Introduction to Eggs and Egg Functionality

Training Guide

Who Are We?

American Egg Board

The American Egg Board is the national marketing organization for America's egg farmers, created by an Act of Congress in 1976.

We are 100% farmer funded and we provide a wealth of resources to help promote the sales of American eggs, globally.

Supporting our Partners

Resources

We support all our channel partners — **from manufacturing to CPG and retailers to foodservice** — with resources and information that will help them achieve business goals, navigate industry challenges, inspire partnership, collaboration, and more.

MARKETING SUPPORT

CONSUMER INSIGHTS

EGG NUTRITION CENTER

SUSTAINABILITY

SCIENTIFIC RESEARCH

INNOVATION

Innovation: Eggcelerator Lab

Resources

What is the Eggcelerator Lab?
It's the egg industry's innovation center, designed to spark innovation and bring new ideas to market:

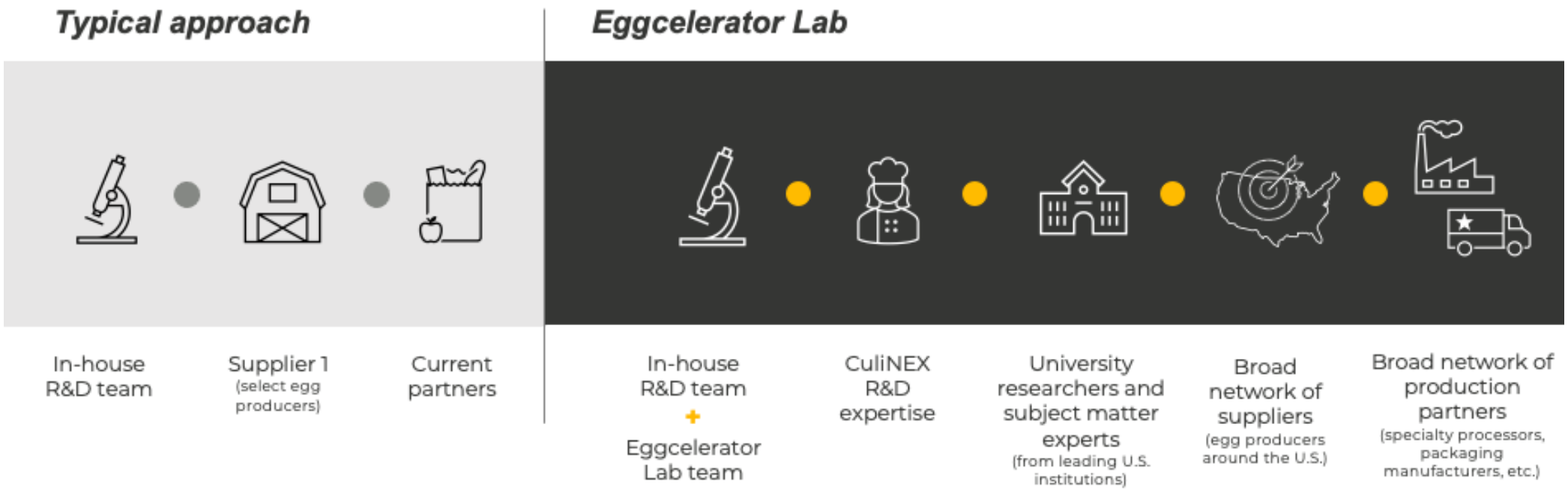
- *State-of-the-art insights and innovation network*
- *Unique innovation resources and capabilities*
- *World-class culinary center (CuliNEX)*

Our Mission:
To generate value and drive demand for the egg industry through innovation in a way that creates viable solutions to unmet consumer, market, and industry needs.

Innovation: Eggcelerator Lab

RESOURCES

The Eggcelerator Lab offers an extensive network of supplier and partner relationships. We are supplier- and partner-agnostic, so we can help assemble the right team for your innovation.



Innovation: Eggcelerator Lab

RESOURCES

Our proprietary Eggcelerator Lab assets create value for clients.

Agenda

Eggs 101

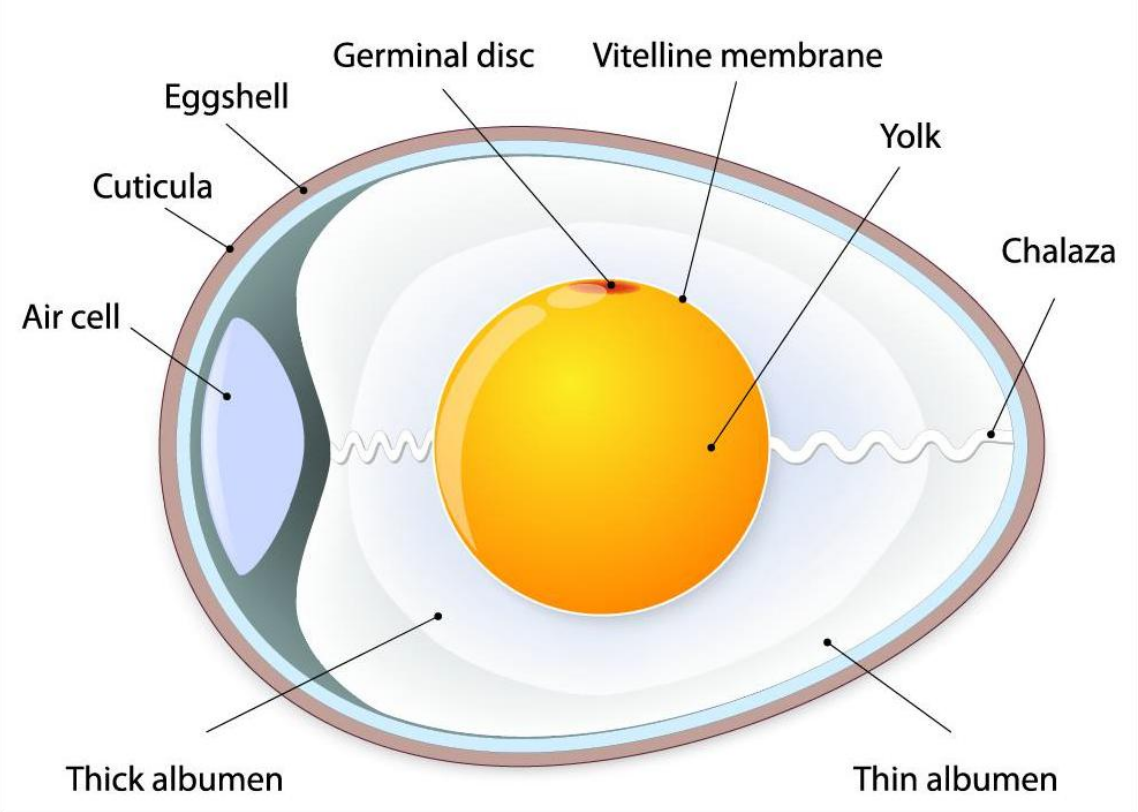
- Egg Introduction
- Creation
- Source
- Farming Types
- Sustainability
- Nutrition
- Uses and Functionality

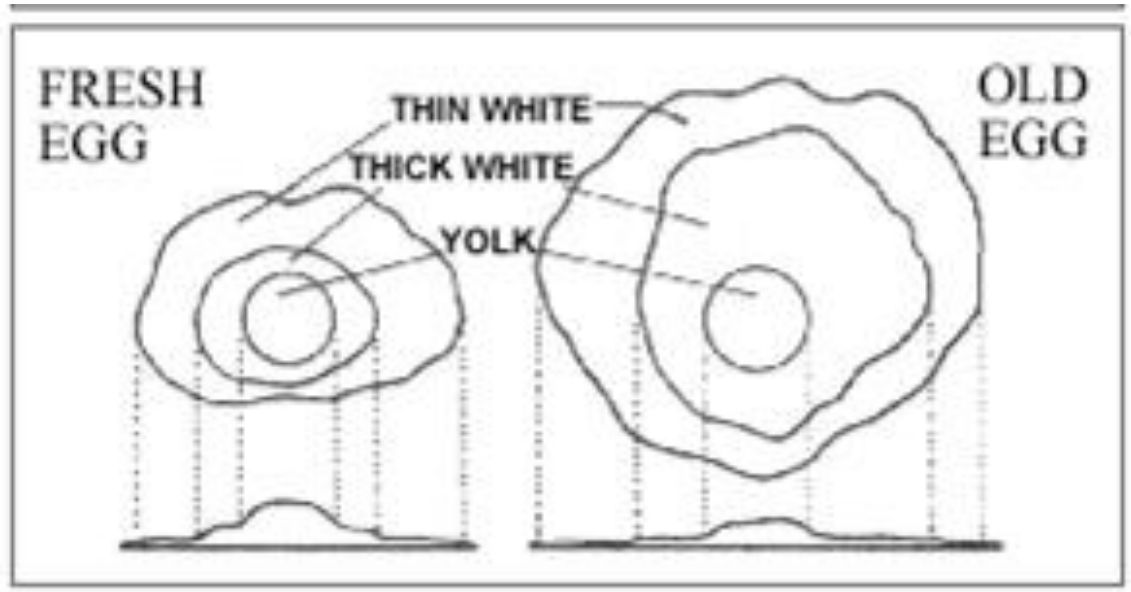
Eggs 201

- Egg Products
- Advantages
- Whole Eggs
- Egg Whites
- Egg Yolks
- Conversion
- Formats
- Handling
- Functional Egg Ingredients
- Enzymatically Modified
- Yolks
- Whole Eggs
- Egg White
- Hi-Gel
- Hi-Whip

