OME SAY FIRE IS MOTHER NATURE’S WAY OF CLEANING UP the forest, ridding the environment of superfluous elements. This parallels financial recessions, which encourage a reduction in clutter and a return to basics. Indeed, today’s consumers are looking for ways to purify and simplify, and they’re starting with their diet.

Formulating “pure & simple” foods

Harleysville, Pa.-based Natural Marketing Institute (NMI) has named “pure & simple” one of the top trends for the new decade. “New trends in purity and simplicity are evident as we move to simpler inputs, focused messaging, cleaner labeling, streamlined design and easy delivery. We are removing layers of complexity — a change we desire because it becomes easier to determine the true fit of products and services with personal values,” according to NMI. “Simplicity and purity is not a ‘dumbing
down,’ but rather an attempt to get at the essential core of what is really needed. This ‘less is more’ trend is resonating with values-driven consumers, natural and eco-friendly enthusiasts, and convenience shoppers — purity and simplicity is now the ultimate sophistication.”

Few food ingredients are as “pure & simple” as egg products, which “are recognized by product developer as bringing more to product formulations with less,” according to Elisa Maloberti, director of egg product marketing, American Egg Board, Park Ridge, Ill. “In fact, with 20-plus functions, some might say egg products are anything but simple. But the truth is, egg products are uniquely pure and simple.”

Direct from Mother Nature, with a touch of modern technology that cracks, separates and packages convenient forms of whole eggs, whites and yolks, egg products can replace a number of chemical-sounding ingredients, which today’s consumer is growing increasingly adverse to. Their inclusion on ingredient statements is simple: egg, egg white, egg yolk. Consumers know that eggs are real food; they possess a better-for-you image that is not possible with chemically processed food ingredients.

According to Datamonitor, New York, labeling terms such as “natural” and “organic” are no longer as powerful as they once were as a result of their prevalence in the industry. The new approach to convey “better for you” is to take a machete to ingredient lists, replacing those that sound more at home in a chemistry lab with simple ingredients that consumers recognize…real foods such as egg products.

The Häagen-Dazs Five line is not some scientific breakthrough in ice cream manufacturing. In fact, it’s more of a return to the way all ice cream was once made, with real foods such as milk, cream, sugar and eggs. Its conception came from the marketing department of parent company Dreyer’s Grand Ice Cream, Oakland, Calif.

Early in 2008, the marketing team observed a consumer focus group where a panelist mentioned that when he shopped recently, he found himself comparing a bag of potato chips that had 20 ingredients with a bag that had three. He said the bag with the short list was the obvious choice. Other panelists were nodding in agreement, and the concept of Five was born.

Häagen-Dazs was likely the first mainstream food brand to embrace better-for-you simplicity. The brand’s Five ice cream illustrates the trend with just five ingredients for each ice cream flavor, one of which is eggs. “The Häagen-Dazs Five line is all about the essentials, and as a result, the pure essence of each ingredient comes alive,” says Cady Behles, Häagen-Dazs brand manager.

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The “20-Plus Functions of Eggs”

Eggs helped Häagen-Dazs get down to five ingredients, as eggs possess 20-plus functions, many of which benefit ice cream products. Shredded Shrimp

Egg products in batters help breadings adhere to breaded foods.
cream formulations. (See Dairy and Eggs sidebar on page 3.)

Following is a brief overview of eggs’ many functions. Additional details, as well as formulating tips can be found at www.aeb.org.

**ADHESION/BINDING**

The proteins in egg products, specifically in the whites, assist with adhesion and ingredient binding. When they are heated or exposed to acid, they coagulate, causing the egg product to change from a liquid to a semi-solid or solid. When the proteins solidify, they function as an adhesive, connecting ingredients or food components with each other.

For example, an egg wash, which is slightly beaten egg whites with some water, can be brushed onto the surface of baked foods. This sticky solution helps topically applied nuts or seeds adhere to the surface during baking. Egg products are often added to batters used for breaded foods to help adhere the breading to the food. Research suggests that batters with protein levels of 10% to 15% tend to be the most effective binding agent.

**AERATION/FOAMING/STRUCTURE**

When air is incorporated into a liquid or viscous solution, the solution entrapsthe air bubbles, forming a foam. If the foam is stabilized by proteins, it leavesthe food, increasing its height and reducing its density.

