

Accept No Substitutes

Research shows no single
substitute matches the
functionality of egg products.



The incredible edible egg™
American Egg Board



Accept No Substitutes

A sage once wrote you can't compare apples to oranges. Although this term is often used as metaphor, in literal terms nutritionists and food scientists know this for a fact. Apples and oranges behave nothing like each other if added to formulations, and both possess quite different nutritional profiles.

This adage holds equally true for eggs and egg replacers. Eggs possess unique nutritional properties and contribute desirable functional attributes unequaled by any single egg alternative. Eggs also contribute a clean, natural image to help create a consumer-friendly ingredient statement for packaged or prepared foods.

Food manufacturers searching for the best possible combination of ingredients and the most economical choices often (mistakenly) believe an egg alternative can help them achieve cost savings. It might, in the short-term. However, researchers at Kansas State University, Manhattan, KS, evaluated the performance of egg products and their potential replacers in various formulations using physical and sensory analysis. The study results support a hypothesis that eggs require more than a simple 1:1 substitution with an egg alternative to acquire similar ingredient functionality in many prepared foods.

Specifically the researchers studied yellow cake, angel food cake, mayonnaise, pasta and French vanilla ice cream. All of these particular applications rely on egg functionality to achieve proper form, taste and function. In addition they help highlight for the broad universe of food products the beneficial properties of egg products in formulation.

Real egg products supply such desirable functionalities as:

- Volume
- Texture
- Color
- Foaming
- Solubility
- Coagulation
- Emulsification

Yellow Cake

The first part of the study examined yellow cake. Eggs proved essential for multiple functions in this cake system including foaming, emulsification, coagulation and color. When whole eggs were replaced, the resulting cake suffered from textural differences. Food manufacturers also need to remain aware of the value of shelf life studies when evaluating potential ingredient substitutes. Some whole egg replacement blends were similar in springiness on day one, but then deteriorated each successive day.

Volume was affected as well. Replacing eggs with a single ingredient did not produce volumes similar to that of a yellow cake made with whole eggs. Formulations require more adjustment and a longer list of ingredients due to the blend of substitutes required. Cost savings vanish rapidly when an ingredient substitution that appears less expensive at

the onset of a project either doesn't perform as anticipated or must be used in combination with other ingredients to achieve the desired affect. Formulations might require a great deal of adjustment, and the ingredient label statement grows longer and more confusing.

The color was not as intense or yellow, exhibiting a whiter cast in the cakes using egg substitutes. In terms of palatability, the flavor of the whole egg control cake was significantly greater than of blend variations. Sensory data showed that egg replacement blends did not emulate the sensory attributes of dry whole egg in yellow cake with significant differences in surface stickiness, color and egg flavor.

Overall when judging a 100% replacement, no egg substitute used was able to emulate all the attributes of whole egg products in a yellow cake system. No replacement exactly emulated whole eggs in all aspects of volume, contour, texture of crumb, overall springiness and color.

Pasta

Many types of pasta or noodles rely on eggs in formulation. Eggs enhance the formation of a protein network during mixing and kneading to improve the cooking quality. They lend a darker and more yellow color to fresh pasta. And there is a significant increase in the nutritional value of pasta containing egg.

The researchers experimented with a variety of partial or complete substitutes, including ingredients such as whey proteins, soy flour or blended alternatives. Their discoveries revealed that a 100% replacement, with whey protein for example, does not process well enough to sheet the dough. Another finding with the 100% substitution, using soy flour, is that the noodles exhibited a higher cooking loss. Blended alternatives provided a significantly higher water uptake. The type of substitutes chosen significantly affected the color, stickiness and firmness of cooked noodles.

In essence, once again, the researchers determined that whole egg could not be totally replaced in a 1:1 equation with any of the egg substitutes in the pasta without some loss of quality.

Angel Food Cake

The researchers selected this medium as a good system to evaluate the functionality of egg substitutes relative to egg white protein.

While many of the egg alternatives were able to produce stable foam, the data did show that not all egg alternatives that performed well in a separate foaming study could withstand the high temperatures (375°F /190.5°C for 30 minutes minimum) required to bake an angel food cake.

Also known as egg white, the albumen contains more than half of the egg's total protein, niacin, riboflavin, chlorine, magnesium, potassium, sodium and sulfur. No single substitute can mimic the valuable nutritional contribution of egg white or egg products.

The egg protein alternative did not perform as well as the control in the physical attributes evaluation. The cake formulated with the egg alternative exhibited a firmer crust, lower volume and darker color, when a light texture, high volume and light color are desirable for an angel food cake.

The egg product control significantly outperformed the angel food cake formulated with the egg alternative in all sensory categories evaluated. As the final word on the comparative market potential of an angel food cake formulated with real egg products or a substitution, consumers indicated that they were willing to purchase the egg product control *two to one* over the angel food cake formulated with the egg protein alternative.

Ice Cream

Many ice cream makers use frozen and powdered egg yolks because the egg yolk solids improve the whipping ability of the mix, acting as emulsifiers. The emulsifying action of egg yolk solids aids in developing the appropriate fat structure and air distribution necessary for smooth mouthfeel and good meltdown characteristics desired in ice cream. Investigations have shown that egg yolks improve the rate of whipping more if they are sweetened with 10% sugar before being frozen, a customization easy to request from the egg product supplier.

The use of egg yolk solids in ice cream produces a firmer ice cream at a given drawing temperature. The egg yolk solids increase the whipping rate. There is improved appearance and less change in percentage overrun while ice cream is melting. The egg yolk solids slightly improve the texture and lend increased food value.

In sensory testing, 81% of the panelists would purchase the control ice cream, using real egg yolk solids, compared to 36% for the soy-based egg alternative.

Egg products are available liquid, frozen or dried for the convenience of the food formulator. Regardless of form, the egg's nutritional and functional qualities remain intact. When properly stored, egg products will maintain a stable shelf life for months.

Some of the advantages of egg products include:

- Reduced risk of contamination
- Extended shelf life
- Convenience
- Consistent performance
- Product stability
- Functionality

Apples, oranges or eggs? All adages aside, choosing the right ingredient for its desired flavor, nutritional and functional attributes simply make sense. Research backs up the contention that no single 1:1 substitution contributes the same functionality obtained from egg products, nature's most nearly perfect food.