Eggs 101

Egg Structure

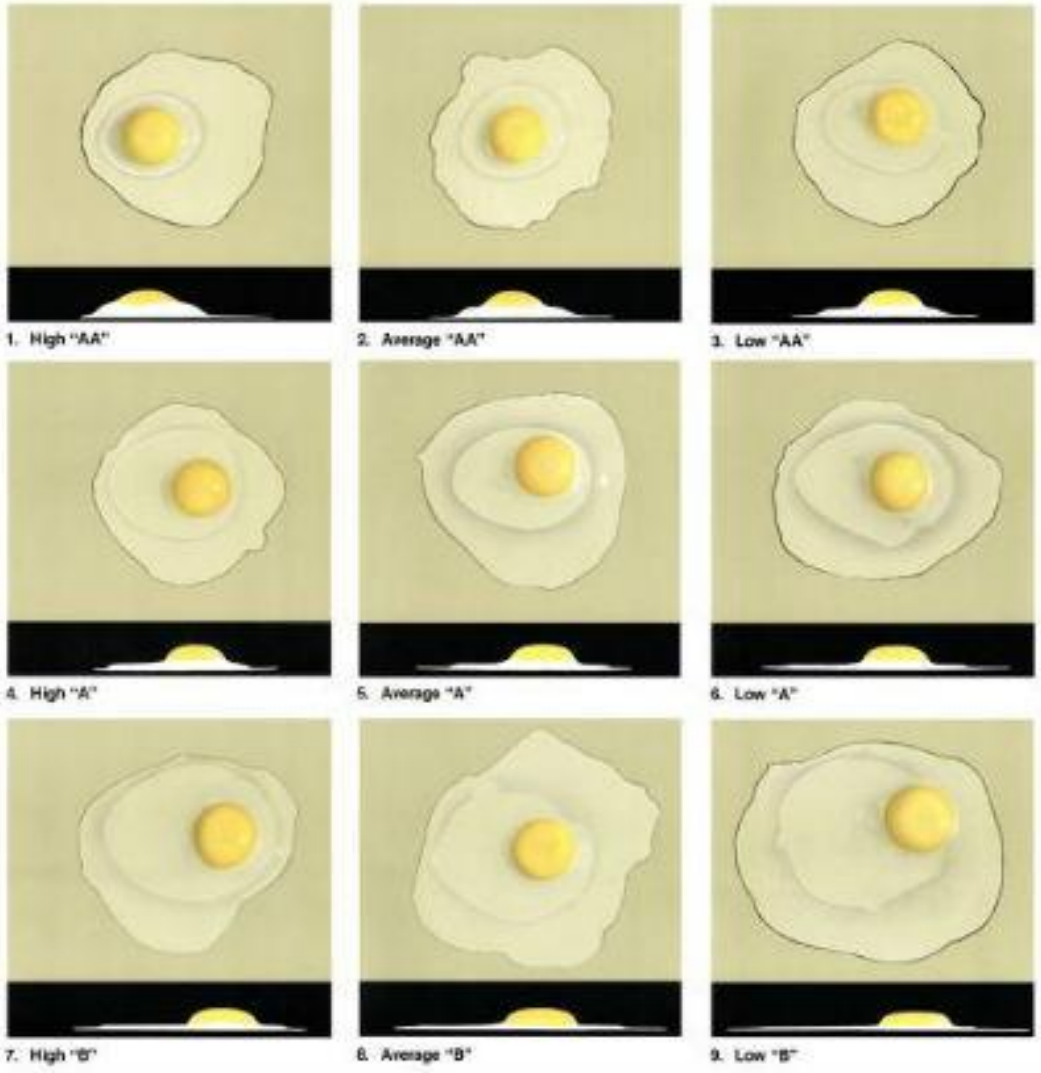


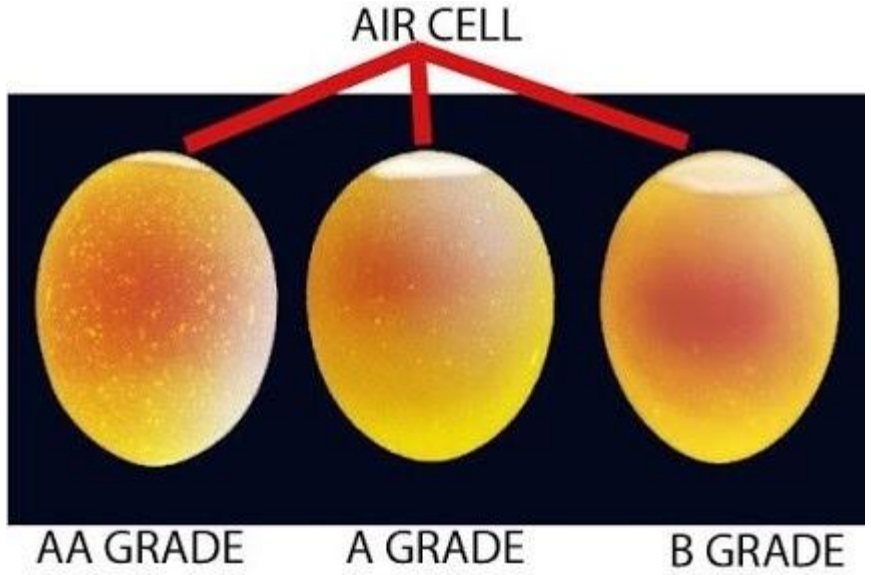


(source: www.usaproduce.com)

Source: www.chickens.allotment-garden.org/eggs/structure-egg/

Shell Egg Quality

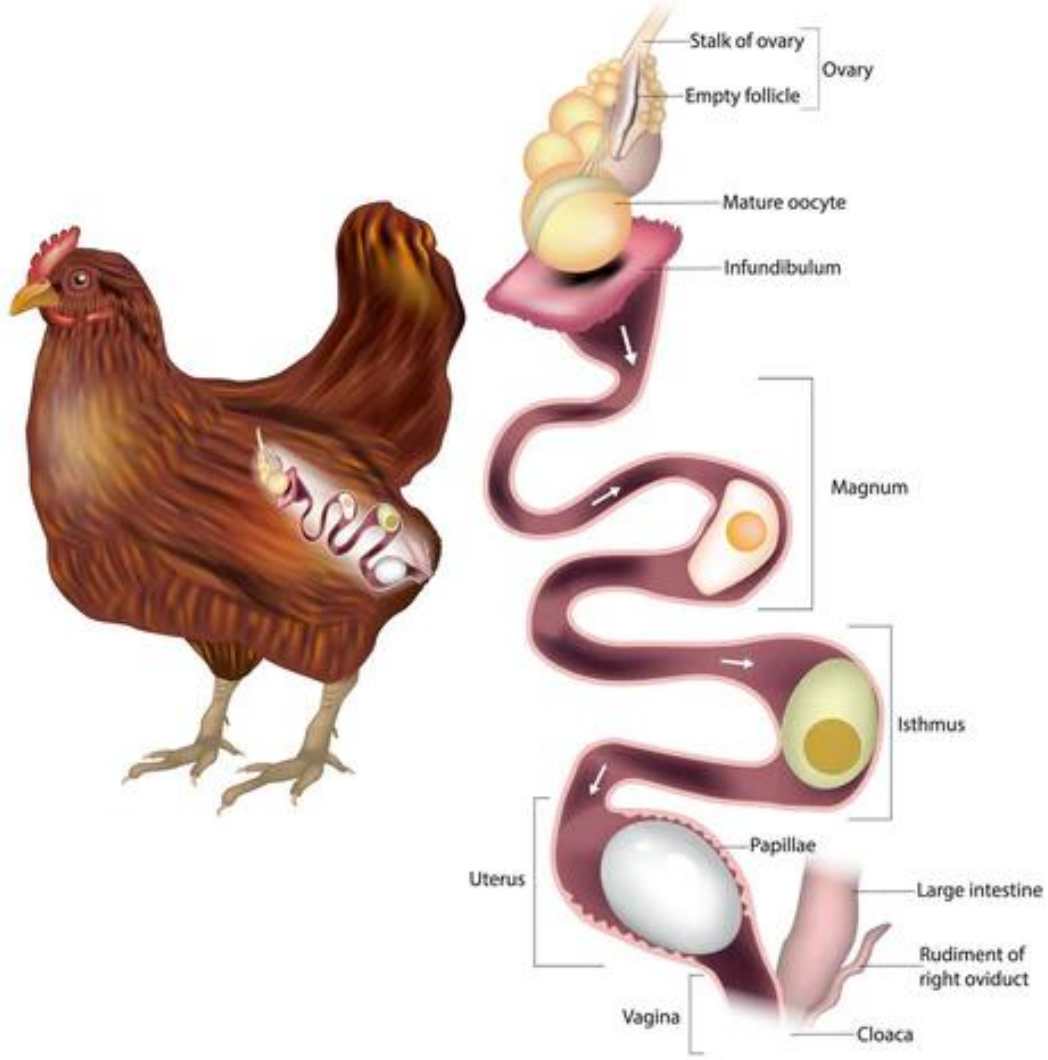




Egg Creation and Source

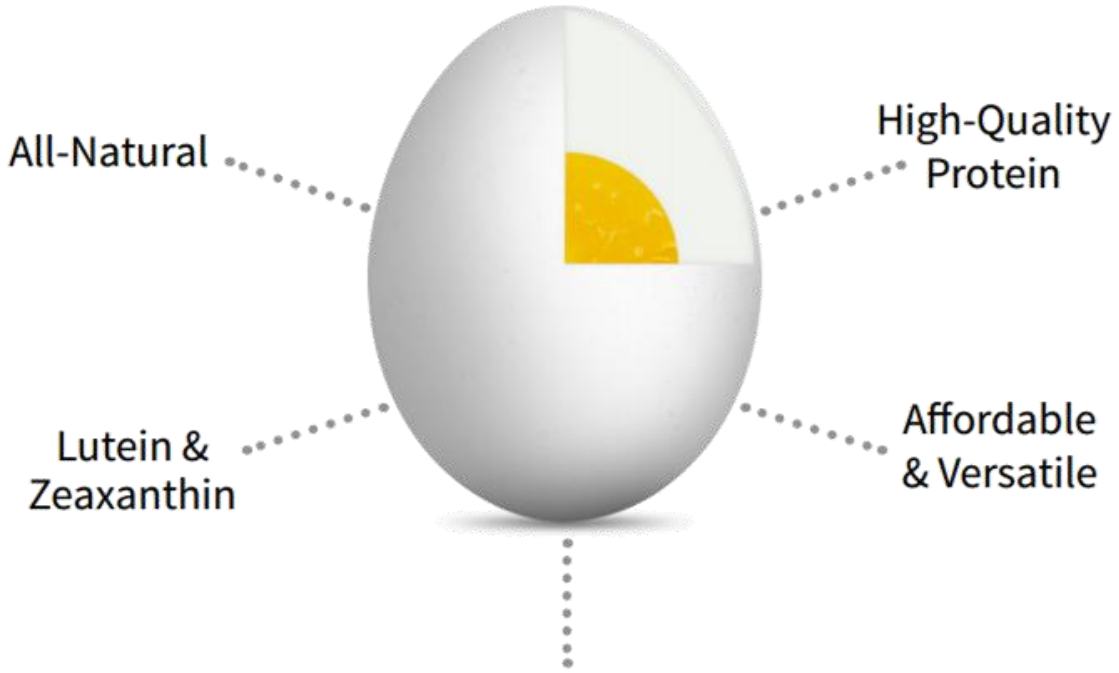
1. **Ovary**: Hens carry future eggs in their ovaries.
2. **Ovulation**: The ovary releases an egg yolk.
3. **Oviduct**: The egg travels through different sections:
    - **Magnum**: Egg white forms around the yolk.
    - **Isthmus**: Shell membrane develops.
    - **Uterus (Shell Gland)**: Hard outer shell is created.

