REALEGGS

YELLOW BATTER CAKE APPLICATION RESEARCH

COMPARING THE FUNCTIONALITY OF EGGS TO EGG REPLACERS IN YELLOW BATTER CAKE FORMULATIONS

RESEARCH SUMMARY

YELLOW BATTER CAKE RESEARCH EXECUTIVE SUMMARY

Researchers used a standard commercial yellow batter cake formula containing eggs as the Control for the study. Eggs were then reduced and/or removed from the Control formula and replaced with commercial egg replacer ingredients, which were used at the manufacturer's suggested rate. The samples were evaluated quantitatively in commonly used cake analytical tests and then qualitatively in organoleptic tests.

All areas of cake quality were negatively affected, especially flavor and texture; not a single product performed as well as or better than real eggs. Both the best and worst performing products were a blend of ingredients. Other poorly performing replacers included whole algal flours, which produced undesirable flavors and weak textures. Of the products tested, real eggs outperformed all egg replacers in function and taste. Manufacturers must test egg replacers and spend time optimizing formulas for acceptable results.

OBJECTIVE

The purpose of the study was to provide research-based formulation and application information for food manufacturers on the use of egg replacers in yellow layer cakes. Due to the many performance contributions of real eggs in bakery cakes, it was hypothesized that no single ingredient would be able to replace the multiple functions provided by eggs in yellow layer 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 was selected, based on recommended use to reduce or replace whole eggs in yellow cake. Ingredient specs, 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 replacement varied from 25 to 100 percent, and almost all 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, so it needed to be added back in the form of water to balance the formula). Only two companies recommended removing 100 percent of the eggs from yellow cake formulas. Different egg replacer ingredients have varying water absorption capacities. If an ingredient absorbs an excessive amount of water (such as fibers and hydrocolloids), 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.

FORMULAS

Control/Gold Standard Formulas

A commercially-available yellow cake mix, requiring only the addition of water and dried or liquid eggs, was used in testing to standardize ingredients and limit variables.

Negative Control

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

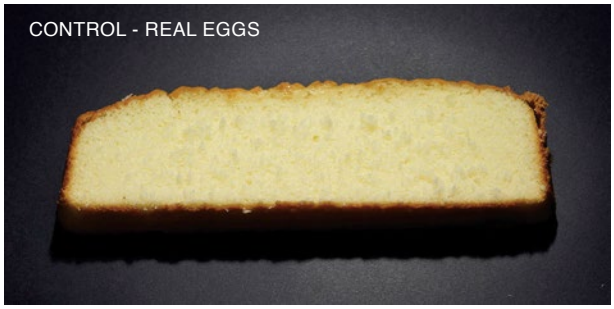
Test Formulas

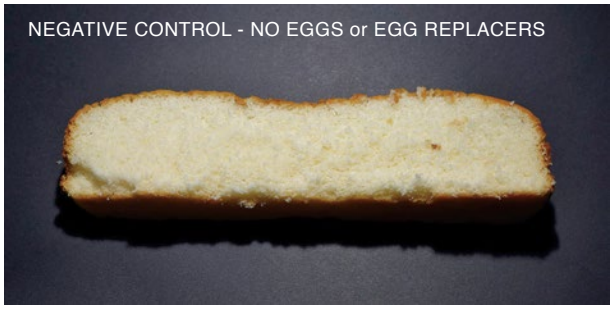
Seven egg replacer ingredients were tested in yellow cake formulas, including:

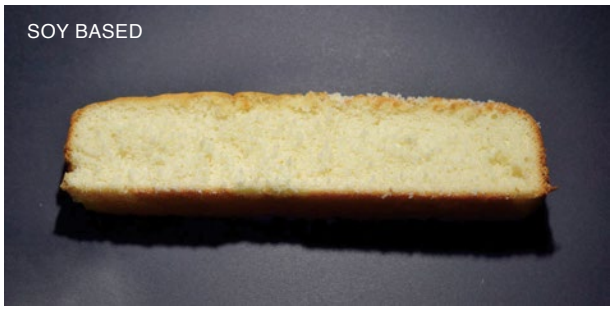
- Starch-based blend
- Soy-based blend
- Whey protein concentrate
- Blends of various ingredients
- Whole algal flour

