

# EGGS:

Incredible  
and Irreplaceable



The incredible edible egg™  
American Egg Board



*By Donna Berry  
Contributing Editor*

# EGGS:

## Incredible and Irreplaceable

**T**ucked in between culinary mainstays such as “Joy of Cooking” and “Better Homes & Gardens Cook Book” is the county-fair poultry barn’s freebie: “Wholesome Recipes Using Eggs.” Like a fine wine, after the dust gets brushed off, what’s inside has improved with age.

The message on eggs keeps getting better. Today’s product developers know that nothing beats egg products when it comes to naturally adding nutritional value and functionality to a food product.

### *Naturally nutrient-dense*

When it comes to designing foods for today’s label-reading consumers, formulators keep two criteria high on their priority list: natural and nutrition. With more and more products touting their nutrient contents on front-package panels, consumers are seeking out foods that assist their pursuit of health maintenance and overall wellness. The egg fits the bill.

“Consumers are starting to understand that they can reduce their need for medical treatment by managing their health through dietary choices. Popping a pill is not always the best answer,” says Donald McNamara, Ph.D., executive director, Egg Nutrition Center, Washington, D.C. “The human body can exist in marginal nutritional deficiency

for long periods without obvious signs of illness. In fact, people have been kept alive on diets of synthetic nutrients. But what we are learning with improved technology is that nutrient intake levels to avoid health complications from deficiencies are not always equivalent to intake levels for optimal health promotion.

“Choosing naturally nutrient-dense foods that are balanced in key nutrients is essential, as whole foods contain many important nutrients that are still being identified as essential for health, wellness and longevity,” continues McNamara. This includes choosing prepared and packaged foods made with naturally nutrient-dense ingredients—ingredients such as egg products. A comprehensive listing of the types of egg products available to food designers, including a full breakdown of their nutritional profiles, is available from the American Egg Board’s EGGSolutions website ([www.aeb.org/eggproducts](http://www.aeb.org/eggproducts)).

“Consumers are increasingly seeking out prepared foods made from ingredients they would use if they made it from scratch at home,” says Elisa Maloberti, director of egg product marketing, American Egg Board (AEB), Park Ridge, IL. “Eggs, and egg products, which are convenient forms of the same eggs one would crack at home, are

a nutrition powerhouse of vitamins, minerals and high-quality protein, and void of *trans* fats, which many consumers are avoiding these days. In fact, eggs and egg products are some of the few natural sources of some specific nutrients that have recently been recognized as playing an important role in health maintenance and wellness.”

### *Essential at the beginning*

Choline, a nitrogen compound found in eggs, is one of the nutrients at the forefront of recent research. Part of the molecule phosphatidylcholine (which is commonly referred to as lecithin, although commercial lecithin is not pure phosphatidylcholine), choline is needed throughout the body for cell-membrane structure and function. It is necessary for the synthesis of the neurotransmitter acetylcholine, for lipid transport from the liver and for fetal brain development.

Choline deficiency can induce fatty liver disease in adults, as well as impaired memory and brain development in fetuses deprived of choline in utero. “Advancements in science have led researchers to identify choline as a critical nutrient in the diet of pregnant women,” says McNamara.

A study by Dr. Steven Zeisel, Ph.D., Department of Nutrition, School of Public Health, School



**Egg ingredients deliver high-quality protein and several vital nutrients, including choline and carotenoids—without any appreciable carbohydrates or trans fats—thereby boosting a product’s nutritional profile.**

of Medicine, University of North Carolina, Chapel Hill, and published in the *Journal of the American College of Nutrition* (“Choline: needed for normal development of memory,” 2000; 19:528S-531S) suggests that women who receive an ample amount of choline during pregnancy can help improve a child’s brain function for life. Additional studies in animal models have also shown that the offspring of females who did not receive choline during pregnancy had attention and memory-task impairment. Based on these findings, the Institute of Medicine added choline to the list of essential nutrients, particularly for pregnant women, in its 2003 recommendations.

Although the liver can make some choline, production is inadequate to meet the body’s demands. For men, the adequate intake (AI) is 500 mg per day; for women, it is 425 mg per day. This need increases for women during pregnancy and lactation, at which time the AI is respectively 450 mg and 525 mg.

