REALEGGS

MAYONNAISE APPLICATION RESEARCH

COMPARING THE FUNCTIONALITY OF EGGS TO EGG REPLACERS IN MAYONNAISE FORMULATIONS

RESEARCH SUMMARY

MAYONNAISE RESEARCH EXECUTIVE SUMMARY

For this study, real whole eggs were reduced and/or removed from mayonnaise formulas and replaced with commercial egg replacer products at the manufacturers' suggested rates. All the mayonnaise samples 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 FDA has mandated that mayonnaise is to contain no less than 65 percent of vegetable oil by weight, an acidifying ingredient and an egg yolk-containing ingredient (FDA 2016). In commercial mayonnaise production, the FDA allows for several types of egg yolk-containing egg ingredients in formulations, including: liquid egg yolks, frozen egg yolks, dried egg yolks, liquid whole eggs, frozen whole eggs, and dried whole eggs or any combination thereof (FDA 2016). Frozen salted liquid egg yolk and salted liquid whole egg were used in the Control formula tested.

OBJECTIVE

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

EGG REPLACING INGREDIENTS

After researching available egg replacers, six egg replacers were selected based on their recommended use to reduce or replace eggs in mayonnaise. 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.

FORMULAS

Control/Gold Standard Formulas

The Control formula consisted of soybean oil, water, liquid salted whole eggs, liquid salted egg yolks, white distilled vinegar, lemon juice concentrate, and granulated sugar.

Negative Control

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

Test Formulas

Six egg replacers were tested in mayonnaise formulas. Those selected consisted of the following ingredients:

- Starch
- Blends of various ingredients, including starches, proteins, emulsifiers, leaveners, enzymes and hydrocolloids
- Dairy Proteins
- Algal Flour
- Fiber

All six manufacturers selected for testing recommended removing 100 percent of the eggs from mayonnaise formulas; almost all recommended that the ratio of wet to dry ingredients be kept the same. (When removing some or all 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.)

MAYONNAISE VISUAL COMPARISON

TESTS

The mayonnaise formulas were all prepared in the same conditions, in the same model equipment, on the same day. Consistent batching, mixing and portioning, procedures were used to limit variables. Mayonnaise samples were evaluated plain and in a chicken salad application. Testing was performed at the CuliNex Test Kitchen in Seattle, Wash., and Medallion Labs in Minneapolis, Minn.

Analytical Tests

Color
pH
Emulsion stability
Rheology

Subjective/Sensory Tests

Appearance
Color
Mouthfeel
Smoothness in mouth
Aroma
Flavor
Overall commentary

RESULTS & DISCUSSION

pH

All egg replacer tests had lower pH values than that of Control, but were all higher than that of the Negative Control. This suggests the egg replacers do function to help stabilize the pH level in the mayonnaise test formulas, but not as well as mayonnaise made with eggs. Additionally, the egg replacers that had added protein, performed better than the replacers that had lower protein contents

Emulsion Stability

Emulsion stability was first assessed visually in a pass/fail test. Control plus four of the Test egg replacers passed—all were visibly emulsified. Negative Control and the remaining egg replacer samples failed for being broken in appearance. The samples that did not provide enough emulsion stability to create a single-phase product were not tested in the LUMiSizer for emulsion stability.

Control along with one sample showed the greatest stability during LUMiSizer testing with either no distinguishable mechanism of emulsion breakage or a minimal effect from the conditions of the testing. The remaining samples had varying degrees of instability.

Rheology

Samples with broken emulsions were not tested. All tested samples had a yield stress, but there were two distinct groups of samples: those that had a low-yield stress (thin textured) and those that had a high-yield stress (thick textured.) The two groups of test results suggest that some egg replacers perform better at creating a thick texture than others.

All tested samples displayed pseudoplastic, shear thinning behavior. The samples were again separated into the same two groups by their flow data as they were by their yield stress data. The egg replacer tests with an added protein content, exhibited higher viscosity and showed more shear thinning than their low-protein counterparts. This suggests that the protein content of the test mayonnaise formulas may be a factor in providing the appropriate texture. The Control sample recovered from shear very rapidly and its structure did not change upon sitting.

Appearance

No test matched Control appearance exactly, but several Tests were similar. The Tests that were not emulsified were deemed unacceptable. It can be concluded that egg replacers vary in ability to contribute to characteristic mayonnaise appearance, with several failing to meet established targets and others coming relatively close.

Color

Panelists only evaluated fully emulsified samples for color. All of the Test mayonnaise samples evaluated were significantly different in color than Control. The results suggested the removal of eggs significantly impacts the color of mayonnaise and that it is noticeable to tasters.

EATING QUALITY

Aroma

Most mayonnaise aroma of the Tests was similar to Control and not significantly different in intensity, especially when evaluated in application. It can be concluded although most egg replacers do not have a negative impact on the aroma of mayonnaise, some tasters may pick up on negative attributes.

Texture – Mouthfeel

Results suggested egg replacers do not significantly impact the mouthfeel of mayonnaise, but may result in a slight increase in perceived oiliness/fattiness.

Texture – Smoothness

Results suggested most egg replacers do not impact smoothness perception, but some egg replacer products may not dissolve completely, resulting in a gritty texture that may be noticeable to tasters.

Flavor

The egg replacer Tests were generally perceived as having higher acid intensity than Control. Tests results suggested although the use of egg replacers may affect the flavor of the mayonnaise when tasted on its own, these differences may not be perceptible to tasters when used in application.

Overall Likability

Panelists agreed that Control was the best tasting sample. While texture, color and acidity varied among the egg replacer samples, panelists agreed a number of them were acceptable, particularly when used in application. Samples that failed the visual emulsion test were described as “not… acceptable as a mayonnaise sample” and “does not meet expectations for a mayonnaise.”

CONCLUSIONS

The changes to mayonnaise with reduced egg content were noticeable. The sensory evaluation results from panelists on the organoleptic attributes of the mayonnaise tested were generally consistent with the findings of the objective analytical test results. The areas of mayonnaise quality most negatively affected when eggs are removed and/or replaced included emulsion stability, appearance, color and flavor. Attributes where differences among samples were minimal included pH, aroma, smoothness and mouthfeel.

Tasters unanimously preferred the Control to the test formulas. Its light yellow color, thick, emulsified appearance, and bright, clean flavor won panelists’ approval as the most appealing mayonnaise.

The Negative Control Test with neither eggs nor egg replacing ingredients was found to be an unacceptable mayonnaise substitute: it was completely un-emulsified, with a clearly delineated water and oil phase. These results indicate that eggs and/or egg replacers are necessary to make an acceptable mayonnaise or mayonnaise substitute.

Overall, egg replacer performance varied drastically. Some products were thick and emulsified completely, while others were thin, oily and never achieved full emulsification. Some egg replacers produced mayonnaise with heightened acidity and even some off flavors, while others were muted in flavor. The results suggest dairy protein-based egg replacers may perform most similarly to real eggs in mayonnaise applications, while other products, even when used in combination with other functional ingredients such as legume proteins and gums, may not be effective in replicating established mayonnaise attributes.

Even though ingredient manufacturers may have usage rate recommendations and even starting formulations that incorporate the use of other functional ingredients, their 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 mayonnaise 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 mayonnaise formulations.

COMPLETE RESEARCH REPORT & FINDINGS

For a copy of the complete 68-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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