

WHITE PAPER



REAL EGGS: INTEGRAL ROLE IN BAKING

REAL Eggs contribute to gold standard quality,
while enhancing ingredient statements



American Egg Board

In a world where consumer expectations evolve at sometimes dizzying speed, one product characteristic persistently rises to the top. Quality remains a primary feature cited by every consumer group. According to research firms like Euromonitor, the latest facets of this desire for quality mix authenticity and transparency alongside premiumization and farm-to-fork traceability. Manufacturers can deliver quality baked goods that meet consumer expectations by using the right ingredients and thereby build and supplement a stellar brand reputation.

Highly functional, recognizable ingredients like REAL eggs deliver on the quality promise for both the consumer and the manufacturer. On the consumer side, eggs represent a comforting staple that appear in 94% of kitchens nationwide. On the manufacturing side, egg ingredients deliver more than 20 functional properties that interact synergistically with both common and unique ingredients used to create gold standard cakes, muffins, cookies, cheesecakes, and other popular products. The product appearance, taste and subtle variables like crumb quality, tenderness and texture can be traced in part to the role eggs play in baking operations.¹

What consumers want

Creating quality baked goods for consumers can pay off when their expectations are met. Another study says that not only are consumers looking for original, high-quality products in bakeries, they're will to pay more. One portion of the study said, "all-natural ingredients (with) no added preservatives will increase the value of your bakery's products" in the eyes of the consuming public.²

Baked goods add value to the food and beverage market overall, totaling almost \$311 billion in economic output.



And while bread and rolls lead the segment in quantity and dollar amounts, in terms of sales, cakes remain the most profitable items for the baker or bakery.



Sales of cakes and cupcakes in retail bakeries are expected to increase by an average of 7.2% per year through 2021, according to one source.³ In-store bakery sales of \$13.8 billion were dominated by desserts, sweet goods and cookies.

Two important drivers for growth in the baking industry according to the "Power of Bakery" study include indulgence and emotion. Food Marketing Institute (FMI) Vice President, Rick Stein pointed out, "Indulgence is a clear sales driver in fresh bakery, claiming 76% of total department sales." On the emotional side, the same study says top of mind word associations related to "bakery" are "dominated by positive terms that convey emotion, such as 'yummy' or even 'love.'"

Although demographic groups express varying preferences for form, style or flavor, one annual study reveals that bakeries cannot underestimate the impact of **taste** upon purchase decisions, a common factor regardless of age or gender. Although it always is the highest ranked factor when making a purchase decision for a food or beverage, in this year's annual International Food Information Council (IFIC) Foundation survey, the "taste" factor leapt to 86% compared to 81% in 2018.

The Hartman Group Inc. report, *Premiumization: Indulgence and its relationship to quality*, states that premium products and higher quality ingredients constitute a trend across the spectrum of packaged foods, driven by Generation Z and Millennials. There is an increased appreciation of food and seeing it for its true value, rather than looking for the best deal. And the winning “recipe” for manufacturers appears to be high-quality, simple ingredients that are optimized for taste.⁴

REAL Ingredients that Enable, Enhance and Enrich

With quality a desirable product characteristic and demographic preferences defined, what are the benefits for the baker of using egg ingredients? First of all, it fits the definition of a cupboard-friendly ingredient that is fresh and natural. Egg ingredients offer a pleasant to neutral taste. Additionally, the more than **20 functional properties that act synergistically in food formulations contribute specific benefits within a broad variety of popular baking applications.**



While anecdotal observation over the course of decades of modern food processing suggested that egg ingredients supplied superior functionality and flavor to certain products, and various studies looked at individual aspects of egg functionality, no comprehensive study compared their use to those of alternative ingredients, until now.

A few years ago, CuliNex, the nation’s premier Clean Label product development consultancy, examined the most popular applications within the baking industry (outside of bread and rolls), such as sponge cake, yellow cake, muffins, cookies, etc., and released their findings related to a comparison of egg ingredients and egg replacers. The evidence supplies analytical quantitative and qualitative test results that empirically support the anecdotal evidence. The consultants concluded that no single replacer can supply the same gold standard results achieved when using real eggs in formulation.