And voilà! Breakfast is on its way. 🥚🌟



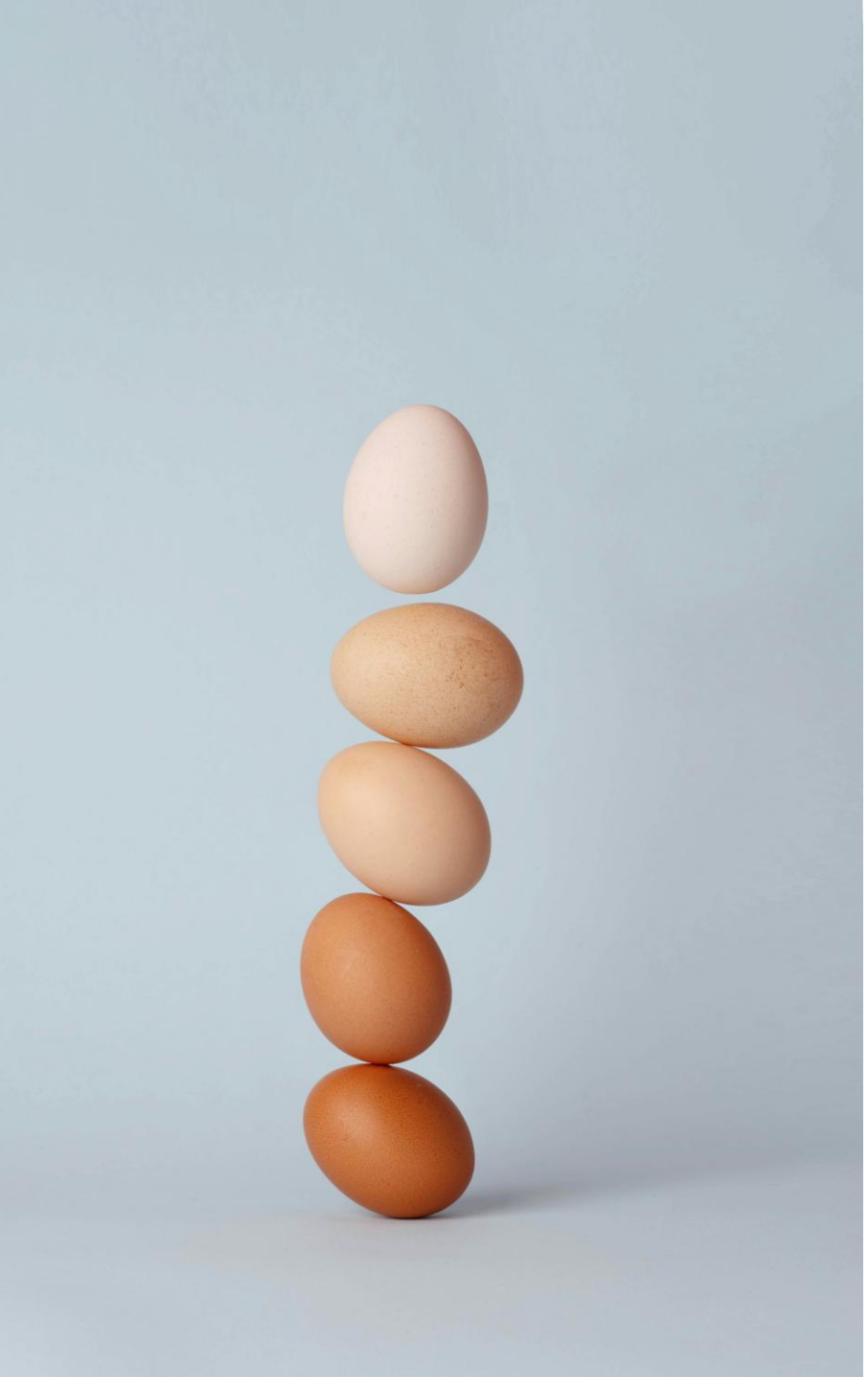
Nutritional Value of Eggs

Eggs are a nutrition powerhouse



All for 70 calories in a large egg!

U.S. Department of Agriculture, Agricultural Research Service. FoodData Central, 2019. DB#01123.

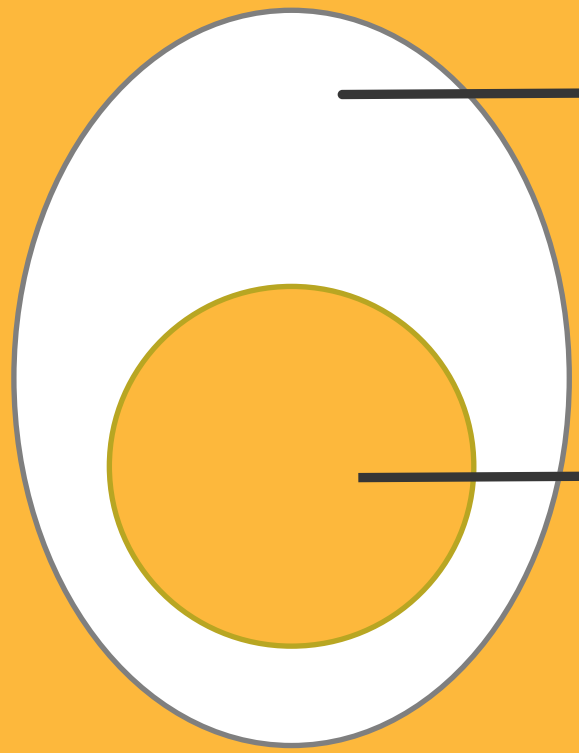


The nutrition in an egg is second to none

- Eggs have been a staple in the human diet for thousands of years
- The range of nutrients in an egg is sufficient to sustain a developing chick embryo
- Eggs contain various amounts of most nutrients needed to sustain human life

The egg white and yolk have different amounts of calories, protein, and fat

Whole Egg
- 70 calories
- 6g protein
- 5g fat
- 0g carbohydrate



Egg White
- 15 calories
- 3.5g protein

Egg Yolk
- 50 calories
- 2.5g protein
- 4.5g fat

U.S. Department of Agriculture, Agricultural Research Service. FoodData Central, 2019. DB#01123, DB#01124, DB#01125.

High-quality protein helps maintain and repair muscle at all ages and stages

- Protein Digestibility Corrected Amino Acid Score (PDCAAS): highest possible score
- Dietary protein directly influences muscle mass, and along with resistance exercise, can impact muscle strength.
- There is growing consensus that older adults need a higher amount of protein to maintain lean body mass and function.

Nutrition Facts label highlights the value of eggs

Nutrition Facts

12 servings per container

Serving size
1 egg (50g)

Calories per serving **70**

Calories per gram:
Fat 9 • Carbohydrate 4 • Protein 4

Amount/Serving	% Daily Value*
Total Fat 5g	**6%**
Saturated Fat 1.5g	8%
Trans Fat 0g	
Polyunsaturated Fat 1g	
Monounsaturated Fat 2g	
Cholesterol 185mg	**62%**

Amount/Serving	% Daily Value*
Sodium 70mg	**3%**
Total Carbohydrate 0g	**0%**
Dietary Fiber 0g	0%
Total Sugars 0g	
Includes 0g Added Sugars	0%
Protein 6g	**12%**

*The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.

Vitamin D 1mcg 6% • Calcium 30mg 2% • Iron 0.9mg 4% • Potassium 70mg 0%
Vitamin A 80mcg 8% • Vitamin E 0.5mg 4% • Riboflavin 0.2mg 15% • Niacin 1.4mg 8%
Vitamin B6 0.1mg 6% • Folate 25mcg DFE 6% • Vitamin B12 0.5mcg 20%
Biotin 11mcg 35% • Pantothenic Acid 0.8mg 15% • Phosphorus 100mg 8%
Iodine 28mcg 20% • Zinc 0.7mg 6% • Selenium 15mcg 25% • Choline 150mg 25%

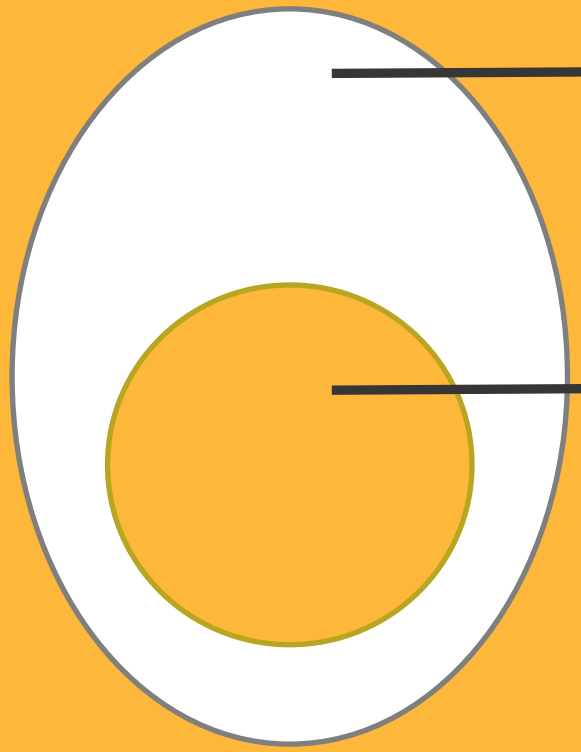
U.S. Department of Agriculture, Agricultural Research Service. FoodData Central, 2019. DB #01123.
Staggs, CG et al. J Food Compost Anal. 2004;17(6):767-776.

Eggs are a good or excellent source of eight essential nutrients

Nutrient	Amount in 50 g	%DV	Claim
Protein	6 g	12%	Good Source
Riboflavin	0.2 mg	15%	Good Source
Pantothenic Acid (Vitamin B5)	0.8 mg	15%	Good Source
Vitamin B_{12}	0.5 mcg	20%	Excellent Source
Iodine	28 mcg	20%	Excellent Source
Selenium	15 mcg	25%	Excellent Source
Choline	150 mg	25%	Excellent Source
Biotin	11 mcg	35%	Excellent Source

21 CFR §101.154 / U.S. Department of Agriculture, Agricultural Research Service. FoodData Central, 2019. DB #01123. / Staggs CG et al. J Food Compost Anal 2004. / U.S. Food and Drug Administration. Total Diet Study: Elements Results Summary Statistics Market Baskets 2006 through 2013. 2017.

The egg white and yolk have different amounts of vitamins and minerals



Egg White

- 10% DV Riboflavin
- 4% DV Niacin
- 10% DV Selenium

Plus 252 mcg lutein and zeaxanthin!

Egg Yolk

- 4% DV Vitamin D
- 8% DV Vitamin A
- 6% DV Riboflavin
- 4% DV Niacin
- 4% DV Vitamin B_6
- 6% DV Folate
- 15% DV Vitamin B_{12}
- 10% DV Pantothenic Acid (B_5)
- 6% DV Phosphorus
- 4% DV Zinc
- 15% DV Selenium
- 25% DV Choline

U.S. Department of Agriculture, Agricultural Research Service. FoodData Central, 2019. DB#01123, #01124, #01125.

For the majority of the population, *dietary cholesterol* has minimal impact on *serum cholesterol*

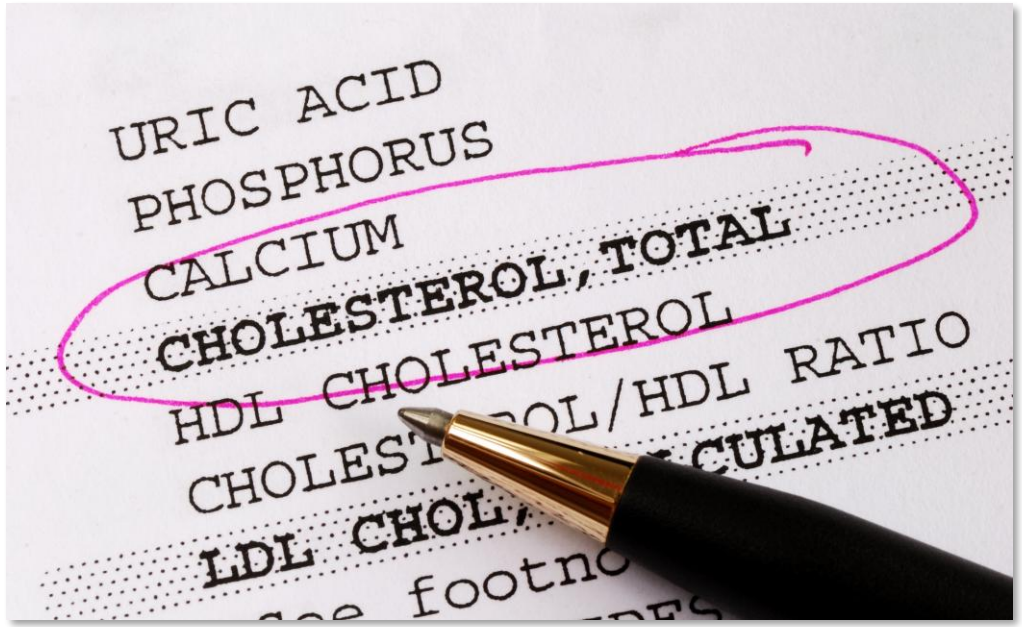
Nutrition Facts

12 servings per container

Serving size **1 egg (50g)**

Amount per serving	
Calories	**70**
	% DV*
Total Fat 5g	**6%**
Sat. Fat 1.5g	8%
Trans Fat 0g	
Cholest. 185mg	**62%**
Sodium 70mg	**3%**
Total Carb. 0g	**0%**
Fiber 0g	0%
Total Sugars 0g	
Incl. 0g Added Sugars	0%
Protein 6g	**12%**
Vit D. 1mcg 6% • Calcium 30mg 2%	
Iron 0.9mg 4% • Potas. 70mg 0%	

*%DV = %Daily Value



Fernandez ML. Curr Opin Clin Nutr Metab Care 2012;15(2):117-21.
Blesso, CN and ML Fernandez. Nutrients 2018;10(4).

