



ANGEL FOOD CAKE APPLICATION RESEARCH

COMPARING THE FUNCTIONALITY OF EGGS TO EGG REPLACERS IN ANGEL FOOD CAKE FORMULATIONS



ANGEL FOOD CAKE RESEARCH EXECUTIVE SUMMARY

For this research eggs were reduced and/or removed from angel food cake formulas and substituted with egg replacers used at the manufacturer's suggested rate. Both the angel food cakes and the batters were evaluated quantitatively and qualitatively following industry-standard protocols.

Overall, not a single product performed as well as or better than real eggs in all attributes assessed. The egg replacers varied widely in functionality. The sensory and analytical tests confirm that angel food cakes need eggs or egg replacers in formulation to perform functionally. Manufacturers must test egg replacing ingredients and spend time optimizing formulas for acceptable results.



OBJECTIVE

The purpose of the study was to provide research-based formulation and application information on the use of egg replacers in angel food cakes for food manufacturers. Due to the known multi-functionalities of real egg whites, it was hypothesized that no single ingredient would be able to replace the multiple functions provided by eggs in angel food cake without affecting product quality.

EGG REPLACING INGREDIENTS

After researching 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 were selected based on their recommended use to reduce or replace eggs whites in angel food cake. 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.

The recommended egg white replacement varied from 25 to 50 percent, and almost all manufacturers recommended keeping the ratio of moisture to dry ingredients the same. None of the companies recommended removing 100 percent of the egg whites from angel food cake. 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 can lengthen bake times to get the correct internal temperature and final moisture content.

FORMULAS

Control/Gold Standard Formulas

The Control formula consisted of high whip liquid egg whites, powdered sugar, cake flour, wheat starch, vanilla extract, cream of tartar and salt.

Negative Control

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

Test Formulas

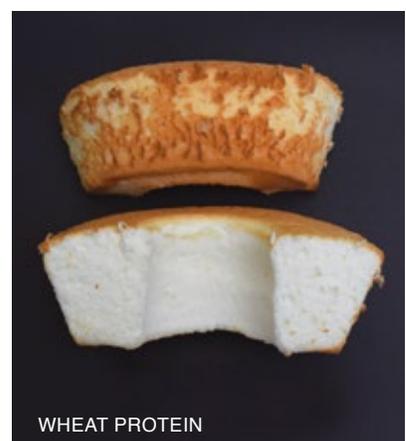
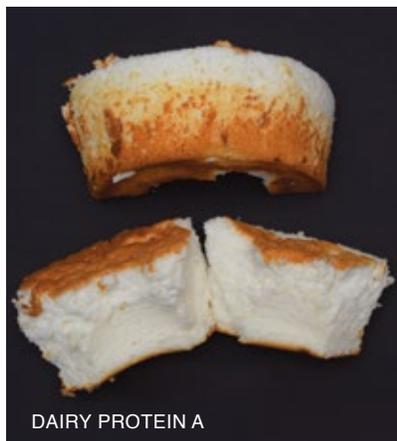
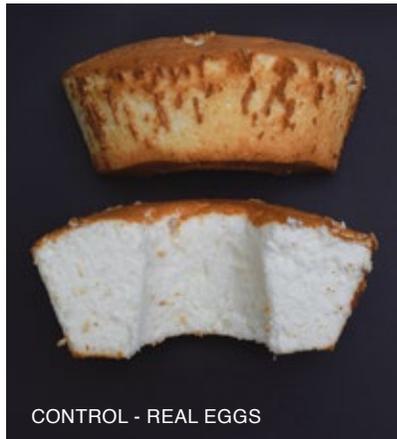
Seven egg replacer ingredients were tested in angel food cake formulas. Egg replacers tested included:

- Gum
- Dairy Protein
- Wheat Protein
- Blends of various ingredients, including starches, proteins, emulsifiers, leaveners, enzymes and hydrocolloids
- Starch

Angel food cake 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 percent in application and percentage of egg white replacement, which varied widely among products.



ANGEL FOOD CAKE VISUAL COMPARISON



TESTS

Both the batter and cooked, cooled cakes were analyzed using industry standard, category-specific tests. Angel food cakes were all baked in the same conditions, in the same oven, over the course of several batches. Consistent batching, portioning, and baking procedures were used to limit variables. Each test was batched in the same mixer using standardized mixing procedures. Identical pans were used, and each was prepared for portioning in the same manner. Bake times were not adjusted or optimized for each test formula, instead a standardized time and temperature was used to ensure each formula was subjected to the same conditions. Batter analytical tests were performed immediately after mixing, while tests performed on the baked angel food cakes were performed after they had cooled completely.