“There is a trend toward designing foods and beverages for specific need-states, particularly products formulated to meet the nutritional needs of women,” says Don Montuori, publisher of the Packaged Facts report “Women’s Foods and Beverages in the United States” from MarketResearch.com, Rockville, MD. “New moms and moms-to-be are very enticed by products that contain the right mix

of nutrients they require during these need-states. These are times that can be particularly draining on the body.”

Marketers interested in formulating foods for pregnant and lactating women need look no further than choline-rich egg products that contain yolk, since the choline is exclusive to the yolk. For example, 100 grams of liquid or frozen egg yolk contains about 695 mg of choline, 100 grams of dried whole-egg product contains about 1,149 mg, and 100 grams of dried egg yolk contains roughly 1,388 mg.

#### ***Critical at the end***

Yolks also contain lutein and zeaxanthin, two carotenoids that play an active role in human eye health as they function to absorb ultraviolet-blue-wavelength light and act as antioxidants to protect cells from free-radical damage.

Age-related macular degeneration (AMD), a debilitating, progressive eye disease faced by more than 15% of the population aged 75 years or older, is the single largest cause of legal blindness in the United States. A study published in *The Journal of Nutrition* shows that when women ate six eggs per week for a period of 12 weeks, lutein and zeaxanthin concentrations increased in the macular region of the eye without any significant increase in their blood cholesterol levels (“Egg intervention increases serum zeaxanthin and macular pigment optical density in women,”

2006; 136:2,568-2,573). Related research has shown that people with AMD had much lower levels of lutein and zeaxanthin in the macular region of the eye than those of a similar age who were free of eye disease (“Macular pigment in donor eyes with and without AMD: a case control study,” *Investigative Ophthalmology & Visual Science*, 2001; 42:235-40).

Because humans are unable to synthesize lutein and zeaxanthin, we must obtain these carotenoids through the diet. “The lutein and zeaxanthin from egg yolks has been shown to be more bioavailable than that from spinach or supplements. This is likely due to the lipid matrix of the yolk,” says McNamara. One large egg yolk (18 grams) provides about 166 mcg of lutein. The amount of lutein varies in egg products based on their concentration of egg yolk, as well as the amount of moisture and other ingredients in the egg product. Some processors feed laying hens a higher level of lutein to increase lutein content in the egg product.

Carotenoids are what make the yolk yellow. “These pigmented phytonutrients, when used as an ingredient in food formulations, give that food a desirable, rich, creamy color,” says Glenn Froning, Ph.D., technical advisor, AEB. “This pigment is one of the reasons egg yolks are a very important ingredient for most baking operations. Egg-yolk products also are highly functional ingredients

**When working with baked goods, egg ingredients help designers regularly create excellent volume, contour, crumb springiness and color. Eggs also lend wholesome appeal to ingredient statements.**



that impart many structural benefits to bakery products.” (For more on baking with egg ingredients, see the sidebar, “Ensuring Success in the Oven.”)

### **Quality protein with whites**

Yolks provide a concentrated source of lipid-based functional ingredients such as choline and lutein, but whites, or egg albumen, contain more than half of the whole egg’s total protein. Furthermore, because egg whites are about 88% water and 10% protein, when dried to make various egg ingredients, they become concentrated sources of high-quality protein.

“In recent years, advances in nutritional science have shown that diets high in quality protein can assist with weight loss and weight management,” says McNamara.

In a 10-week study at the University of Illinois, Urbana-Champaign, Donald Layman, Ph.D., professor, Department of Food Science & Human Nutrition, examined the efficacy of two isocaloric weight-loss diets among women 45 to 57 years old (“Dietary protein impact on glycemic control during weight loss,” *The Journal of Nutrition*, 2004; 134:968S-973S). The women who ate the higher-protein diet lost slightly more weight, and nearly twice as much fat, compared to those eating a carbohydrate-rich diet.

Though the science is not completely understood, Layman and others researching weight and

body-fat loss associated with high-protein diets have theories. One includes the concept of satiety. Researchers at Wayne State University, Detroit, have shown that egg protein triggers a satiety response, which reduces caloric intake, and could ultimately lead to weight loss (“Short-term effect of eggs on satiety in overweight and obese subjects,” *Journal of the American College of Nutrition*, 2005; 24:510-515).