For testing purposes, the researchers selected a standard control formula and switched out egg ingredients with commonly recommended egg replacers. Using the same formula, the team also created these products using egg ingredients. An extensive analysis compared several physical points for texture and form while sensory panelists evaluated the products for taste and mouthfeel. The sensory panelists consistently preferred the control product using egg ingredients over products resulting from the other test formulas. A complete list of the products tested and study results are available at www.realeggs.org/research.

A few study results and their relationship to product quality as determined by egg product functionality are examined below.

Sponge Cake

One of the most commonly available snack cakes in retail stores in the U.S. is the sponge cake, a type of foam cake that relies on whole eggs for its structure, appearance and taste. Its tough and resilient structure is necessary to be able to hold any variety of fillings, to be frosted, and packaged for shipping.

The ubiquitous sponge cake was one of the multiple applications tested by CuliNex in its comparison of formulations either utilizing real egg ingredients or egg replacers.



Overall, from the list of substitutes tested, not a single product performed as well as or better than real eggs in all attributes assessed.



The areas of sponge cake quality most negatively affected when eggs are removed and/or replaced included batter viscosity, color/appearance and texture.

Tasters unanimously preferred the control (using eggs) to the test formula at the start of testing. Its golden-brown color, high rise, even top, uniformly open cell structure, and sweet, eggy baked good aroma and flavor won panelists' approval as the most appealing sponge cake. It was neither dry nor moist, and its structure was tender in the mouth, yet firm and pleasant to chew.

The Importance of Batter Viscosity

Batter viscosity is a key factor affected when attempting to replace eggs and worth a closer look in terms of its overall effect on the entire baking process and finished results. Batter viscosity or the rheology of the resulting batter, dough or mixture (in the case of cheesecake or pie filling for example) will vary depending upon the application, however it is a vital quality for baked goods due to its impact on processing and end product quality. Specific attributes potentially affected include:

- Phase separation during mixing, floor time and baking
- Machining

- Pumpability
- End product quality and appearance

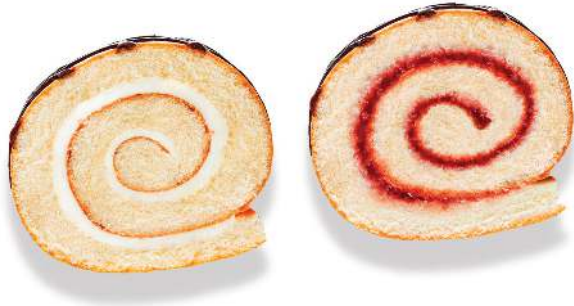
Cake batters in particular need to be sufficiently viscous to prevent loss of gas bubbles incorporated during mixing. These bubbles are recipients of the gas produced by raising agents and steam, which cause expansion and help reduce batter density. When gas bubbles are lost, the batter expansion will be restricted as new bubbles cannot be created after mixing has stopped.

In addition, viscosity is temperature dependent meaning as batter is heated, it thins out. "The likelihood of phase separation of the more dense components, such as starch granules is greater and such components can sink to the bottom of the baking tin. The result would be a gummy layer at the bottom and a fragile, coarse open structure at the top," says one source.

This separation of recipe components needs to be avoided by maintaining a certain level of viscosity up to the point where starch gelatinization occurs, and the structure is set.⁵

Viscosity also determines the best process and equipment needed for commercial products to run smoothly. The "ability to characterize the pseudoplastic behavior of the batter can pay dividends in more ways than one." There can be a correlation between the density of the baked product and batter viscosity.⁶

In sponge cakes in particular, as batter relative to density begins to increase or is less well aerated, the sponge drops in volume. *Instrumental Assessment of Food Sensory Quality* states, "Batter viscosity is one of the important physical properties in cake baking."



During baking the velocity gradient in the batter as a whole will induce convection current at a given moment that depends on its viscosity. Retention of air and leavening gases in batters is clearly reflected in the specific gravity values of the batters and is also a function of batter viscosity.