2020 Dietary Guidelines for Americans provides four key recommendations

Nutrient Dense:
Provides vitamins, minerals, and other health-promoting components and has little added sugars, saturated fat, and sodium.

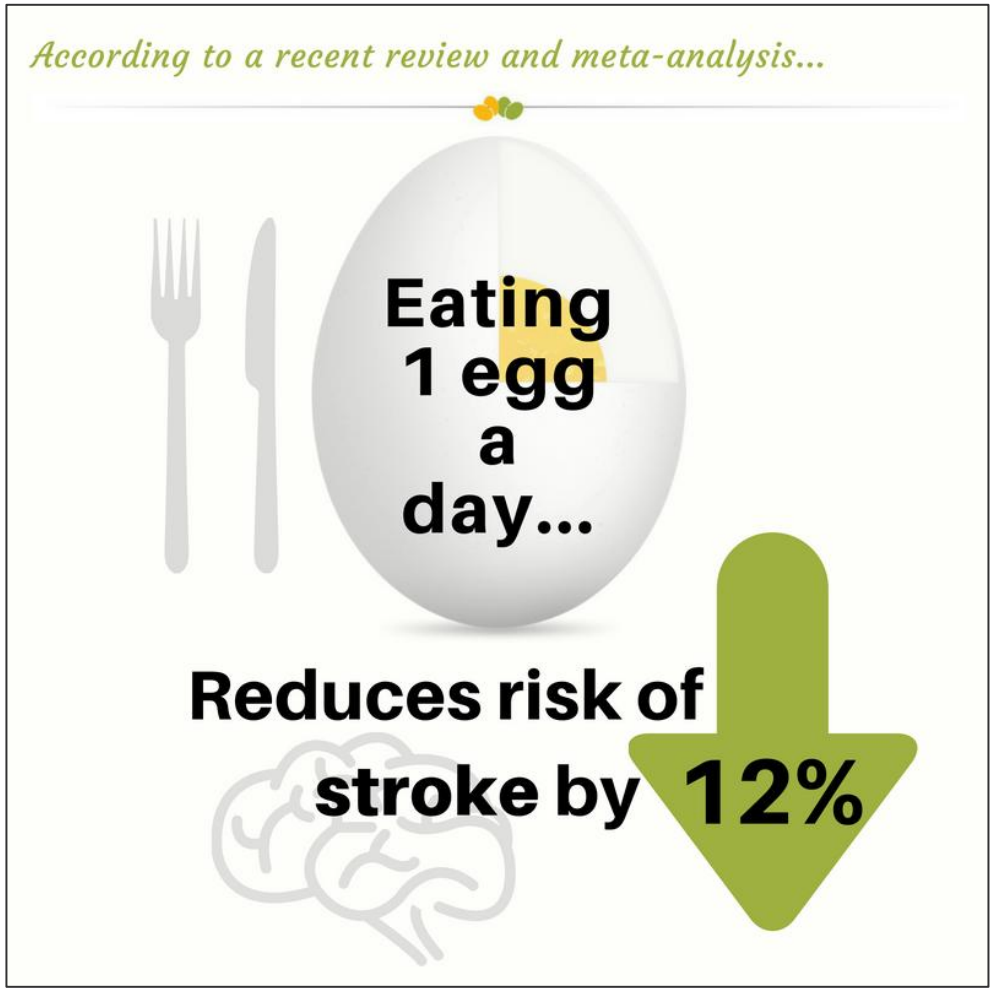
Vegetables, fruits, whole grains, seafood, eggs, beans, peas, and lentils, unsalted nuts and seeds, fat-free and low-far dairy products, and lean meats and poultry – when prepared with no or little added sugars, saturated fat, and sodium – are nutrient-dense foods.

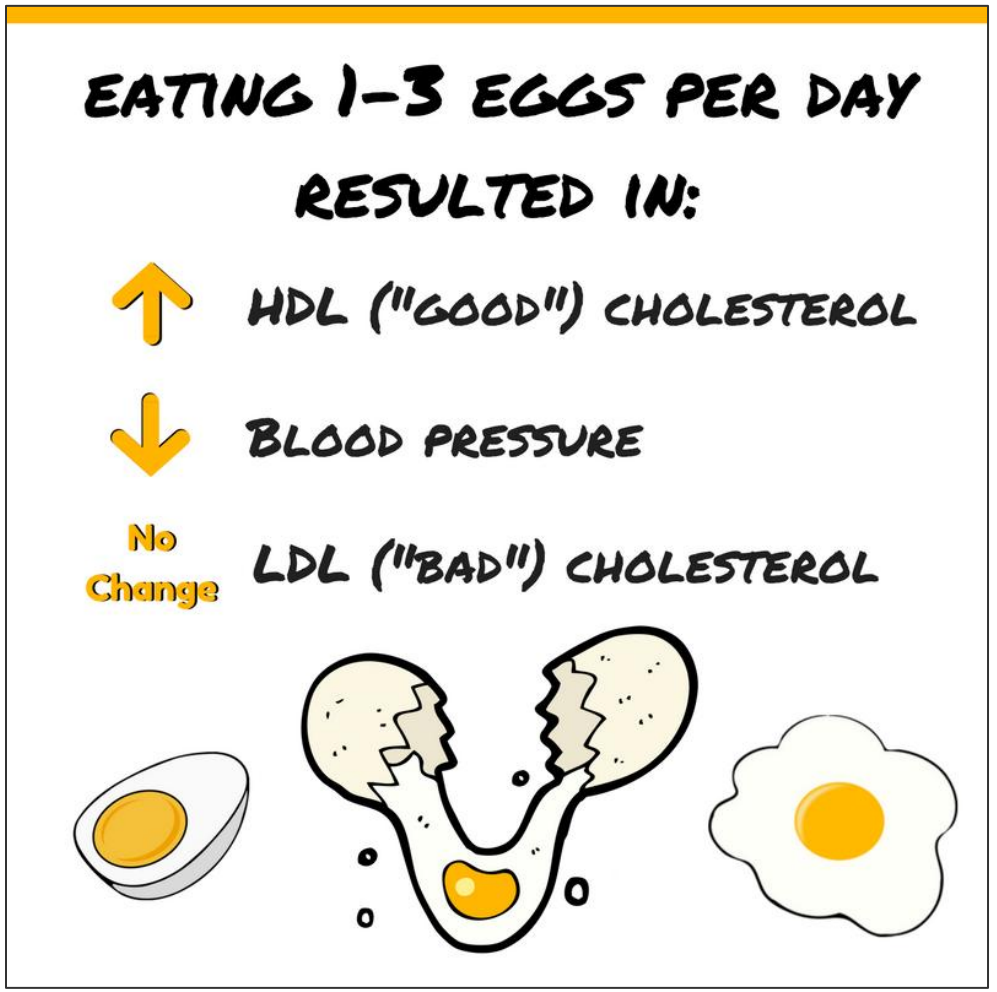
U.S. Department of Agriculture and U.S. Department of Health and Human Services. *Dietary Guidelines for Americans, 2020-2025.* 9th Edition. December 2020. Available at DietaryGuidelines.gov. Figure taken from Chapter 1, page 17.

HOW EATING AN EGG

IMPACTS YOUR HEALTH

Eggs and Cholesterol





Sustainability Research & Resources

AEB Sustainability Program Vision

Support knowledge and tools for progress

Coordinate industry for a path forward

Support engagement with customers, stakeholders

Give voice to our farmers' values

Measuring & Communicating Sustainability of Eggs

Life Cycle Assessment

Sustainability Framework

Survey & GHG Calculator Tool

2019 LCA Confirms Industry Impact Areas

Since the 50-year study, AEB worked with the Egg Industry Center (EIC) and United Egg Producers (UEP) to conduct a Life Cycle Assessment of the U.S. egg industry in 2019.

We wanted to account for the change in production methods due to the growth of cage-free production. Results found that the industry's environmental footprint has remained remarkably consistent, with hen feed making the largest contribution.

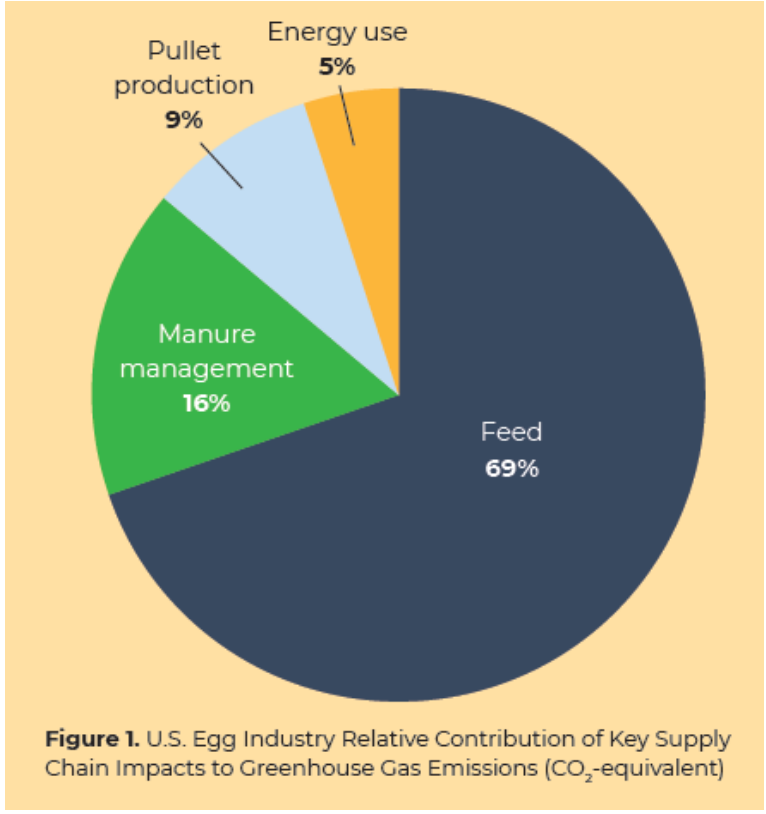
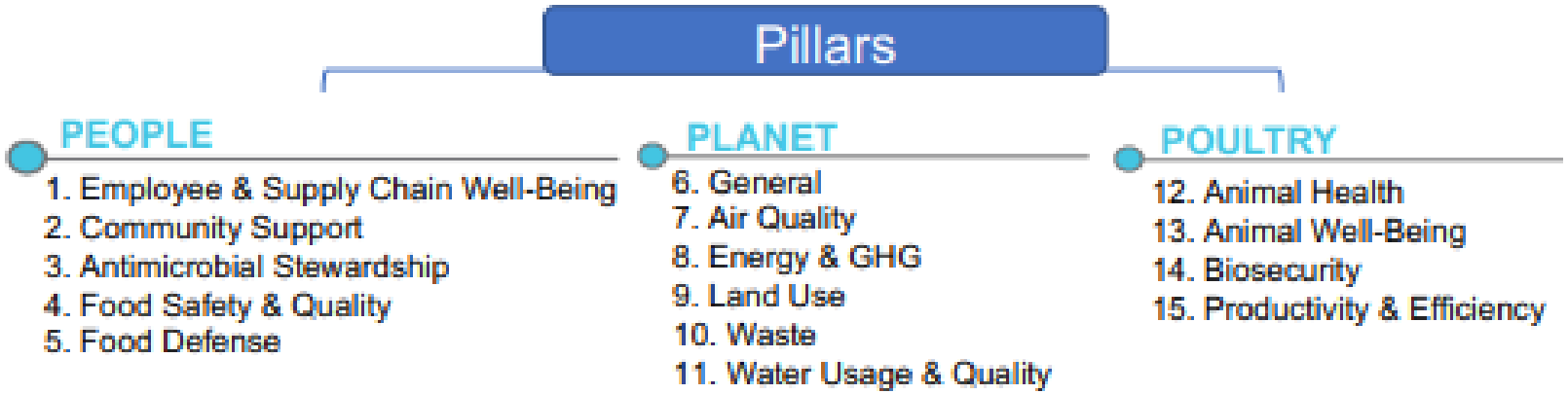