The viscosity of all egg products is ideal for incorporating air cells during the whipping or beating process. As whipping or beating progresses, air bubbles decrease in size and increase in number, all the time surrounded by egg proteins. Liquid egg products have low air-liquid interfacial tension; thus, when eggs are beaten or whipped, the proteins denature, or simply, they unfold. This exposes two oppositely charged ends of the protein molecule: the hydrophobic, or water-hating end, and the hydrophilic, or water-loving end. The proteins

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**Dairy and Eggs: A Match Made by Mother Nature**

Though obtained from two different animals, milk and eggs have quite a bit in common. They are both nutrient dense and a source of high-quality protein. They are both fresh products with a relatively short refrigerated shelf life.

And most importantly, they are all-natural real foods that complement each other as ingredients in numerous product applications.

“Häagen-Dazs Five is ice cream focused on the simplicity and goodness of five ingredients — milk, cream, sugar, eggs and one hero ingredient,” says Cady Behles, Häagen-Dazs brand manager, Dreyer’s Ice Cream Co., Oakland, Calif. “We use only real eggs — nothing artificial — in our ice creams. Eggs are a natural emulsifier with natural binding properties that help keep ice cream suspended in its creamy state. Most other ice cream brands — including many labeled ‘all natural’ — use guar gum and carrageenan, which are substantially less expensive than eggs. Using only real eggs, instead of gums, reflects our brand’s philosophy of uncompromised quality and craftsmanship.”

The product developers at Kozy Shack, Hicksville, N.Y. recognize how milk and eggs complement each other, too. Last year the company introduced a new milk-based pudding line called simplywell, which provides high-quality nutrition without sacrificing taste, and contains 25% fewer calories than the company’s regular puddings. The portion-controlled, 4-ounce, 100-calorie cups come in five varieties: Dark Chocolate, French Vanilla, Green Tea Chai, Lemon Ginger and Pear Mangosteen. All are made with eggs, which contributes to the 3 grams of protein in every cup.

In addition to being a source of high-quality protein, eggs contribute to a slightly aerated, creamy smooth pudding. Also, when the egg proteins coagulate, they thicken the pudding, eliminating the need for a blend of hydrocolloids. Because eggs do so much, Kozy Shack can simplify ingredient statements and provide consumers with an all-natural, wholesome dairy product.

Maybe this is the reason why milk and eggs are merchandized together in the grocer’s dairy case. They are the perfect match.
align themselves between the air and water, securing the air bubbles with their hydrophilic chains pointing into the water and dangling their hydrophobic chains in the air. During baking, these proteins bond with each other, forming a delicate, yet reinforced network.

Egg whites do this much better than yolks because of the unique proteins found in whites. In fact, even though the term foam technically refers to any system where there are entrapped air bubbles, in the food industry, when discussing egg products, the term tends to be exclusive to egg white foams. This is because egg whites, unlike any other natural food ingredient, are able to create the largest possible food foam, a foam six to eight times greater in volume than unwhipped, non-aerated liquid egg white.

Whole eggs and egg yolks can also increase the volume of foods, including certain baked goods and dairy desserts such as ice cream and custard, but just not as much as egg whites alone.

The egg white proteins that enable such impressive foaming are ovalbumin and ovomucin. Ovalbumin is responsible for original foam volume when egg whites are whipped, while ovomucin holds onto the air bubbles during heating and has elastic qualities that allow the protein to stretch as the air bubbles enlarge.

A number of variables can impact the stability of egg white foams. For starters, it is possible to overbeat or over whip egg white foam. When this happens, the foam dries out and sets, which prevents the air bubbles from further expanding during the baking process. If egg white foam stands for more than five minutes, air starts to escape and it quickly returns to its liquid state. A little bit of a recipe’s sugar content can be added during foam preparation to prevent air from escaping. If added properly, the result is a smooth, stable foam that does not collapse or drain as quickly as a foam without added sugar. However, sugar can also retard foaming if too much is added, or added too fast.

Historically bakers and chefs used copper bowls to stabilize egg white foams. The copper in the bowl combines with conalbumin and helps to stabilize the protein during heating. Today, a more common approach to stabilizing egg white foam is to add cream of tartar, known chemically as potassium bitartrate. This acidic salt lowers the pH of the egg white, which in turns increases the number of free-floating hydrogen ions in the egg white. This helps stabilize the foam, much like copper.

