures were used to limit variables. Processing methods were neither adjusted nor optimized for test formulas, instead a standardized time and procedure was used to ensure each test saw the same conditions.



FROZEN CUSTARD VISUAL COMPARISON



Custard base analytical tests were performed before churning, while tests performed on the finished product were performed after churning and hardening for a period of 8 to 12 hours.

Testing was carried out at the CuliNex Seattle Test Kitchen and Medallion Labs in Minneapolis, Minnesota.

Analytical Tests

Base viscosity
Color
Overrun

Subjective/Sensory Tests

Appearance
Color
Smoothness
Mouthfeel
Flavor
Overall commentary

RESULTS & DISCUSSION

BASE

Base Viscosity

Control and Negative Control had the same viscosity. Overall, many egg replacers appear to match Control in creating target viscosity in frozen custard base, while some egg replacers may be difficult to disperse and may result in clumping.

Overrun

All tests had lower overrun than Control. Negative Control had significantly lower overrun than Control, signifying that very little air was incorporated during processing. Overall the results suggest some egg replacers did perform functionally, contributing to increased product volume.

FROZEN CUSTARD

Appearance

The samples were rated as being fairly similar in appearance, according to panelists' commentary. Panelists agreed Control had an appealing, slightly fluffy looking appearance, with a smooth, creamy looking texture. Panelists noticed a flaky-looking appearance and visible ice crystals in some Tests, while other samples were determined to be acceptable in appearance, but did vary in color.

Color

Panelists commented that Control had a "very nice yellow butter color," with the other frozen custard samples being relatively similar in shade and intensity to Control. Some of the egg replacer samples were rated as being slightly more pale and white, while others were slightly more dark and yellow. Negative Control was deemed "much whiter than Control;" it was the lightest and least yellow sample. These results suggest some frozen custard formulas made with egg replacers may need color optimization to achieve the desired hue, but most samples were not outside the range of acceptability.

Smoothness

While there were some slight differences in texture among the samples, there were no statistically significant differences in the scores assigned by panelists. Due to the nature of frozen samples and the sensory evaluation protocol, the extreme cold of the dry ice and the warm air temperature in the tasting room may have influenced the nuances of the frozen custard texture. These small, but impactful environmental biases, influenced taster commentary, and no meaningful conclusions about the iciness of samples could be drawn.

Mouthfeel

There was no statistical significance of the scores assigned to mouthfeel, but some slight differences were captured in commentary from panelists. Control was described as having a "fatty mouthfeel



that coats and lingers in the mouth,” whereas some of the samples with reduced egg content were noticeably leaner and shorter in mouthfeel duration. Overall, there were small changes to the perception of mouthfeel in samples with reduced egg content, with some formulas needing optimization to match the target mouthfeel of gold standard frozen custard.

Flavor

The flavor of Control was described as “milk, egg, sweet, creamy, rich” and without off flavors. Negative Control was missing the characteristic egg flavor associated with frozen custard, with panelists commenting it was “not as rich,” although no off notes were detected. In summary, frozen custard made with reduced egg content may lack characteristic flavor, and some egg replacers may contribute off flavors thought to be out of place in the application.

Overall Commentary

Due to the inherent limitations of sensory evaluation of a frozen product, there may have been inconsistencies in the temperature, and therefore perceived texture and mouthfeel of the samples depending on how quickly each individual panelist consumed their samples. The commentary on overall likability ranged drastically among panelists, even on Control.

CONCLUSIONS

The use of ingredients to reduce or replace eggs in frozen custard can be a challenging product development exercise, and the acceptability of formulations may be difficult to predict without evaluating samples organoleptically. In these tests, the sensory evaluation results from panelists on the organoleptic attributes of frozen custard were generally consistent with the findings of the analytical test results. The areas of frozen custard quality most negatively affected when eggs were removed and/or replaced included viscosity, overrun, color, texture, flavor and overall

impression. According to results from the sensory panel, attributes where there was not a statistically significant difference between Control and most egg replacer tests included appearance, smoothness and mouthfeel.

The Control frozen custard was described as having an appealing, slightly fluffy looking appearance, with a smooth, creamy looking texture. It had a buttery, yellow color and an egg, sweet, rich flavor characteristic of frozen custard. Overall, it was well liked by panelists.

The results from sensory evaluation on Negative Control were not statistically different from Control in viscosity, mouthfeel or smoothness, but it did have less overrun and the lightest color. Panelists remarked that the flavor and color of Negative



Control were weakened, making it generally not as appealing as Control. Furthermore, frozen desserts made without any egg yolk solids would not be able to be marketed as frozen custard, due to regulations mandated by the FDA on the minimum required egg content of said products.

Overall, the successful reduction of eggs in frozen custard may be possible, however products made with less than the required egg solids content may not be marketed as such to consumers. Reduction of eggs and replacement with other ingredients or blends may also add to the complexity and length of ingredient labeling. Results varied among products, with color and flavor targets being the most difficult attributes to match.

Even though ingredient manufacturers may have usage rate recommendations and even starting formulations, many do not know how their product performs in a variety of applications. Their recommendations for incorporating egg replacers

into formulas can be vague and hard to follow, making product optimization using egg replacers a time-consuming exercise. Formulators must determine the best ingredients for frozen custards through hands-on testing on the bench and in the plant to achieve the desired results, balancing cost with functionality and flavor. Ultimately that may mean using real eggs in frozen custard formulations.

COMPLETE RESEARCH REPORT & FINDINGS

For a copy of the complete 46-page research report with further study background and detailed findings, please contact Elisa Maloberti at info@RealEggs.org or call **847.296.7043**.





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