Figure 1. U.S. Egg Industry Relative Contribution of Key Supply Chain Impacts to Greenhouse Gas Emissions (CO_2-equivalent)

Egg Industry Center | the INCREDIBLE EGG | AMERICAN EGG BOARD | United Egg Producers d/b/a Egg Farmers of America

Reference: U.S. Egg Industry Lifecycle Assessment. Egg Industry Center, Iowa State University and University of British Columbia. Conformance with International Organization for Standardization 14040:2006 standards

AEB is a member of US-RSPE & Supported Development of Sustainability Framework



US-RSPE
U.S. ROUNDTABLE FOR SUSTAINABLE POULTRY & EGGS

- Multistakeholder effort to develop the first sustainability framework specifically for the layer, broiler, and turkey supply chains
- Voluntary reporting tool will help measure continuous improvement for full U.S. egg supply chain from producer to customer
- After two years of development, the framework launched at the end of 2022
- **AEB is covering participation costs for smaller egg producers - Growers/operators with fewer than 4 million hens will be able to access the Framework without fees for up to 3 years**. Contact Kristen Wharton at kwharton@aeb.org for more information.

Master Sustainability/ESG Survey Development & Emissions Calculator

- What we heard from egg producers: Customer sustainability surveys are lengthy, time consuming, and contain cumbersome data requests
- In support of egg producer's needs, AEB has initiated a project aiming to:
    - Assess and understand leading egg customers' sustainability commitments and data need ramifications, identifying commonalities across customer surveys and data requests.
    - Deliverables:
        - *Master Sustainability Survey and How to Guide*
        - *Online Tool (that streamlines questions and provides a GHG calculator)*

Eggs 201

Culinary Functionalities

1. Clarifying Agent

- Egg whites help clarify consommés, turning cloudy liquids into crystal-clear, flavorful broths
- The process involves creating a “raft” of solids using egg whites, which traps impurities and clarifies the liquid

2. Enriching Flavors

- Eggs enhance the richness and color of foods like cakes, pancakes, waffles, and bread
- Brioche, with its buttery goodness, owes its richness to eggs
- Eggnog, made by combining egg yolks, sugar, and infused milk or cream, is another delightful example

3. Emulsifying Agent

- Eggs stabilize emulsions, such as mayonnaise and hollandaise sauce, by binding oil and water together.

4. Leavening Agent

- In recipes like angel food cake, popovers, and Dutch babies, eggs contribute to rising and lightening the texture

Culinary Functionalities

5. Thickener

- Egg yolks thicken custards, sauces, and lemon curd due to their protein content.

6. Tenderizer

- Eggs add tenderness to baked goods and meatloaf.

7. Moisturizer

- Eggs prevent baked goods from drying out.

8. Glazing

- Brushing beaten egg on pastries or bread creates a glossy finish.

Remember, eggs offer countless options both on their own and when combined with other ingredients. They’re true kitchen superheroes!

What Eggs Do For You

- Adhesion
- Aeration
- Antimicrobial
- Binding Browning
- Clarification
- Coagulation
- Coating
- Color
- Crystallization Control
- Drying
- Edible Packaging Film
- Emulsification
- Finishing
- Flavor Foaming
- Fortification
- Freezability
- Gluten-Free
- Gloss
- Humectancy
- Insulation
- Moisturizing
- Mouthfeel
- pH Stability
- Protein Enrichment
- Richness
- Shelf Life Extension
- Structure
- Tenderization
- Texture
- Thickening
- Whipping Ability

Functions of Eggs In Baked Goods

- Aeration/Foaming
- Emulsification
- Coagulation/Gelation
- Humectancy & Shelf Life

Functions of Eggs in Baked Goods

- Aeration/Foaming
- Emulsification
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Appealing Appearance

Volume & Structure

- Lecithin in egg yolks promote batter emulsification
- The foaming properties of eggs help promote batter aeration in cakes and cookies
- Air bubbles trapped in the batter expand when heated and increase product volume
- Proteins in eggs denature and set final product texture

Color & Browning

- Carotenoids in yolks provide a golden hue to the crumb
- Proteins in eggs participate in Maillard reaction, producing desirable brown exterior

Tender Texture

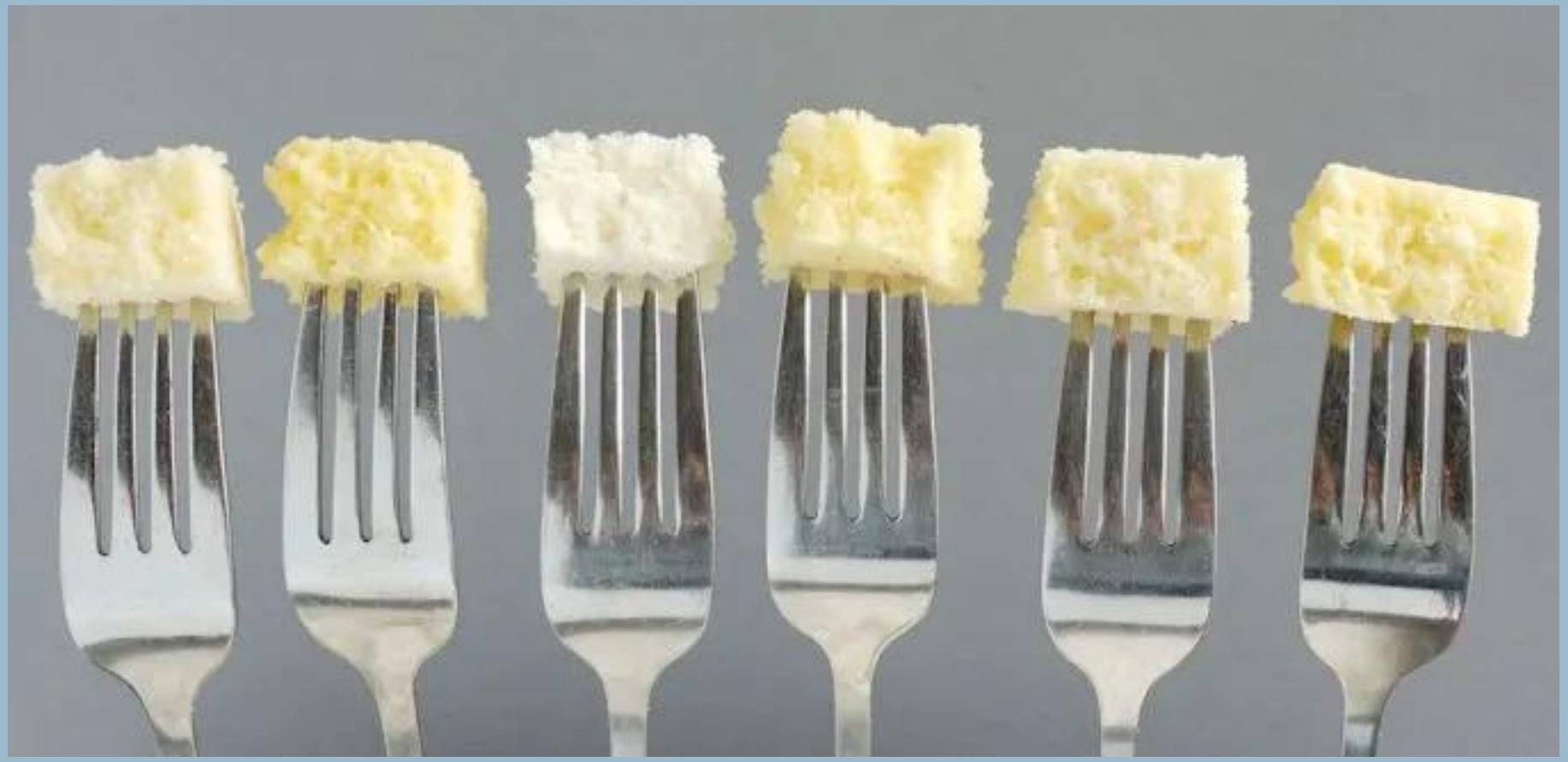
Texture

- Proper fat emulsion produces a more tender texture
- Prevents toughening by interfering with gluten development
- If batter is not well-emulsified, products can have uneven crumb, greasy mouthfeel and course/crumbly texture

Shelf-Life Extension

- Lecithin lodges between starch chains to retard the onset and rate of starch retrogradation (staling)
- Help reduce moisture loss by helping form proper cell structure, which resists staling better
- Proteins act as a humectant and bind water, reducing water activity and spoilage

Eggs in Cake Baking



The same recipe made with varying amounts of eggs, yolks and whites.
Notice color, texture and height differences.

Aroma & Flavor

While egg whites are almost completely neutral in flavor, egg yolks can heavily influence the perception of taste in baked goods

- Contain more than 100 volatile flavor compounds
- Contribute characteristic eggy, “sweet, baked good” aroma and flavor
- Influence rheological properties and sensory characteristics such as flavor, mouthfeel and texture
- Enhance perception of fat-soluble aroma and flavor compounds
- When decreased or removed, increased flavoring ingredients may be required

Rich Mouthfeel

Thickening

- When heated, the proteins in eggs change from fluid to irreversible gel
- Coagulation is responsible for the texture of puddings, custards, fillings
- Starches and gums prevent overcooking and syneresis

Mouthfeel

- Yolks provide a rich, creamy mouthfeel
- Fillings thickened solely with starch can be pasty
- Excessive use of hydrocolloids can be slimy or gummy

Flavor Enhancement

- The neutral, clean flavor of eggs enhances fat-soluble flavors
- Some starches and hydrocolloids can mute flavors

Culinary Functionality:

Aeration

Emulsion

Coagulation

Aeration and Foaming

When beaten, egg white proteins denature and form a matrix encapsulating air bubbles, foaming up to 6-8 times original volume.