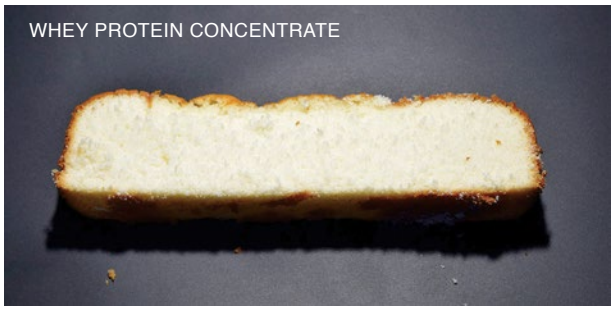
Yellow cake test formulas were created using the aforementioned cake mix, water and the egg replacer ingredients. Formulations were based on an ingredient manufacturer's recommended percent in application and percentage of whole egg replacement, and varied widely.

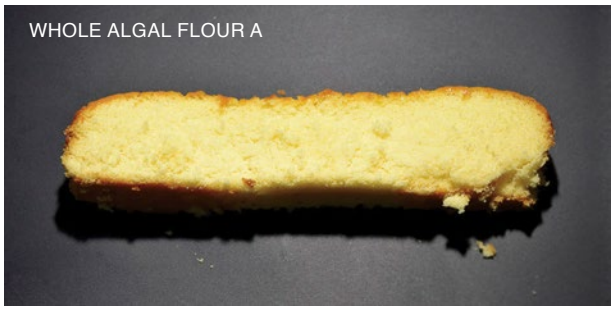
YELLOW BATTER CAKE VISUAL COMPARISON

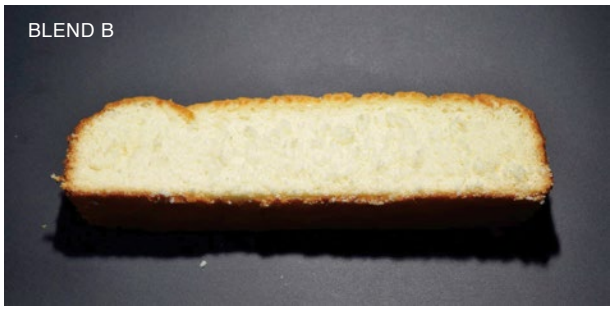


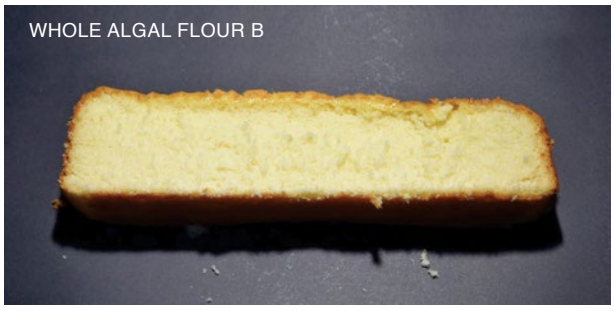












TESTS

Both the batter and cooked, cooled cakes were analyzed using industry standard, cake-specific tests. Cakes were all baked in the same conditions, in the same oven on the same day. They were cooled for 10 minutes before being de-panned, wrapped in standard plastic cling wrap and stored in cardboard cake boxes. Batter analytical tests were performed immediately after mixing, while tests performed on the baked cakes were performed after they had cooled completely.

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

Tests used to assess yellow cake batter and finished cakes:

Analytical Tests

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

Subjective/Sensory Tests

Cooked appearance
Cooked aroma
Texture
Flavor
Overall likability

RESULTS & DISCUSSION

BATTER QUALITY

Batter Specific Gravity

A target range for BSG was set for Control batter during initial testing to ensure a consistent Control product. None of the Test formulas matched or exceeded the Control formula in aeration.