“Batter viscosity is also decisive in relation to the production process: changes in viscosity could lead to problems in handling the batter, in mold filling (metering) and in cleaning the machinery or to greater energy expenditure on pumping in the case of high-viscosity batters.”⁷

Angel food cake

Recognizable desserts with simple ingredient statements resonate with consumers today, along with an increased desire for treats that are better for you. Angel food cake is inherently low in fat and simple in formulation. It can fit within a lower-fat or lower-calorie dessert presentation. Because angel food cake is both universally available and neutral in flavor it was selected to test egg replacers in application.

According to Bakerpedia, angel food cake quality “is largely determined by the foaming properties of egg whites.”⁸ An angel food cake in particular, relies on the aerating or foaming properties of egg whites for its characteristic texture, height, appearance and cell structure.

In fact, egg white is the primary functional ingredient in an angel food cake system

which has, according to Baking Science & Technology, “one of the simplest formulations because it calls for only three basic ingredients; egg whites, sugar and flour.”

Egg whites form foams greater in volume than yolks due to the unique proteins found in the white. Egg whites, unlike any other natural food ingredient are able to create the largest possible food foam, six to eight times greater in volume than unwhipped, non-aerated liquid egg white. The foam is created by whipping and trapping air bubbles inside liquid albumen. “After heating, the air bubbles expand and egg white proteins coagulate around them, giving permanence to the foam structure.”

For such a simple formulation, several key reactions occur during the mixing and baking process. Key reactions related to egg white performance include:⁹

- **Expansion of egg white protein-stabilized foam cells**
- **Coagulation of the proteins so they can stabilize the air cells**
- **Evaporative loss of water to further enhance rigidity and texture development and chemical reactions of the sugars and proteins that develop color and flavor**

Baking Science and Technology lists cream of tartar as an essential ingredient to successful angel food cake formulating. It aids with foam stability and brightness of foam color. By stabilizing the egg white foam, it helps avoid collapse of the foam prior to coagulation and prevents the foam from shrinking during the last stage of baking to retain cake volume, shape and even air cell distribution. The acid helps egg whites arrive at an optimum pH to develop proper foam volume and then maintain its stability. One other tip to help attain maximum specific volume of the egg whites during angel food cake preparation is

to hold the initial temperature of the egg white within a range of 17 to 22 C (62 to 72 F).

The CuliNex studies found that the use of ingredients to reduce or replace egg whites in angel food cakes is challenging for even the most accomplished baker. When this variety of cake was tested and evaluated comparing the use of egg whites to replacers, the areas of angel food cake quality most negatively affected when eggs were removed and/or replaced, included batter specific gravity, appearance, height, flavor and overall likability.

Tasters on the sensory panel unanimously preferred the control to the test formulas. Its 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 and pleasant to chew.

Yellow batter cake

Yellow batter cake is ubiquitous across retail outlets and in-home kitchens. While angel food cake is unique in the fact that it doesn't use a shortening element, yellow batter cake like other batter cakes, does include a shortening element.

Yellow batter cake's market penetration combined with its simple flavor profile, led to its selection as one of the baking applications tested by CuliNex to compare the use of real egg ingredients versus egg replacers. The tests once again compared qualitative and sensory analyses to determine the effects on a gold standard recipe for yellow batter cake when eggs were replaced or reduced. In conclusion the testers found that the use of ingredients to reduce or replace eggs in yellow batter cakes is challenging for even the most accomplished baker.

The tests showed that no one single egg replacer performed as well as or better than real eggs in yellow batter cake.



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, and most importantly, baked good flavor and texture.



The tender texture of today's cakes relies on the gas bubbles whipped into the batter. Beaten egg helps stop the fat-coated air bubbles from collapsing when heated. The egg proteins form a layer around each air bubble and as the cake is baked, the layer coagulates to form a "ridged wall around each bubble, preventing it from bursting and ruining the cake's texture."¹⁰ In addition, the eggs add the majority of the liquid in a yellow batter cake.