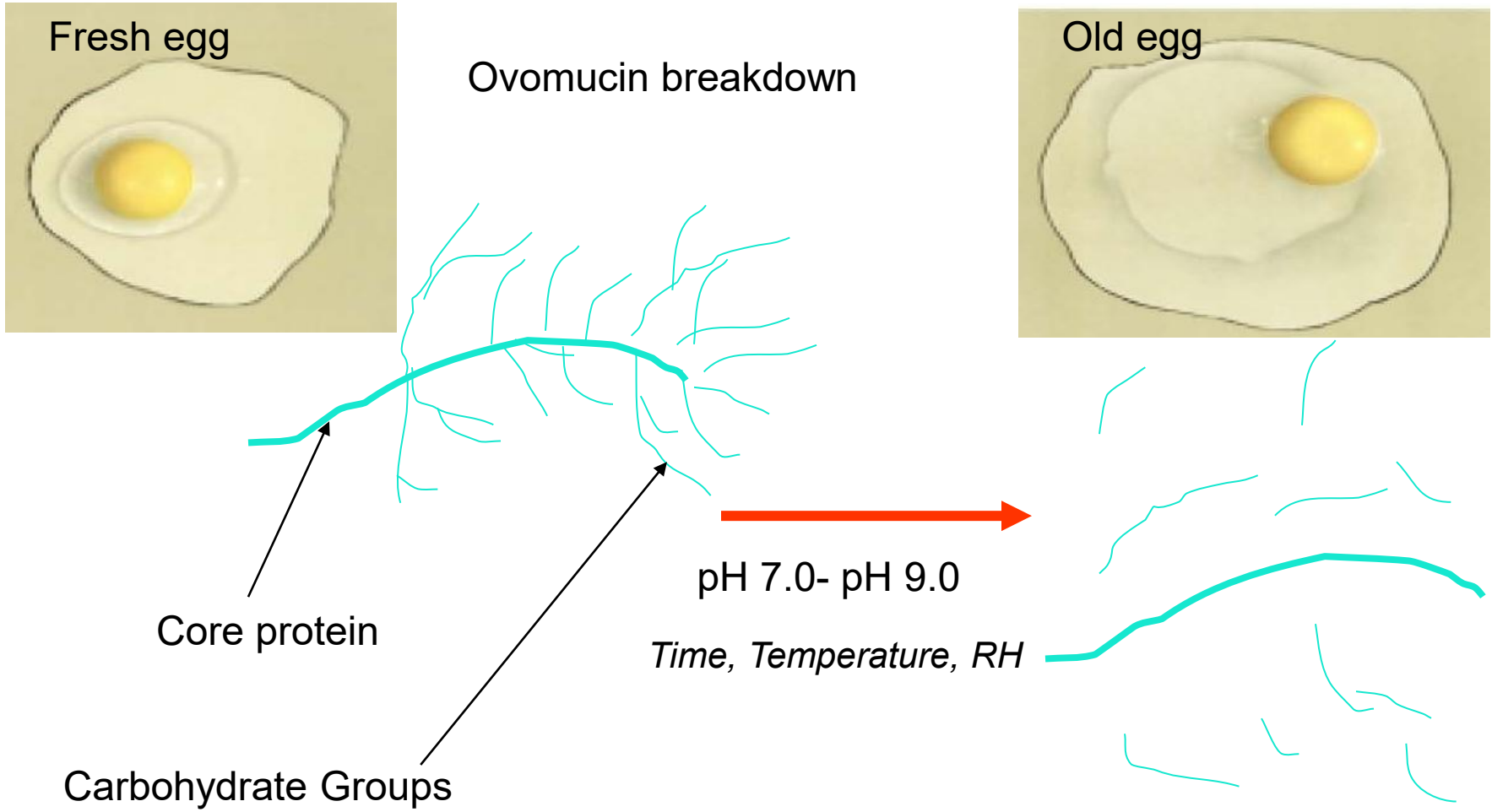
Variables that affect foaming:

- Fat contamination
- Over beating
- Pasteurization increases whip time
- Temperature during foam formation
- Excessive heat during cooking
- Egg quality
- Hen age
- Increased solids increases volume & stability
- Higher pH decreases foaming ability

Ingredient Affect on Egg White Foams

Ingredient	Effect
Water	Increases initial foam volume, decreases stability
Acids	Increase protein denaturation, aid initial foaming
Salt	Aids in protein denaturation and initial foaming
Sugar	Delays initial foaming, stabilizes foams during heating
Flour	Aids in structure stabilization
Gums	Aid in foam stabilization, aid moisture regulation and prevent foam shrinkage
Fats	Contamination from yolks or residue on equipment decreases volume

Impact of Egg Age & Quality



Foaming and Surface Activity

- Foam ability (volume) due to ovalbumin egg white protein - 55% of egg white protein
- Foam stability due to ovomucin egg white protein – elastic and holds on to air in the oven
- Yolk contamination -”fat bullets” destroy foam

Failed Angel Food Cake

Whip-It, Whip-It, If You Can

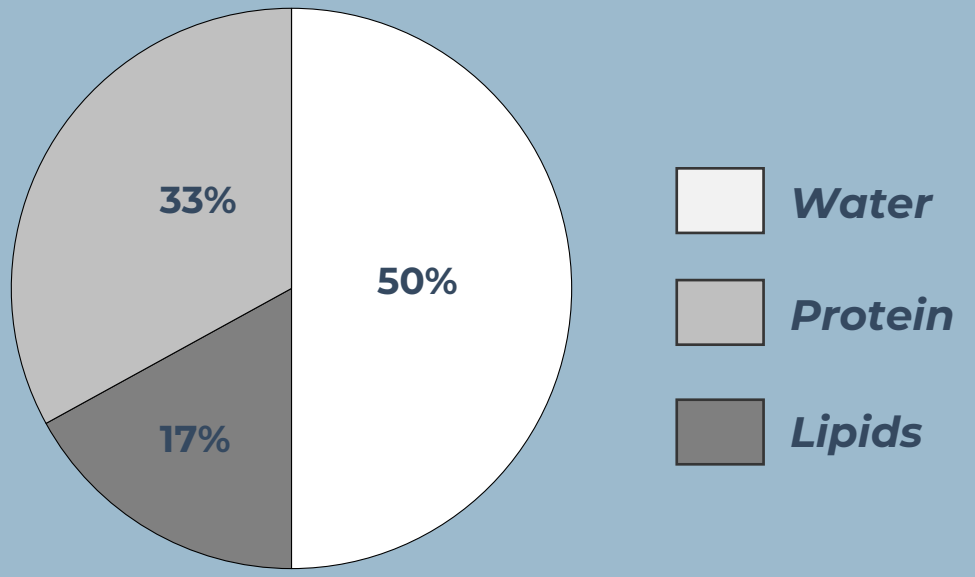
Pure Egg White

Yolk-Contaminated Egg White

Emulsification

Egg Yolk Composition

- Approximately 50% water, 17% protein (mainly ovovitellin), 33% lipids (mainly triglycerides, lecithin [phospholipids] and cholesterol)
- Minerals: iron, phosphorus, calcium, manganese, iodine, copper and zinc
- Vitamins A and D, B_{12}, E, biotin, choline, folic acid, inositol, pantothenic acid, pyridoxine and thiamin
- Xanthophyll: main yellow pigment

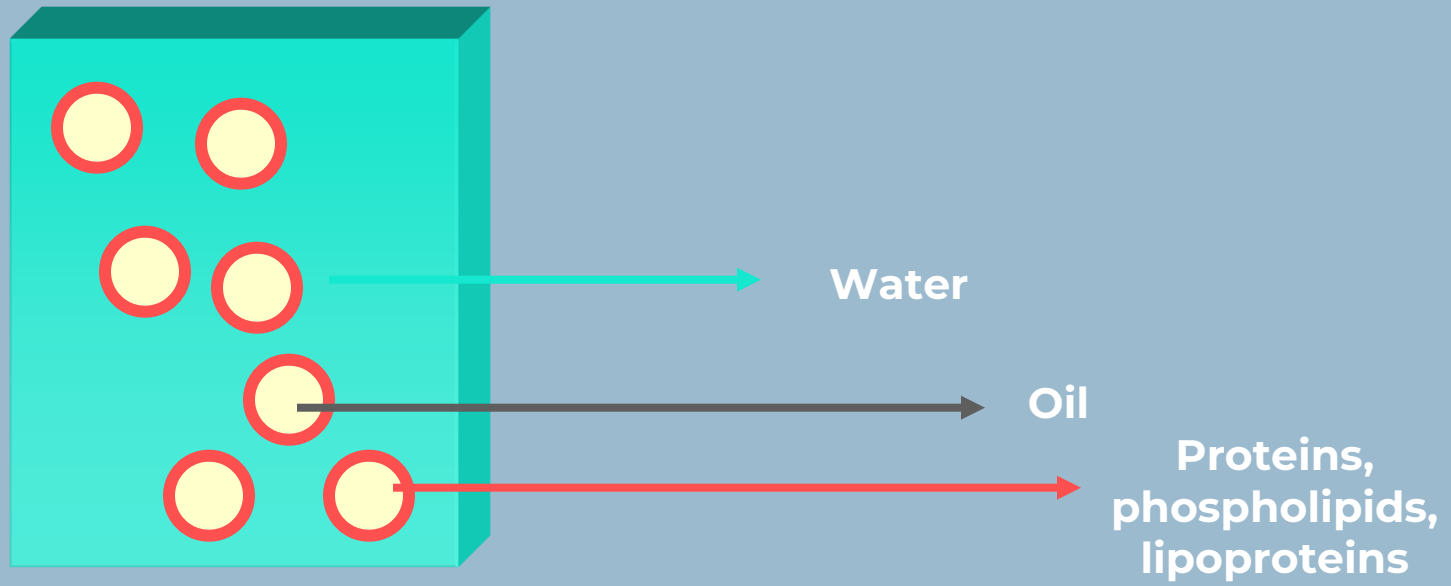


Egg Yolk Composition

Emulsions + Surface Activity

3 Components necessary for an oil-in-water emulsion

- Oil
- Water
- Interface, proteins, phospholipids, lipoproteins



Emulsification

A stable mixture of two immiscible liquid phases, one which is dispersed in the other

- Egg yolks can be used to fortify whole egg blends to increase emulsifying action
- No essential differences are found in emulsifying properties of dried whole egg and yolk and fresh liquid eggs

Emulsification

Whole egg, albumen and yolk can serve as extremely effective natural emulsifiers.

