



SUGAR COOKIE APPLICATION RESEARCH

COMPARING THE FUNCTIONALITY OF EGGS TO EGG REPLACERS IN SUGAR COOKIE FORMULATIONS

SUGAR COOKIE RESEARCH EXECUTIVE SUMMARY

For this study, eggs were reduced and/or removed from sugar cookie formulas and replaced with commercial egg replacer products at the manufacturers' suggested rates. Baked cookie eating quality was evaluated quantitatively and qualitatively. While egg replacers varied in functionality, not a single product performed as well as or better than real eggs. Overall changes in quality from the reduction or removal of egg products in sugar cookies are slight but noticeable. The areas of sugar cookie quality most negatively affected when eggs are removed and/or replaced included the color/appearance, aroma, flavor and texture. The highest performing egg replacers were a starch-based product and a blended ingredient product. Fiber and whole algal flour-based products were unacceptable to panelists, due to differences in structure and color. Manufacturers must test egg replacers and spend time optimizing formulas for acceptable 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 sugar cookies. Due to the known performance characteristics of real eggs in bakery cookies, it was hypothesized that no single ingredient would be able to replace the multiple functions provided by eggs in sugar cookies without affecting product quality.

EGG REPLACING INGREDIENTS

After researching egg replacers, nine 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 sugar cookies. 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 replacement varied from 25 to 100 percent. Six companies recommended removing 100 percent of the eggs in the sugar cookie formulas. Almost all of the egg replacer suppliers suggested replacing the eggs with a one-to-one ratio to dry eggs.

FORMULAS

Control/Gold Standard Formulas

The Control formula consisted all-purpose flour, granulated white sugar, margarine, vegetable oil, water, corn syrup, dried whole egg, baking powder, salt, baking soda, and vanilla powder.

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

Nine egg replacer ingredients were tested in sugar cookie formulas, including:

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

Sugar cookie test formulas were created using all-purpose flour, granulated white sugar, margarine, vegetable oil, water, corn syrup, dried whole egg, baking powder, salt, baking soda, vanilla powder, and the egg replacer ingredients.

TESTS

Cooked, cooled cookies were analyzed, using industry standard, cookie-specific tests. Cookies were all baked in the same conditions, in the same oven on the same day. Analytical tests were performed on baked cookies after they had cooled completely.



SUGAR COOKIE VISUAL COMPARISON



Analytical Tests

Baked good shape
Color
Texture
Moisture
Water activity

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

BAKED GOOD APPEARANCE

Baked Good Height/Shape

All egg replacer Test samples were similar in shape to Control, but spread slightly less. Negative Control spread too much in the oven and was shorter in height and larger in diameter than all other Tests. This suggests the egg replacers provided binding functionality in the dough, which produced an acceptable amount of spread and rise in all the Test cookies.

Cooked Appearance & Color

On all days of testing, Control was rated significantly more appealing than all the other Tests, and described, “as one would expect from a sugar cookie,” with an “appropriately

cracked top.” Control was described as having “nice golden color” and was ‘neither pale nor dark.’ All other Tests were paler in color compared to Control.

EATING QUALITY

Cooked Aroma

Cooked aroma intensity and likability did not change significantly over time in any of the samples, including Control. Control was the most highly rated, with a ‘slightly strong’ and ‘slightly appealing’ aroma that was described as smelling like “a classic high-quality, sweet, buttery cookie.” The results imply that in formulas with reduced egg content, overall aroma is slightly weakened and less appealing.

Moisture & Water Activity

Most of the samples experienced some fluctuation in moisture content over time. And although they were not significant changes, they did impact eating quality. Most egg replacers did not have an effect on water activity.

Texture

There was no significant change in structure or mouthfeel of Control over the course of testing in sensory analysis, but it did become harder and took more force to break in texture analysis testing.