In another study by Layman, overweight women consumed a high-protein, low-carbohydrate, reduced-calorie diet for 16 weeks (“A reduced ratio of dietary carbohydrate to protein improves body composition and blood lipid profiles during weight loss in adult women,” *The Journal of Nutrition*, 2003; 133:411-417). These subjects lost 21.6 lbs. compared to the 14.8 lbs. lost by women on a high-carbohydrate, reduced-calorie control diet. The high-protein group also lost more body fat (19.4 lbs. vs. 12.3 lbs.) and less lean body mass (0.9 lbs. vs. 2.4 lbs.) than the carbohydrate group.

A possible additional benefit of such a high-protein diet includes stabilizing blood glucose and insulin levels during periods of energy restriction encountered during weight management. Layman says overweight women with abnormally high insulin levels can achieve a three-fold greater reduction in plasma insulin on a high-protein, low-carbohydrate diet compared

to the high-carbohydrate control diet. This is another theory on how high-protein dieting leads to greater weight and body-fat loss.

“Egg-white products readily boost the protein levels of foods,” says Froning. “Eggs contain the highest-quality food protein known. It’s so nearly perfect that egg protein is often the standard by which all other proteins are judged.” Eggs have a biological value—the efficacy with which protein is used for growth—of 93.7%, compared to 84.5% for milk and 74.3% for beef. Whole egg also has a protein equivalency ratio (PER) of 3.8, and egg albumin has a protein digestibility corrected amino acid score (PDCAAS) of 1.18, surpassing the level of 1.0 assigned to proteins that meet all essential amino acid requirements.

### **Beneficial absences**

Egg products not only look good on ingredient statements, they can round out Nutrition Facts labels because of what they contain—and what they don’t.

For example, all egg products are virtually free of *trans* fatty acids from a labeling standpoint. “All of an egg’s fat is concentrated in the yolk, and practically all of the fat is *trans*-fat-free,” says Froning. “Egg-yolk products have been very helpful in assisting formulators, especially bakers, with eliminating *trans* fatty acids from formulations.” But, he says, “*trans*-fat elimination in formulations should

not focus exclusively upon the fat ingredient and how it can be changed. Product designers must take a systems approach, and egg products can be part of that system.”

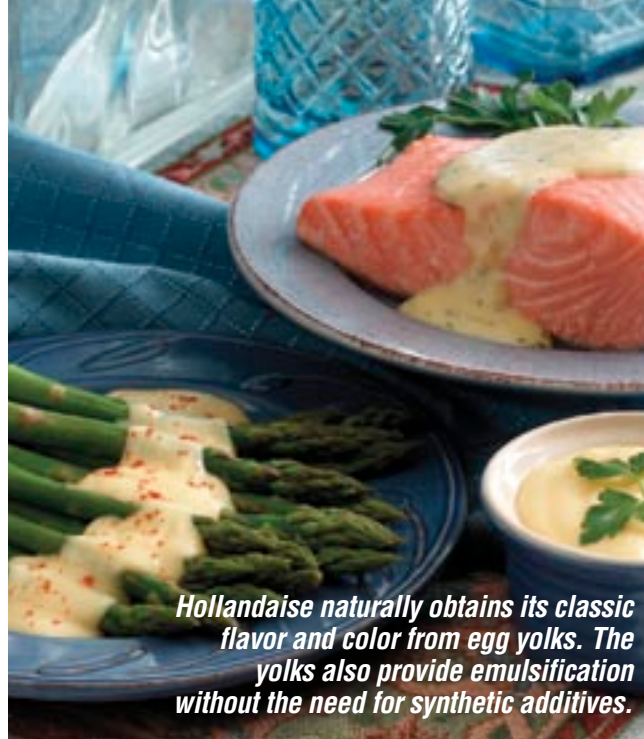
Egg yolks contain a negligible amount of naturally occurring *trans* fats. For example, 100 grams of liquid egg yolk contains a mere 0.28 grams of *trans* fatty acids. This increases to 0.45 grams in 100 grams of dried egg-yolk product.