There are a number of other variables that impact egg white foam stability. For example, salt can decrease the foam’s stability by weakening the matrix of...
the protein bonds. Water can increase the volume and lightness of a foam, though there is a greater likelihood that some liquid will drain off due to the reduction by dilution of proteins. In fact, egg white diluted by 40% or more of its volume in water cannot produce a stable foam. Temperature also impacts the development of egg white foam, which reaches its greatest volume if beaten closer to room temperature than refrigerated temperature.

There is no ingredient as detrimental to egg white foam as fat…even a trace amount. Because fat molecules have hydrophobic and hydrophilic ends similar to protein, fat competes with protein for special alignment with gas bubbles. However, unlike proteins, fats don’t bond with each other. They won’t create any cross-linked bonds to reinforce the network of gas bubbles.

**ANTIMICROBIAL**

Lysozyme, a protein found in egg white, has the ability to inactivate certain Gram-positive microorganisms. It can prevent the outgrowth of microbes in hard cheese production that cause a defect known as “late blowing,” control lactic acid bacteria in wine production and be used as a general food preservative in select applications.

**BROWNING/COLOR**

When exposed to heat, the proteins in egg products can participate in the Maillard reaction, producing a desirable brown color. Also, egg yolk contains xanthophyll, a carotenoid that has a yellow-orange pigment and gives the yolk its characteristic color. This pigment contributes a rich color to various foods.

**CLARIFICATION**

Eggs, especially whites, can clarify or clear various fluid products, including consommé, broth and even wine. When the fluid is heated, added egg white coagulates, capturing and holding minute particles. Depending on the size and weight of the encased particles, the cooked whites may sink to the bottom, allowing the clarified mixture to be carefully poured off. Sometimes the whites may bubble to the top where they are skimmed off, resulting in a crystal-clear product.

**Concocting Creamy Condiments**

One of the catchphrases of 2009 was “Staying in is the new going out.” Despite some indications of economic recovery, foodservice is expected to struggle for some time as consumers continue to rediscover their cooking and entertaining skills. With this in mind, many chefs need help, especially when exploring ethnic cuisine and extreme flavors. This is where condiments come into play, as condiments provide layers of flavors with minimal effort by the cook.

As trolls down the condiment aisle of any supermarket reveals a smorgasbord of dressings, sauces and toppings for consumers to pour, squeeze and spread on all types of foods. Many are based on mayonnaise, an egg yolk–emulsified concoction of vegetable oil, water, vinegar and other ingredients.

“When developing our new Ketchup Ranch Dip and Sauce, we knew the best way to achieve a rich, creamy mouthfeel would be to start with mayonnaise as a base, as the egg yolks required in the manufacture of mayonnaise are one of the best all-natural emulsifiers,” says Paul Kusche, director of marketing at Litehouse House Inc., Sandpoint, Idaho. “We blend the mayonnaise with buttermilk and other ingredients, and the egg yolks continue to function and keep the system smooth and creamy.”

Egg yolks contain a number of emulsifiers, including lecithin and lipoproteins. These molecules have one end that dissolves in water and another in oil and ring dissimilar lipids together. This unique ability to blend immiscible liquids makes egg yolks an essential ingredient in the “-aises”—mayonnaise and Hollandaise and Béarnaise sauces—as well as cream puffs and cake batters containing shortening. Other ingredients such as gums can provide emulsification, but without the flavor, color and nutrients contributed by egg yolk.

Depending on the desired viscosity of the condiment, a formulator may opt to add additional egg yolk even when mayonnaise is the base. The extra egg yolk increases viscosity and produces optimum stability.
COAGULATION/THICKENING

Natural protein consists of complex, folded and coiled individual molecules. Loose bonds across the folds and coils hold each protein molecule in a tight, separate unit. These bonds can be disrupted when exposed to heat or acid, or by physical means such as whipping, causing the protein to denature.

When two unfolded protein molecules with their oppositely charged ends approach each other, the molecules unite. Essentially, millions of protein molecules join in a three-dimensional network, or simply, they coagulate, causing the egg product to change from a liquid to a semi-solid or solid. Coagulation influences egg products’ ability to foam, seal, thicken and more.

There are more than 40 different proteins in a whole egg, some only located in the white and others predominantly in the yolk. These proteins influence the rate of denaturation and coagulation. Egg white protein coagulates between 144°F and 149°F; egg yolk protein coagulates between 149°F and 158°F; and whole egg protein coagulates between 144°F and 158°F. However, the number of variables influence the rate of coagulation, as well as the ability of the proteins to remain in the three-dimensional network.