Many egg replacer Tests were similar to Control on Day 1, but all changed over time. The force required to break Control on Day 1 was significantly less than that of all other Tests. Negative Control was “hard, crunchy, and compact,” and became more so over time. The texture analysis scores aligned with sensory evaluation scores. On Day 1, Negative Control was the second hardest sample and exhibited



the least flexibility, making it one of the toughest samples. This shows that without egg, the texture was hard and crunchy, undesirable in a chewy sugar cookie.

Flavor

Flavor intensity scores varied little among samples throughout testing. Control was described as having “sugary, buttery flavor as expected from a classic sugar cookie,” scoring the highest of all the Tests in flavor likability every day of testing.

Overall Likability

In overall likability, Control had the highest average score over the course of testing.

CONCLUSIONS

The use of ingredients to successfully reduce or replace eggs in sugar cookies can be challenging for even the most accomplished baker. The sensory evaluation results from panelists on the organoleptic attributes of the sugar cookies were generally consistent with the findings of the objective analytical test results.

The areas of sugar cookie quality most negatively affected when eggs are removed and/or replaced include the color/appearance, aroma, flavor and texture. Tasters unanimously preferred the Control to the Test formulas.

Its appealingly cracked top, slight chew and sweet, classic sugar cookie aroma and flavor won panelists’ approval as the most appealing cookie.

It was neither dry nor moist, and its structure was firm in the mouth, yet chewy and pleasant to eat. It did become slightly harder over time in texture analysis, but panelists did not find these differences to be unappealing.

The sugar cookie formula made without eggs, Negative Control, performed poorly in creating proper spread/rise; it was too thin and spread too much in the heat of the oven. It had reduced aroma and the lowest flavor intensity, indicating that eggs contribute to the characteristic sweet baked good aroma and flavor of sugar cookies. Overall, it scored in the middle of the Test formulas, being neither particularly appealing nor unappealing to panelists.

Egg replacers varied in both analytical tests and sensory evaluation results. The egg replacer most closely resembling Control in many attributes was one of the starch-based products.



It produced cookies with the highest rise and least spread of all the samples, resulting in puffy-looking cookies with well-defined cracks. It also had the highest moisture content, which was consistent throughout testing. It was similar in texture and flavor to Control, but did have a slightly reduced aroma and became harder over time. Overall, cookies made with this product were very well liked by panelists.

Another high performing egg replacer was one of the blended products. It had a similar rise to Control, but did not spread as much. The color of the cookies was paler and the edges were smoother. Unlike Control, these cookies started as the hardest samples in texture analysis, but became softer over time. The cookies had a weak aroma and a dry texture but a very well-liked flavor, which resulted in medium overall likability scores.

Egg replacers that did not perform very well in sugar cookies included the fiber-based product, the other blended product and the algal flour-based product. The fiber-based product made for cookies with a very pale color and dry, cracked-looking edges. They had a salty, floury aroma and flavor of Play-Doh, which panelists found to be off-putting. Also amiss in the fiber-based cookies was the texture, which was soft and crumbly, rather than firm and chewy, as one would expect in a chewy sugar cookie.

The cookies made with one of the blended products were much too chewy, and became the hardest cookies over time. While the shape, appearance, color and flavor of the cookies were acceptable, panelists could not get beyond the dry texture.

The algal flour-based product produced cookies that were much too dark and yellow. They had

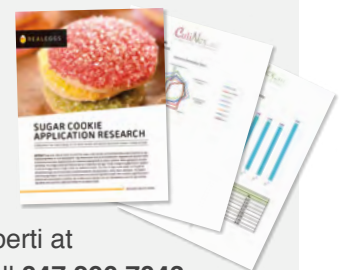
a dry texture at the start of testing, but became more flexible and chewy over time. The cookies did not rise as much as Control and had a slightly reduced aroma, but ultimately the bright yellow color made the cookies unacceptable to panelists.

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 sugar cookie formulations 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 sugar cookie formulations.

COMPLETE RESEARCH REPORT & FINDINGS

For a copy of the complete 56-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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