After rehydration, the *trans*-fat level is comparable to liquid egg yolk. The level is low enough that if no other—or very little—*trans* fatty acids are included in a formulation, labels can read “0 grams” *trans* fats in the Nutrition Facts.

Most egg products are also virtually free of carbohydrates. The exceptions are egg products described as sugared. “Sugar, or sometimes other carbohydrate-based ingredients, is added to egg products to improve their functional performance and physical properties,” says Froning. “However, for the most part, egg products are carbohydrate-free.”

This, of course, was a real coup during low-carb’s heyday. “There still is a lot of interest in keeping carbs low in order to make reference to being low-glycemic,” says Froning.

According to AACC International, St. Paul, MN, glycemic carbohydrates elicit a measurable glycemic response—change in blood glucose concentration—after ingestion. The only carbohydrates that can do this are classified as “available carbohydrates” or “net carbohydrates.” Since basic egg products are virtually free of carbohydrates, adding them to a formulation does not contribute to the food’s glycemic-carbohydrate content.



*Hollandaise naturally obtains its classic flavor and color from egg yolks. The yolks also provide emulsification without the need for synthetic additives.*

### ***The natural way to stabilize***

Egg products are natural alternatives to many stabilizers, ingredients that help maintain a product’s uniformity or consistency under a variety of conditions encountered during processing, storage or use.

Many ingredients in the marketplace function as stabilizers for specific applications. “Few are as natural and label-friendly as egg products. In fact, egg products can perform more than 20 distinct functions in foods, many of which are characterized as stabilization,” says Froning. “Furthermore, unlike many chemical-sounding stabilizing ingredients, egg products can simplify and enhance ingredient statements. Consumers know eggs and are comfortable with eggs. Their inclusion in foods suggests that the product is natural and wholesome.”

In some applications, egg products preclude separation of blended ingredients by slowing or preventing the movement of particles, either droplets of immiscible liquids, air or insoluble solids. Their phospholipids also function as emulsifiers when they uniformly blend two immiscible substances—i.e., oil and water. Egg products do the same with foams, which are gas-in-liquid products. Plus, the egg proteins help create the foam structure,

which results in a lighter, airier product.

“We also know that egg products bind the components and ingredients of foods, keeping the food stable,” adds Froning. For example, egg yolk acts as a natural protein binder for noodles, which is particularly useful in parcooked refrigerated pastas in modified-atmosphere packaging, or those in refrigerated or frozen prepared foods.

In frozen pasta, as well as an array of other frozen foods—even something as simple as pizza crust—egg products provide stabilization by preventing ice crystallization.

“Stabilization of ice crystals is important in all types of frozen foods, particularly ones that may encounter numerous freeze/thaw cycles,” says Froning. “The more freeze/thaw cycles a food encounters, the larger the ice crystals. Large crystals can break down product structure, thus destabilizing the structure. They can also result in an undesirable, gritty mouthfeel, which in the case of frozen desserts, is highly undesirable.”

Egg products are also ideal alternatives to carbohydrate-based stabilizers when product designers are going for a gluten-free formulation. Gluten is the protein that people with celiac disease must completely eliminate from their diet.

Gluten is found in all forms of wheat, rye, oats, barley and related grain hybrids. For celiacs, avoiding most bread, pasta, cookies and similar products is pretty straightforward. However, gluten is present in many foods. For example, if pudding or ice cream contains a wheat-starch stabilizer, a celiac cannot eat it. Processed meats typically contain wheat-starch-based fillers, as do salad dressings, soups and dips.

One of gluten's claims to fame is that it provides structure to foods. Therefore, when formulating gluten-free, food designers seek out ingredients that assist with similar functionality. As gluten is a protein, it only makes sense to seek out other functional proteins, one of which is egg white.

As mentioned, egg white—particularly dried egg white—provides a very concentrated source of high-quality protein. “Often in combination with other gluten-free ingredients, in a systems-style approach, egg whites are an ideal gluten replacement—even in gluten-free breads, which can be made with alternative grains, such as rice,” says Froning.