- Acts as a stabilizing agent by reducing surface tension
- Reduces the force required to create the droplets that comprise an emulsion
- Acts as a thickening agent, increasing viscosity and aids in emulsion stability

Factors Effecting Emulsification

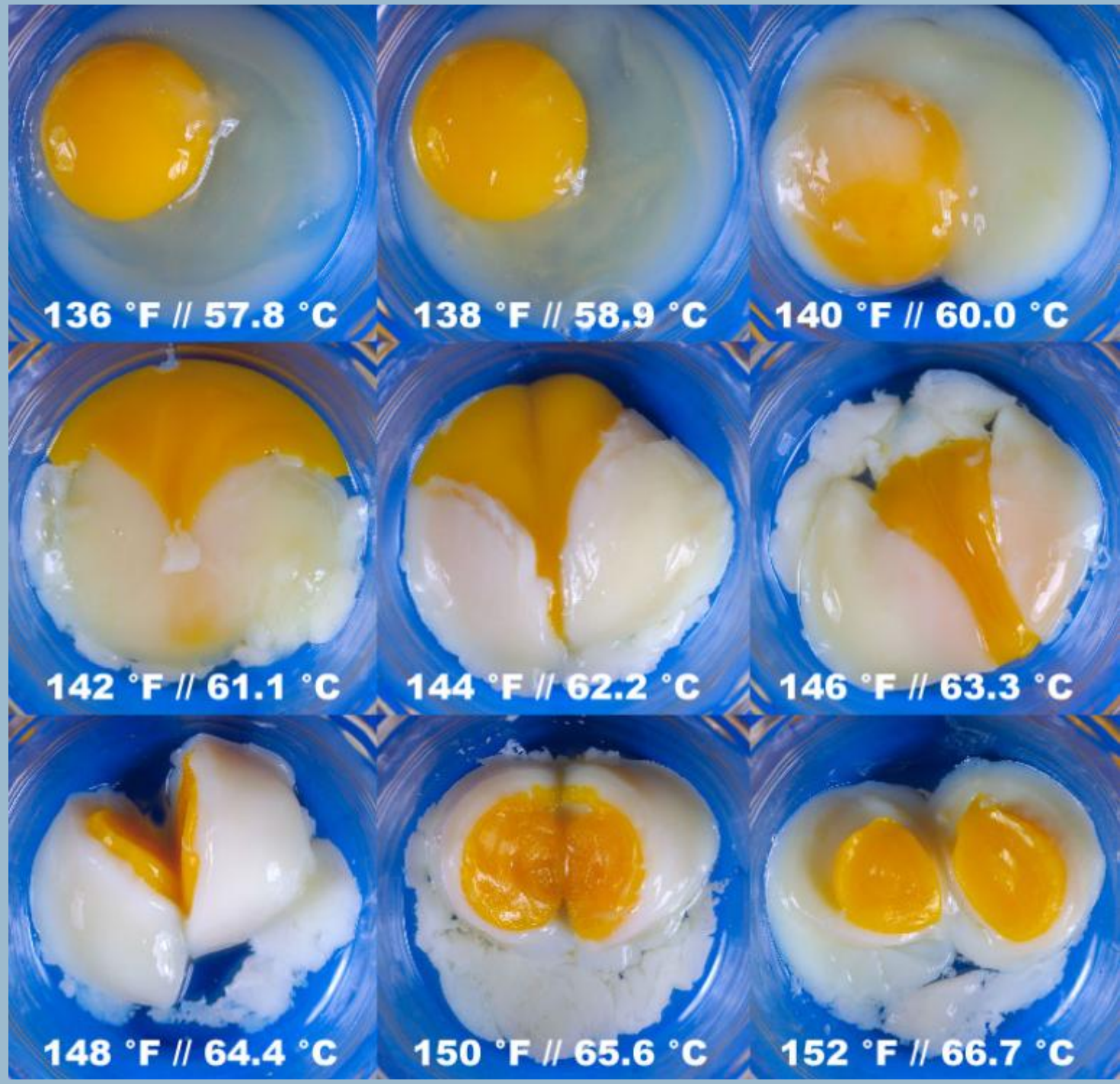
Variable	Effect
Increased yolk	More viscous, stable emulsion
Freezing	Reduces emulsification capacity; addition of salt or sugar before freezing helps retain emulsification properties
Drying	Reduces emulsification capacity; addition of sugar before drying helps
High temperatures	Reduces emulsification capacity
Acid	Decreases emulsification capacity
Salt	Increases emulsion stability
Increased viscosity	Increases emulsion stability
Higher sheer	Decreases droplet size, increasing emulsion stability
Enzyme modification	Enhanced emulsification and stability in high-heat applications, increases viscosity. Requires label declaration

Coagulation

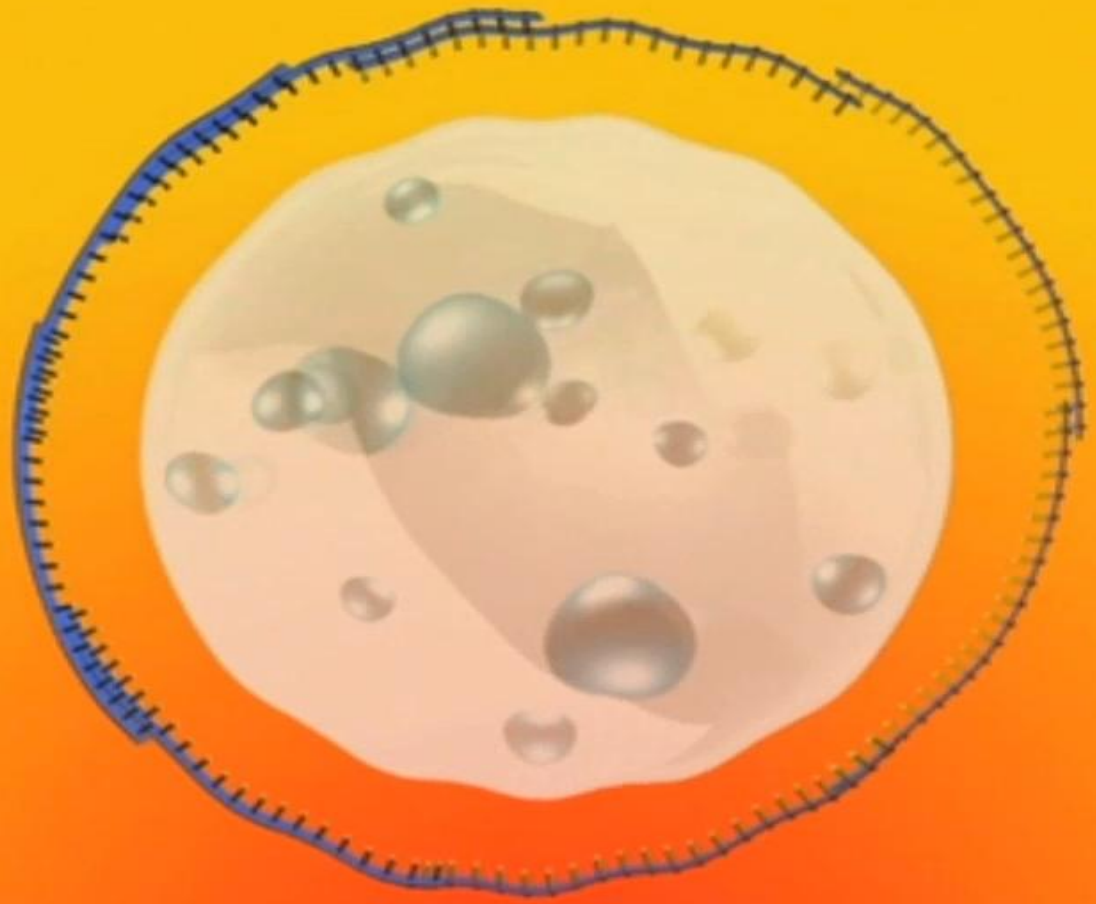
Coagulation

Egg whites and yolks contain different proteins that coagulate at different temperatures.

Egg Component	Temperature of Coagulation
Whole egg	62.2°C – 70°C 144°F - 158°F
Egg white	62.2°C – 65°C 144°F - 149°F
Egg yolk	65°C – 70°C 149°F - 158°F



EGG PROTEINS



Egg Products

Egg products are versatile ingredients derived from eggs that have been processed and transformed into various forms to meet the needs of commercial food production, culinary applications, and consumer convenience. These products offer the nutritional benefits and functional properties of eggs while providing added convenience, safety, and versatility in handling and storage.

Types of Egg Products

1. Pasteurized Whole Egg: Pasteurized whole egg is made from fresh eggs that have undergone a pasteurization process to eliminate harmful bacteria while preserving their nutritional content and functional properties.

- **Formats:** Available in dry (powdered), and liquid pasteurized, refrigerated or frozen forms, providing convenience and extended shelf life for food manufacturers and consumers.
- **Applications:** Widely used in baking, cooking, and food processing applications where whole eggs are required as ingredients, such as cakes, muffins, quiches, and sauces.

Types of Egg Products

2. Egg Whites: Egg whites, also known as albumen, are the clear, protein-rich component of eggs that surround the yolk.

- **Formats:** Available in dried (powdered), and liquid pasteurized, refrigerated or frozen forms, offering flexibility and ease of use in various culinary and industrial applications.
- **Applications:** Commonly used as a binding agent, leavening agent, or foaming agent in baking, confectionery, and food processing. Egg whites are also popular in fitness and health-conscious recipes for their low-fat, high-protein content.

Types of Egg Products

3. Egg Yolks: Egg yolks are the yellow, nutrient-rich component of eggs that contain fat, cholesterol, vitamins, and minerals.

- **Formats:** Available in dried (powdered), and liquid pasteurized refrigerated or frozen (sugared or salted, usually at 10%) forms, providing convenience and consistency in recipes.
- **Applications:** Used for their emulsifying, thickening, and flavor-enhancing properties in a wide range of culinary applications, including sauces, custards, pastries, and ice creams. Egg yolks contribute richness, creaminess, and color to dishes.

Benefits of Egg Products:

Safety: Pasteurization and controlled processing ensure the safety of egg products by reducing the risk of foodborne illnesses associated with raw eggs.

Convenience: Pre-packaged and processed egg products offer convenience, consistency, and extended shelf life compared to fresh eggs, reducing waste and saving preparation time.

Versatility: Egg products can be easily incorporated into a variety of recipes and food formulations, providing functional properties such as emulsification, foaming, binding, and flavor enhancement.

Nutritional Value: Egg products retain the nutritional benefits of fresh eggs, including high-quality protein, essential vitamins (such as B12 and D), minerals (such as iron and zinc), and healthy fats (found in egg yolks).

U.S. Egg Products

Whole Egg Availability & Applications

Product	Frozen	Dried	Applications
Whole Egg	✓	✓	• Bakery, Doughs, Pie Bases & Fillings • Baby Foods • Noodles • Foodservice
Salted Whole Egg	✓		
Whole Egg with/without Free Flow		✓	
Whole Egg with Citric Acid	✓		