Batter Viscosity

The Control cake batter had a target viscosity of 5.5 cm at 60 to 65 °F over 30 seconds. The range in batter viscosity among the Test formulas was quite large.

BAKED GOOD APPEARANCE

Baked Good Height

The height of the baked Control cake was the highest of all formulas; none of the Test formulas were able to replicate the height of control. The Control was also very evenly baked, with no major differences between the height in the center of the cake and the height on the edge. Baked good height did not change over time.

Cakes without proper rise can be weak and dense, not having enough structure to trap the gas necessary for leavening. Cakes that rise too much in the center would need to be trimmed excessively to be level for frosting, and would result in excess waste.

Cooked Appearance & Color

The cooked appearance of the tests did not change over time. The Control was the only cake to be rated a nine, extremely appealing, by panelists. The top had slight wrinkling and a golden brown crumb with sparse dark spotting; it was the darkest of all the samples. The egg replacer cakes looked dissimilar from one another: from very pale, dry, starchy/matte, swirl-patterned to extremely dark reddish brown and wrinkly with sunken centers. Most of the cakes had a very light yellow crumb, without benefitting from any additional color from whole eggs.

EATING QUALITY

Moisture

The moisture of all the cakes decreased during the span of the testing from Day 2 to Day 7. However, Control and a couple of the egg replacer tests did not exhibit a downward trend for the entirety of the shelf life testing. Control stayed consistently closer to an ideal texture score in sensory analysis, though.

Water Activity

Water activity was equal to or lower than Control across all cake samples. While a lower water activity is associated with increased shelf life, it can come at the expense of eating quality; none of the Test formulas exceeded the flavor likability scores in sensory analysis of Control.

Texture

Over time, the Control cake was downgraded very little in sensory analysis. Incidentally, the Control scored in the middle of the data set in texture analysis. The other cakes fell on either side of Control.

All of the cakes including Control exhibited undesirable symptoms of moisture migration; the tops of the cakes developed a sticky, gummy layer on the exterior top crust, as the moisture from the crumb seemed to migrate up and the interior crumb became crumbly, dry and stale. Control was the least severe of the formulas.

Cooked Aroma

Aroma intensity and likability changed very little over most of the cake tests throughout shelf life. Control aroma did start to weaken slightly by Day 7. Although not very strong, Control aroma was the most well-liked by panelists, described as “classic cake smell” and scoring the maximum.

Flavor

Across the board, flavor intensity weakened over time. Flavor likeability ranged vastly from Test to Test. The Control was described as basic, neutral “cake” flavor; nothing strong or off-putting, but the flavor did weaken throughout shelf life and became slightly stale.

Overall Likability

Flavor and texture seemed to be the two biggest indicators of overall likability. Control maintained a likability score of nine out of nine from Days 1 through 4 and downgraded to a seven on Day 7, mostly for degradation in texture from staling. The next highest rated sample scored an average of 5.75 throughout shelf life.

CONCLUSIONS

The use of ingredients to reduce or replace eggs in yellow batter cakes is challenging for

even the most accomplished baker. No single egg replacer performed as well or better than whole eggs in objective or subjective tests. The sensory evaluation results from panelists on the organoleptic attributes of the cake are consistent with the findings of the objective analytical test results.

All areas of cake quality are negatively affected when eggs are removed and/or replaced with another ingredient, including the batter viscosity and aeration, rise, color/appearance, & most importantly, baked good flavor & texture.

The product that performed the best of the replacers was a blend of corn, soy and hydrocolloid ingredients. Interestingly, one of the products that performed the worst was also a blended product, a complex mixture containing wheat, soy, milk, leavening, hydrocolloid, and enzyme ingredients. This shows that it may be difficult to make direct comparisons from product to product, especially egg replacer blends.

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 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 yellow batter 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 eggs in yellow cake formulations.

COMPLETE RESEARCH REPORT & FINDINGS

For a copy of the complete 51-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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