



# CHEESECAKE APPLICATION RESEARCH

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COMPARING THE FUNCTIONALITY OF EGGS TO EGG REPLACERS IN CHEESECAKE FORMULATIONS

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# CHEESECAKE RESEARCH EXECUTIVE SUMMARY

Starting with a gold standard cheesecake formula containing eggs as the Control sample, researchers reduced and/or removed eggs from the formula and replaced them with a number of commercial egg replacer products. Six egg replacers were used at the manufacturers' suggested rates. Analytical tests and organoleptic sensory evaluations were performed on each cheesecake formula. Except for water activity, all areas of cake quality were negatively affected, especially flavor and texture. Not a single egg replacer product performed as well as or better than real eggs in all areas assessed. The best performing product was whey protein concentrate based, followed by starch-based products. The worst performing product was whole algal flour, which produced a dark yellow color, undesirable flavors and a weak texture. To fully assess egg replacers, manufacturers must test them on the bench and spend time optimizing formulas for acceptable results.



# OBJECTIVE

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

# EGG REPLACING INGREDIENTS

After researching egg replacers, six egg replacer ingredient companies were selected, based on dollars spent on marketing and advertising in industry publications. A variety of egg replacing ingredients from these companies was selected based on recommended use to reduce or replace whole eggs in cheesecake. Ingredient specifications, nutritionals, starting formulations and recommended usage rates were collected from the manufacturers and used to create test formulas. Egg replacers not recommended for this application were excluded from testing.

Recommended egg replacement varied from 25 to 100 percent. Most suppliers recommended keeping the ratio of moisture to dry ingredients the same. (When removing some or all of the liquid eggs from a formula, moisture is also removed. Therefore it needs to be added back in the form of water to balance the formula.) Only one company recommended removing 100 percent of the eggs from cheesecake formulas. Different egg replacer ingredients have varying water absorption capacities. If an ingredient absorbs an excessive amount

of water, additional water may need to be added to the formula to obtain the correct batter viscosity to flow through production equipment. Additionally, this may result in the need to lengthen bake times to get the correct internal temperature and final moisture content.

# FORMULAS

## Control/Gold Standard Formulas

The Control formula consisted of cream cheese, white granulated sugar, water, liquid whole eggs, unsalted butter, bread flour, nonfat dry milk, corn starch, salt, and vanilla extract.

## Negative Control

A test was conducted with the absence of eggs or egg replacers to demonstrate the need for the functionality of these ingredients.

## Test Formulas

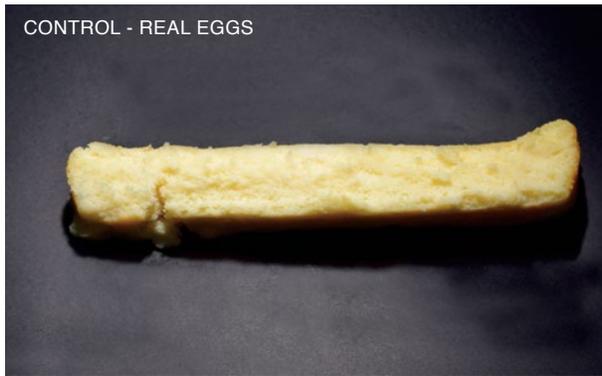
Six egg replacer ingredients were tested in cheesecake formulas:

- Starch-based
- Soy-based
- Whey protein concentrate
- Wheat protein isolate
- Fiber-based
- Whole algal flour

Cheesecake Test formulas were created using cream cheese, white granulated sugar, water, liquid whole eggs, unsalted butter, bread flour, nonfat dry milk, corn starch, salt, vanilla extract, and the egg replacer ingredients. Formulations were based on the ingredient manufacturer's recommended percent in application and percentage of whole egg replacement, which varied widely.



# CHEESECAKE VISUAL COMPARISON



# TESTS

Consistent batching, portioning, baking and cooling procedures were used to limit variables. Each test was batched in the same mixer, using standardized mixing procedures. The pans used were identical, and each was prepared for portioning in the same manner. A standard rack oven was used for baking. Bake times were not adjusted nor optimized for each test formula, instead a standardized time and temperature was used to ensure each test had the same conditions.

Both the batter and cooked, cooled cheesecakes were analyzed using industry standard, category-specific tests. Cheesecakes were all baked in the same conditions, in the same oven, and on the same day. Batter analytical tests were performed immediately after mixing, while tests performed on the baked cheesecakes were performed after they had cooled completely the following day (Day 1).