In frozen products such as ice cream, egg yolks help control density, hardness and texture by encouraging the formation of small ice crystals. This improves the texture and acceptability of product going through freeze/thaw cycles.

COATING/DRYING/FINISHING/GLOSS/ HUMECTANCY/INSULATION/ MOISTURIZING

Slightly beaten liquid egg products can be used as a coating or a glaze on baked goods. There are many glaze variations, based on desired final appearance and texture. In general, yolks contribute a golden color, with the fat component preventing product from drying out. The white is the primary source of proteins. When the proteins coagulate, they assist with adhesion as well as create a seal. When whites are used alone, the coagulation function draws moisture from the product, which eventually evaporates, resulting in a crisp surface. Such an egg wash can also give the baked product a finished, slightly glossy look. (See The Final Touch table on page 7.)

EMULSIFICATION/MOUTHFEEL

The phospholipids, lipoproteins and proteins found in egg yolks are surface-active agents that enable the formation of emulsions between immiscible liquids such as oil and water. Egg yolk emulsions impact the mouthfeel of food in two ways. First, the egg yolk’s natural emulsifiers can coat liquids with fat to create smooth, creamy textures in products from custards to chocolate truffles. Second, these emulsifiers also thicken.

In ice cream, egg yolk helps disperse fat throughout the mix and prevents it from clumping. Yolk also helps improve whipping properties for desired overrun and makes ice cream dry and stiff.

FLAVOR

Though eggs contain more than 100 volatile flavor components, the end result may be described as bland. However, egg yolks contain fats that carry and meld flavors when used in foods. Eggs also provide a well-rounded, yet neutral, richness — a richness that can stand delicately on its own or, without

EDIBLE PACKAGING FILM

Transparent egg white films are suitable as water-soluble packets or pouches for food ingredients. They also have application in breath mint strips and pharmaceutical strips.

CRYSTALLIZATION CONTROL/ FREEZABILITY

Smoothness on the tongue is an important pleasure and quality factor in many foods. In confections, egg whites function as an interfering agent, slowing down the sugar crystallization process.
Mom and pop bakeries have long known the recipe for success: fresh and wholesome ingredients. Commercialized baking operations that maintain this custom are proving to be winners in today’s highly competitive packaged baked goods industry. This is particularly true with private label bakers who recognize the opportunity in appealing to today’s penny-pinching consumer, and who hope to retain their business after the recession by offering premium products at an affordable price. When it makes sense, egg products are part of the formulation.

For example, Target Corp., Minneapolis, may have made its name with affordable-yet-fashionable clothes and home furnishings, but in recent years, the nation’s number two discount retailer has been focusing on growing its food business. And that focus is paying off. Total food sales have been increasing steadily for the company. In 2006, about 32% of all sales were from food, by 2008, this figure jumped to 37%. Sales of Target’s private labels represented less than 1% of its total food sales in 2001. In 2008, this figure jumped to about 20% of food totals.

Quality is key to growing the company’s Market Pantry and Archer Farms private label brands. This is why more than two dozen food scientists weigh, measure, cook, taste and test all mann er of p rivate label groceries at the company’s newly expanded test kitchen. Target’s product developers recently introduced single-serve mini pound cakes (sold frozen in boxes of two). The package describes the cake as rich and moist, and extra-indulgent. Eggs contribute to these attributes.

“The proteins in whole egg enhance the structure and texture of our Archer Farms Pound Cake. Whole egg also provides flavor and contributes to a rich color,” says Jana O’Leary, spokesperson for Target. “Our food scientists know that eggs are one of the most nutritious foods on Earth, and our guests view eggs as a natural, wholesome ingredient.

“Many of Target’s bakery-style cookies also rely on egg products, as egg yolks function as an emulsifier, helping to achieve optimal texture,” says O’Leary. “The company’s frozen tiramisu uses egg products twice. The ladyfinger cookies in clude w hole e gg, w hile the rich and creamy coffee-accented custard includes egg yolk.”

Bake Me a Cake as Best as You Can

Egg products provide that final touch to many baked goods. When slightly beaten, liquid egg products can be used as a coating or a glaze on baked goods. The egg mixture is brushed on the surface of breads, cookies, pastries, rolls, etc., prior to baking, or applied about 15 minutes before the end of baking to prevent over browning. The following equations apply:

- **EGG** + **SALT** = Shiny surface
- **EGG** + **MILK** = Medium-shiny surface
- **EGG** + **WATER** = Less-intense shine, golden surface
- **EGG YOLK** + **WATER** = Shiny-golden surface
- **EGG YOLK** + **CREAM** = Shiny-brown surface
- **EGG WHITE** = Light-colored, crisp surface
- **EGG YOLK** + **WATER** = Sticky surface for adhering nuts and/or seeds
- **EGG WHITE** + **MILK** = Transparent-shiny surface

Bakery isn’t the only category where Target’s food scientists utilize egg’s many functionalities. The company recently introduced refrigerated Archer Farms Buffalo Blue Cheese dip. The dip relies on egg yolks for emulsification and added richness.