### *Cracking the case*

Food-product designers overcome many formulating hurdles

when they investigate the use of egg products. No other ingredient compares to multifunctional egg products—Mother Nature's tool for enhancing the performance of other components in all types of food systems—which are designed to vary their behavior based on product formulation.

Further good news about egg products is that they are easy for product developers to use. They are very versatile and come in a variety of forms to meet manufacturers' specifications. Egg products keep labels clean and consumer friendly, along with naturally providing nutritional and functional benefits.

“The simplicity of listing any egg product in the ingredient statement of a prepared food—rather than chemical-sounding or unpronounceable ingredients—is ap-

pealing to consumers because they know what eggs are,” concludes McNamara. “They would cook with eggs in their own kitchen, so they do not hesitate to serve a packaged food made with eggs to their family.” ■

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## Ensuring Success in the Oven

When it comes to bakery products, egg products are almost as important as the grains. This is why bakers who attempt to reduce costs by partially or completely replacing egg products with egg alternatives often disappoint consumers, as finished product quality typically suffers. Nothing beats the airy volume, moist texture and rich color that egg products provide. And it's not just in bakery products. Egg products possess unique foaming, solubility, emulsification and coagulation properties that make them irreplaceable in most applications that require ingredients with these functions.

Other ingredients can perform some of the functions of eggs, but because eggs perform so many simultaneous roles, they are difficult to replace. Bakers have tried to use various ingredients—whey proteins, soy lecithin, gums such as xanthan and guar, and various wheat ingredients, either singularly or in combination blends—to replace egg products.

However, “Bakers need look no further than egg products,” says Glenn Froning, Ph.D., technical advisor for the American Egg Board (AEB), Park Ridge, IL. “Egg products are multifunctional ingredients that are able to replace a long list of ingredients with one simple word: eggs.”

Eggs come direct from Mother Nature; egg products present more-convenient forms for use in bakery operations.

To demonstrate the value of egg ingredients, Kansas State University (KSU), Manhattan, evaluated the performance of egg products and their substitutes in various formulations using physical and sensory analysis. The study results supported AEB's hypothesis that eggs require more than a simple 1:1 replacement with an egg alternative to acquire similar ingredient functionality in bakery, pasta, frozen desserts and salad dressings. The researchers investigated 10 ingredient systems and a control (dry, whole egg) in a basic yellow-cake formulation. Cake volume, contour, hardness of crumb, springiness of crumb and color values of crumb were evaluated. Sensory data indicated that none of the egg-replacement systems emulated the attributes of dry, whole egg in the finished product. Similar results were obtained for other applications, including angel food cake, pasta, ice cream and mayonnaise.

Manufacturers often find that when formulating specialty products, such as those with no sugar or fat or reduced sugar or fat, all-natural egg products are the only way to go. Tasty Baking Com-

pany, Philadelphia, recently extended its line of sugar-free snacks, branded Tastykake Sensables™. Both the original and new varieties rely on egg products. “Egg products provide exceptional flavor and richness to our products that are not available from alternatives,” says Shelley McDonnough, senior food technologist, R&D. “Eggs provide flavor, structure, emulsification, moisture, color, thickening, tenderness and many other functions. For example, egg whites provide structure in marshmallow and angel food cake.

“We at Tasty Baking recognize that eggs are a natural food product that consumers recognize easily and quickly,” adds McDonnough. “They are also an excellent source of protein and vitamins in one's daily diet.”

Jon Silvon, director of marketing, Tasty Baking, adds: “There are a number of different reasons why consumers are looking to reduce their sugar intake, from weight management to diabetes, but one thing is the same across all of those categories: No one wants to sacrifice the quality and taste of the foods they love. With our expanding line of Sensables products, Tastykake is delivering delicious options for health-conscious people. Egg products help us achieve this.”

*The secret  
to an absolutely*

# airy

*meringue is within your grasp.*

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*The perfect meringue is a fine mixture of egg white protein, air, and sugar that bakes to glorious heights. And what makes this magic possible? The incredible, multifunctional, and all-natural egg. Find out more about its magnificent aeration abilities. Visit [EGGSolutions](http://www.aeb.org) at [www.aeb.org](http://www.aeb.org) or call toll free 877-488-6143.*

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