Tests used to assess cheesecake batter and finished product:

## Analytical Tests

- Batter specific gravity (BSG)
- Batter viscosity
- Baked good height
- Color
- Texture
- Water activity ( $A_w$ )

## Subjective/Sensory Tests

- Cooked appearance
- Cooked aroma
- Texture
- Flavor
- Overall likability

Testing was performed at the CuliNex Seattle Test Kitchen and AIB International Laboratories in Manhattan, Kan.

# RESULTS & DISCUSSION

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## BATTER QUALITY

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### Batter Specific Gravity

All samples were close to the BSG value of Control. This suggests that the egg replacers did function to help aerate the batter, and the density of the batter was close to the Control made with real eggs.

### Batter Viscosity

While no Test matched the viscosity of Control batter exactly, the range in values suggests that with further modification of the water content of the formula, a similar viscosity to control could be attained.

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## BAKED GOOD APPEARANCE

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### Baked Good Height

The Control had a very even rise. While most of the Test formulas all had similar center height measurements to Control, they all had notably higher edges than centers, meaning the tops of the cakes were concave. This exemplifies the effect of egg replacers on the rise and fall of the cheesecake during baking. The Control sample rose and set evenly after baking, but the samples using egg replacers did not rise as evenly, and this showed in the final set shape.

### Cooked Appearance & Color

The Control rated second highest with a 'moderately appealing' score of seven out of nine points. Panelists agreed it had a "nice golden color," and noted it "looks as you would expect." Most of the egg replacer Tests were deemed too dark or yellow-looking.



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## EATING QUALITY

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### Texture

While a tender, creamy mouthfeel is desirable, cakes that are too fragile are incredibly difficult to cut into clean slices and become “gummy, sticky and wet” in the mouth.

### Water Activity

All samples had similar water activity readings. Therefore, the egg replacers did not have significant effect on the  $A_w$  of the cheesecake.

### Cooked Aroma

In aroma intensity and likability sensory evaluation, Control was the most highly rated, with a ‘slightly strong’ and ‘very appealing’ aroma. No Test came close to Control. These results imply that in formulas with reduced egg content, overall aroma is weakened.

### Flavor

Control was described as having “perfect flavor, lightly sweet, neutral, balanced flavors,” the highest of all the tests.

### Overall Likability

In overall likability, Control scored the highest, with an eight out of a possible nine points. It was described as “consistent with a good, mass-produced cheesecake” and was lauded for its light golden color, balance of flavor and creamy texture.

## CONCLUSIONS

The use of ingredients to reduce or replace eggs in cheesecakes is challenging for even the most accomplished baker.

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No single egg replacer performed as well or better than whole eggs in all of the objective or subjective tests.

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The sensory evaluation results from panelists on the organoleptic attributes of the cheesecake are consistent with the findings of the objective analytical test results. Except for water activity, nearly all areas of cheesecake quality were negatively affected when eggs were removed and/or replaced with another ingredient, including the batter viscosity, baked cake rise and shape, color/appearance, and most importantly, finished good aroma, flavor and texture.

While tasters unanimously preferred the Control to the Test formulas, the egg replacer products that performed best were whey-based, followed by starch-based. The whey-based product was similar to Control in flavor intensity and texture, but scored lower than Control in flavor likability, appearance and aroma likability. The starch-based product had the highest rated appearance of all the samples, slightly higher than that of



Control. However, it performed worse than control in every other test, with the batter being much too viscous, resulting in a very thick, sturdy cheesecake that looked appealing but was dry and crumbly in the mouth.

The worst performing egg replacer was whole algal flour; it suffered from an intense, artificial yellow color, a weak texture and strong, off-putting flavors. A baker would need to reduce the level in the formula to achieve the desired light golden hue, but may lose some functionality of the egg replacer. Its strong vegetal/grain/rancid flavors were deemed out of place in subtle, neutral cheesecake.

Egg replacers that didn't perform particularly well, but weren't as offensive to panelists as whole algal flour, included soy-based, wheat-based blend and fiber-based products. Negative Control, without any eggs or replacer ingredients, performed similarly to these Tests, being neither particularly appealing nor unappealing in overall likability, but having an unbalanced flavor.

Unfortunately, few generalizations about egg replacers can be made, because they vary vastly from supplier to supplier. 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. Manufacturer recommendations for incorporating egg replacers into formulas can be vague and hard to follow, making product optimization through the use of egg replacers a time-consuming exercise.

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Formulators must determine the best ingredients for cheesecakes through hands-on testing on the bench and in the plant to achieve the desired results, balancing cost with functionality & flavor.

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Ultimately, that may mean using real eggs in cheesecake formulations.

## COMPLETE RESEARCH REPORT & FINDINGS

For a copy of the complete 47-page research report with further study background and detailed findings, please contact Elisa Maloberti at [info@RealEggs.org](mailto:info@RealEggs.org) or call 847.296.7043.





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