Target’s right on, well, target, when it comes to formulating with quality, wholesome ingredients. With 91% of U.S. retailers planning to expand private label offerings during the next five years, according to a CLEARPulse survey by Clear Seas Research, it is in their best interest to invest in premium formulations in order to secure a loyal consumer base.
clashing, serve as a backdrop to allow more strongly flavored foods or seasonings to shine.

**FORTIFICATION/PROTEIN ENRICHMENT**

Since eggs provide a wide variety of nutrients for a relatively low-calorie count, eggs and egg products are considered nutrient-dense. Foods formulated with egg products contain all the nutrition originally found in the egg product, including high-quality protein, trans-fat free mono- and poly-unsaturated fats, vitamins, minerals and other highly bioavailable nutrients with recognized health and wellness benefits.

Of special note is the quality of protein. Eggs contain all nine essential amino acids, with whole egg protein having a biological value of 93.7 on a 100-point scale. The essential amino acid composition of egg protein is similar to the human body’s requirement, allowing the body to use the protein more efficiently to maintain muscle tone and strength as the body ages.

The egg’s lipid portion, which is found primarily in the yolk, contains 5% of the Daily Value of fat-soluble vitamin D, a nutrient associated with bone health. It is a source of lutein and zeaxanthin, two nutrients classified as xanthophyll carotenoids and have been shown to contribute to eye health. While eggs contain only a small amount of these nutrients, research suggests that the lutein and zeaxanthin from eggs may be more bioavailable, or more easily absorbed by the body, than from richer sources. The lipid portion is also a concentrated source of choline, a nutrient necessary for the normal functioning of all cells in all people, with some segments of the population requiring more choline during certain life stages, such as pregnancy.

**pH STABILITY**

Egg white is one of the few food products that is naturally alkaline with an initial pH as low as 7.6 at time of lay but increasing to about 9.4 with age. As the pH increases, the thick white thins. The pH of a fresh egg yolk is about 6.0 and increases to 6.4 to 6.9 during storage. Storage at refrigerated temperatures greatly slows the pH change and helps reduce the rate of the thick egg white from thinning. In general, these pHs are stable and do not disrupt food product formulations.

**RICHNESS**

Egg yolks add richness to all types of food through color, emulsification, flavor and whipping ability.

**SHELF LIFE EXTENSION**

Egg proteins bind water, making water less available for microorganisms to grow and cause spoilage, as well as prevent certain foods, such as baked goods, from drying out.

**TENDERIZATION/TEXTURE**

The texture of a food not only includes its feel in the hand and mouth, it encompasses the sensory experience of chewing and swallowing. Egg products can impact all of these variables. For example, fats in the yolk produce a tenderer, softer crumb in baked goods and retard the onset and rate of firming that occurs with age. Egg proteins within certain food matrices can help maintain product moisture by binding the water in the structure, thus preventing it from drying out. In doing so, there are textural benefits, such as chewiness that help give products an improved mouthfeel.

**WHIPPING ABILITY**

Egg yolk solids increase the rate of whipping in ice cream, particularly in slow-whipping mixes. Usually not more than 0.5% egg yolk solids in the mix is needed for this purpose. Egg yolk solids are especially desirable in mixes in which butter or butter oil is used as a main source of fat. Research has shown that egg yolks or whole eggs improve the rate of whipping more if they are sweetened with 10% sugar or corn syrup before they are frozen or dried.

**Many egg product options**

This brings us to the many types of egg products available to food formulators. Egg products come in frozen, refrigerated liquid and dried forms. They can be the whole egg, or just the whites or yolks. Sometimes additional ingredients are added for functional purposes, as in the case of improving whipping ability.

In addition to AEB’s website providing egg product functionality information, it also offers technical information on egg product composition, formulas and suppliers. Formulators should always work closely with their suppliers for the most accurate specifications and to ensure that an application reaps as many of the 20-plus functions that an egg product has to offer.