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 costs with functionality and flavor. Ultimately, that may mean using real eggs in yellow cake formulations. While samples varied depending upon the egg replacer tested, in general the visual comparison showed a marked difference in rise, form, uniformity and color between the control made with real eggs and the other seven test samples.

Egg functionality enables the creation of gold standard products by providing a practical toolbox of benefits for the formulator, such as aeration, emulsification, foaming, and more.

Depending on the final application one or more of these functional properties can be critical to creating the proper structure, appearance, texture and taste of the product. Egg ingredients enhance brand identity by aiding the creation of a clean label, as a simple, easily recognizable ingredient familiar to consumers. Egg ingredients enrich the taste and mouthfeel of finished baked goods through the unique combination of and actions contributed by the proteins and fat contained within a standard large egg. One

simple ingredient equals an enormous impact on quality both in perception and reality, to create repeat sales and satisfied customers.



functional benefits egg products can supply include:



ADHESION



**AERATION
/FOAMING**



ANTIMICROBIAL



BINDING



**BROWNING
/COLOR**



CLARIFICATION



**COAGULATION
/THICKENING**



**COATING/DRYING
FINISHING/GLOSS
/INSULATION**



**CRYSTALLIZATION
CONTROL
/FREEZABILITY**



EDIBLE PACKAGING



EMULSIFICATION



FLAVOR



**FORTIFICATION
/PROTEIN ENRICHMENT**



**HUMECTANCY
/MOISTURIZING**



LEAVENING



PH STABILITY



RICHNESS



**SHELF LIFE
EXTENSION**



**TENDERIZATION
/TEXTURE**



WHIPPING

To learn more, see the 20+ benefits at AEB.org/Functionality



Keeping it Real – New REAL Eggs Seal

Consumers of all ages, looking for fresh, real ingredients are reading product labels and looking for clues to product quality. Seven in 10 Americans want to know and understand the ingredient list on products while 20% are most influenced by “real” ingredients when deciding on food and beverage purchases, according to Innova Market Insights.



A quick product burst, seal or call-out on the package front can let consumers know in a glance they’re getting the quality, transparency and authenticity they desire in foods and beverages. One packaging firm says callouts have been “one of the most prominent and successful recent trends in package design,” further stating several brands saw sales “skyrocket” after a redesign that strongly featured a callout.¹¹

In the spirit of assisting with consumer messaging, the American Egg Board is introducing two new REAL Eggs certification seals, one for use with packaged foods and the other for foodservice menus. The Made with REAL Eggs seal is ideal for producers, food manufacturers and foodservice retail outlets to use on packaged goods and fresh prepared foods to positively communicate the use of U.S.-produced real eggs and real egg ingredients as opposed to substitutes, processed from other ingredients. The REAL Eggs seal is available for restaurants and foodservice outlets to use on menus.

In a nutshell, the seal helps communicate that a product contains:

- **No imitations**
- **No substitutes**
- **And is made in the U.S.A.**

A full set of guidelines can be requested at madewithrealeggs@aeb.org.

There is no cost to use the REAL Eggs seal; its use is free, compliments of the American Egg Board. Products do need to be registered annually. Each product or individual sku needs to be registered separately.

Benefits to the user are many and can potentially:

- **Positively impact purchase intent**
- **Offer pricing and margin opportunities**
- **Employ external assets to communicate trusted quality**
- **Leverage communication to support products “reason to believe,” i.e., nutritional or taste benefits**
- **Leverage advertising and communication spending of licensed brand**

This REAL Egg Certification mark will:

- **Deliver recognizable ingredient authenticity and credibility to signal taste and quality**
- **Provide confidence in product credentials and integrity, i.e., authentic vs. imitation ingredients, taste, value, etc.**
- **Streamline choices for busy consumers**
- **Provide a familiar point of reference to add further credibility to parent brand**
- **Reinforce brand perceptions**

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About the American Egg Board (AEB)

The American Egg Board (AEB) is the research, education and promotion arm of the U.S. egg industry. Its mission is to increase demand for eggs and egg products through research and education. The AEB supports American egg farmers by promoting the consistent high-quality and functionality of U.S. eggs and egg products. Visit AEB.org for more information.

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