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

Analytical Tests

Batter specific gravity
Batter viscosity
Height/shape
Color
Texture
Moisture
Water activity

Subjective/Sensory Tests

Appearance
Color
Cell structure
Aroma
Texture
Flavor
Overall likability

RESULTS & DISCUSSION

BATTER QUALITY

Batter Specific Gravity

BSG values varied among the Tests, with some being comparable to Control and others being significantly higher. Analytical results suggest that angel food cake batters need eggs and/or egg replacers to meet aeration targets, and while some egg replacers do function to aerate batter properly, others do not.

Batter Viscosity

Nearly all of the egg replacer formulations thickened batter similarly to Control. The Negative Control batter was much thinner. These results suggest that some egg replacers do function to thicken angel food cake batter appropriately, but without eggs or egg replacers, viscosity targets may be difficult to meet.

APPEARANCE

Height

The height of angel food cakes made with reduced egg content varied considerably among the Tests—only two were similar in height to Control. Negative Control also failed to meet either center or edge height targets. These results suggest eggs and/or egg replacers are vital to reach height targets in angel food cake and some egg replacers do not function well to achieve proper height.

Appearance

Panelists were in agreement that Control was the most appealing sample in appearance. Conversely, Negative Control did not meet appearance expectations. Egg replacer formulations were not consistent in shape, height or color. These results indicate angel food cake with reduced egg content may not meet appearance targets, specifically in perceived moisture accumulation over time on the top crust.



Color

The colorimeter and sensory analysis results relating to cake color were generally in alignment with one another, with egg replacement not showing a significant impact on color. These results suggest egg replacers do function to contribute to characteristic color in angel food cake but may result in a lighter crust color, and cakes with significant egg reduction without replacement may fail to meet color targets entirely.

Crumb Size & Uniformity

Most egg replacer Tests were not significantly different from Control in panelists' ratings of crumb size and uniformity. Negative Control was the only Test significantly different from Control in cell uniformity, being much more uniform. It was also rated as having the smallest cells of any of the cakes, indicating it lacked proper aeration and structure. These results suggest egg replacers do function to aerate angel food cake batter, but that crumb size may differ slightly in cakes with egg replacing ingredients.

EATING QUALITY

Aroma

Control was described as smelling slightly sweet and pleasant. Almost all of the egg replacers performed similarly to Control in contributing to characteristic angel food cake aroma. These results indicate that generally, aroma is not significantly impacted by egg reduction and/or replacement.

Texture

Negative Control was the only sample significantly different from Control in all texture attributes over the course of testing. It was much chewier, firmer and more cohesive than Control in both texture analysis and sensory evaluation. These results indicate angel food cake made without eggs or egg replacers may fail to meet texture targets.

Moisture

None of the samples were significantly different in moisture (both in analyzed content and perceived moisture in sensory analysis) from one another over the course of the seven-day shelf life. These results show that egg whites do function to help retain moisture in angel food cake over time and that egg replacers performed similarly to egg whites in moisture content and retention.

Water activity

There was no significant difference in water activity among samples, indicating eggs and/or egg replacers do not play an integral role in controlling water activity in angel food cake.

Flavor

Most of the egg replacer test samples were comparable to Control in flavor perception, although with some increased sweetness noted. The sample made without eggs, Negative Control, did not meet flavor expectations. These results indicate flavor may be impacted by egg reduction and/or replacement, especially sweetness perception.

Overall likability

Panelists noted defects in most Tests, ranging from minor variances in appearance and texture to overly sweet notes and off flavors. Negative Control was most different from Control; panelists deemed it unappealing. These results suggest angel food cakes made with reduced egg content and/or egg replacers may result in cakes with slightly different eating qualities and that some consumers may find these variances unappealing.

CONCLUSIONS

The use of ingredients to reduce or replace egg whites in angel food cakes is challenging for even the most accomplished baker. The sensory evaluation results from panelists on the organoleptic



attributes of the angel food cakes were generally consistent with the findings of the objective analytical test results. The areas of angel food cake quality most negatively affected when eggs are removed and/or replaced included batter specific gravity, appearance, height, flavor, and overall likability. Attributes less affected by egg replacement included batter viscosity, color, crumb uniformity, water activity and moisture.

Tasters unanimously preferred the Control to the Test formulas. Control's golden-brown color, high rise and sweet, neutral flavor won panelists' approval as the most appealing angel food cake. It was neither dry nor moist, and its structure was tender in the mouth, yet firm & pleasant to chew.

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.

Formulators must determine the best ingredients for angel food cakes 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 egg whites in angel food cake formulations.

COMPLETE RESEARCH REPORT & FINDINGS

For a copy of the complete 89-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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