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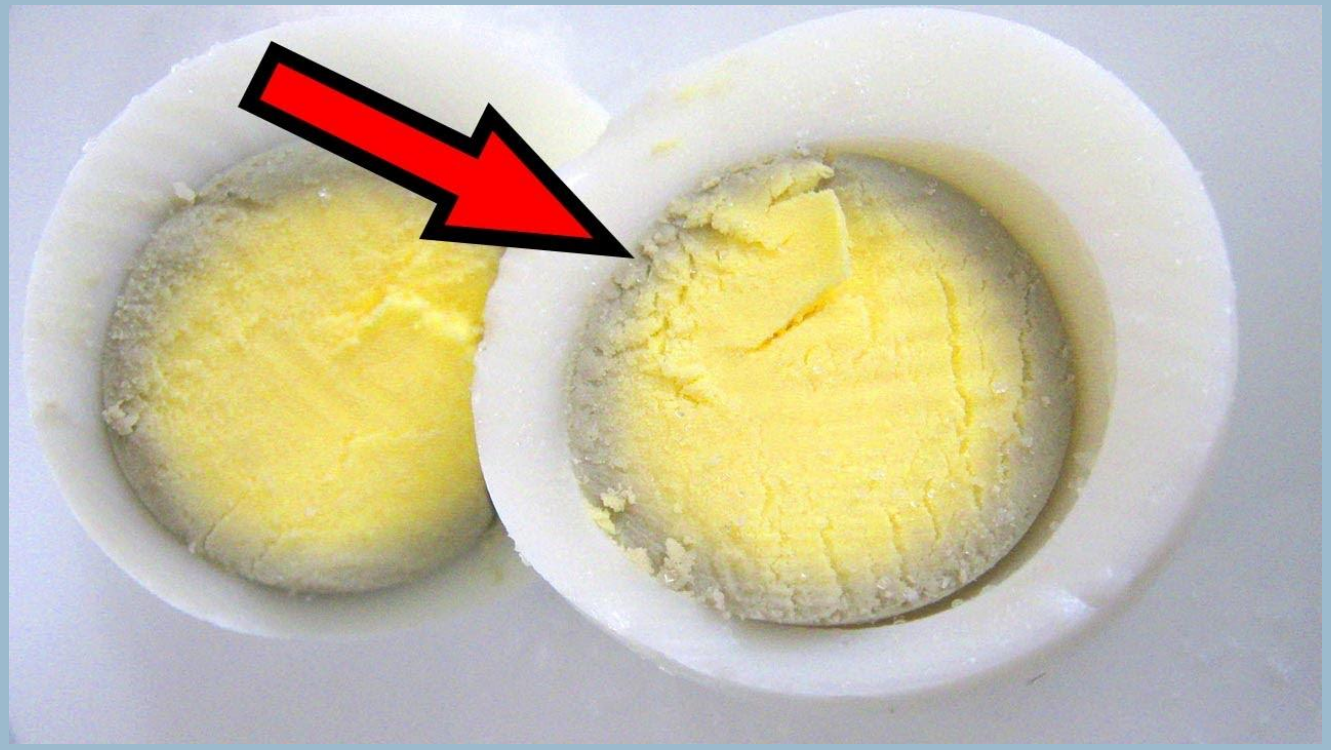
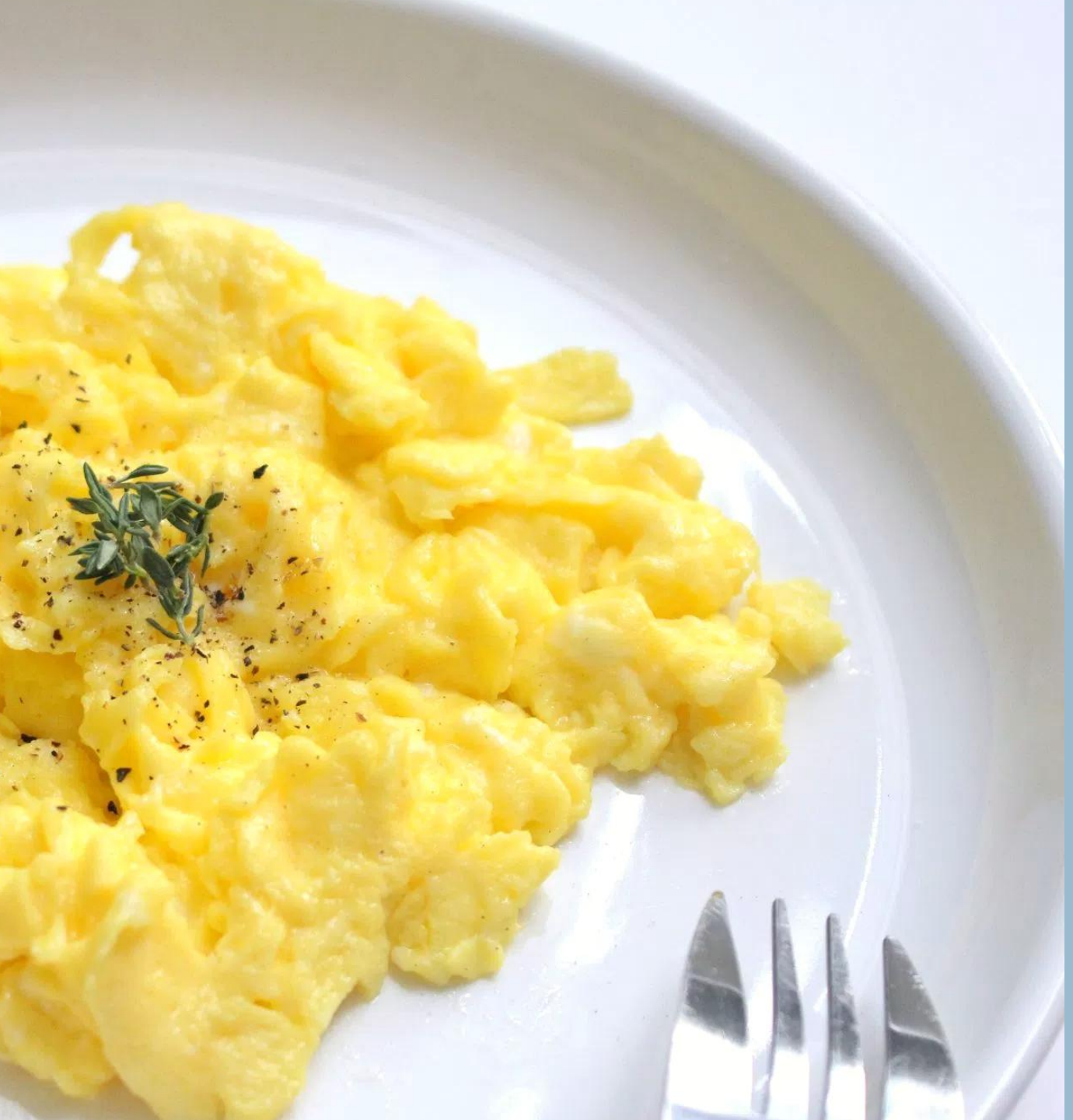
Whole Egg with Citric Acid

Green/grey color is result of sulfur and iron compounds reacting at the surface of the yolk

- Occurs when eggs are held at high heat for extended period of time
- Although unappealing, eggs have normal flavor
- Same reaction can occur in large quantity of scrambled eggs held over heat for buffet service.
- Scrambled eggs made with Liquid/Frozen whole eggs with citric acid will not turn green.





Whole Egg with Citric Acid

Scrambled eggs made with Liquid/Frozen whole eggs with citric acid will not turn green.

Egg White Availability & Applications

Product	Frozen	Dried	Applications
Standard Egg White	✓	✓	Pie Fillings, Baby Foods, Noodles
High-Whip (Angel) Egg White	✓	✓	Bakery, Pie Toppings, Confections, Nougat, Angel Food Cake
High-Gel Egg White		✓	Surimi, Composite Meats, Snack Bars





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Egg Yolk Availability & Applications

Product	Frozen	Dried	Applications
Egg Yolk	✓	✓	Mayonnaise, Salad Dressings & Savory Sauces, Noodles, Baby Foods, Foodservice, Bakery, Doughs
Salted Egg Yolk (10% Salt)	✓		Mayonnaise, Salad Dressings & Savory Sauces
Sugared Egg Yolk (10% Sugar)	✓		Custards, Flan & Sweet Sauces, Bakery, Doughs
Enzyme Modified Egg Yolk (prevents oil separation under extreme conditions, eliminates the need for added emulsifiers and gums)	✓		Mayonnaise, Salad Dressings & Sauces

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Specialty & Pre-Cooked Egg Ingredients

Product	Frozen	Dried	Applications
Whole Egg with Citric Acid	✓		Scrambled Egg Buffet Service
Scrambled Egg Mix	✓	✓	Scrambled Eggs
Precooked Patties and Omelets	✓		Breakfast Sandwiches
Boil-In-Bag Scrambled Eggs	✓		Conveniently Cook Large Batches of Scrambled Eggs
Precooked Scrambled Eggs	✓		Wraps/Bowls, Breakfast Bowls, Salad Toppings

Regulated by FDA, Certified for Export by AMS

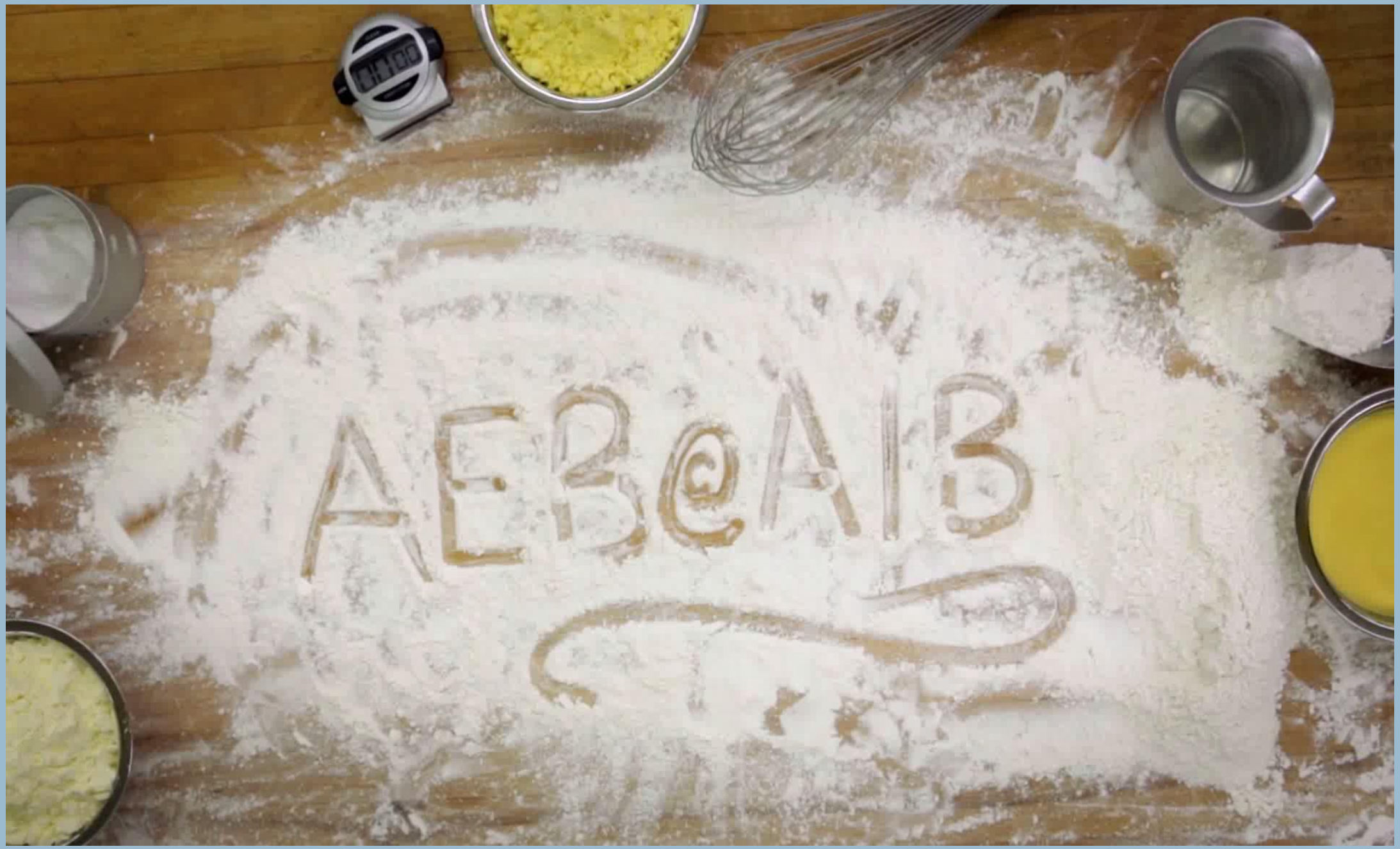
Key Targets – Food Service

- Restaurants (Quick Service, Casual, Fine Dining)
- Lodging (Hotel)
- Elementary Schools, College & University
- Healthcare, Senior Feeding
- Grocery Stores (Restaurants & Self Service)

Conclusion

Egg products play a vital role in modern food production and culinary practices, offering convenience, safety, versatility, and nutritional value. Whether in liquid, dried, refrigerated, or frozen form, these products provide chefs, bakers, and food manufacturers with the tools they need to create delicious and nutritious dishes while meeting the demands of consumers for quality and convenience.

Converting Shell Eggs to Egg Product Equivalencies


AEBOAIB

Converting from Liquid to Dried Eggs

Egg Product Equivalency

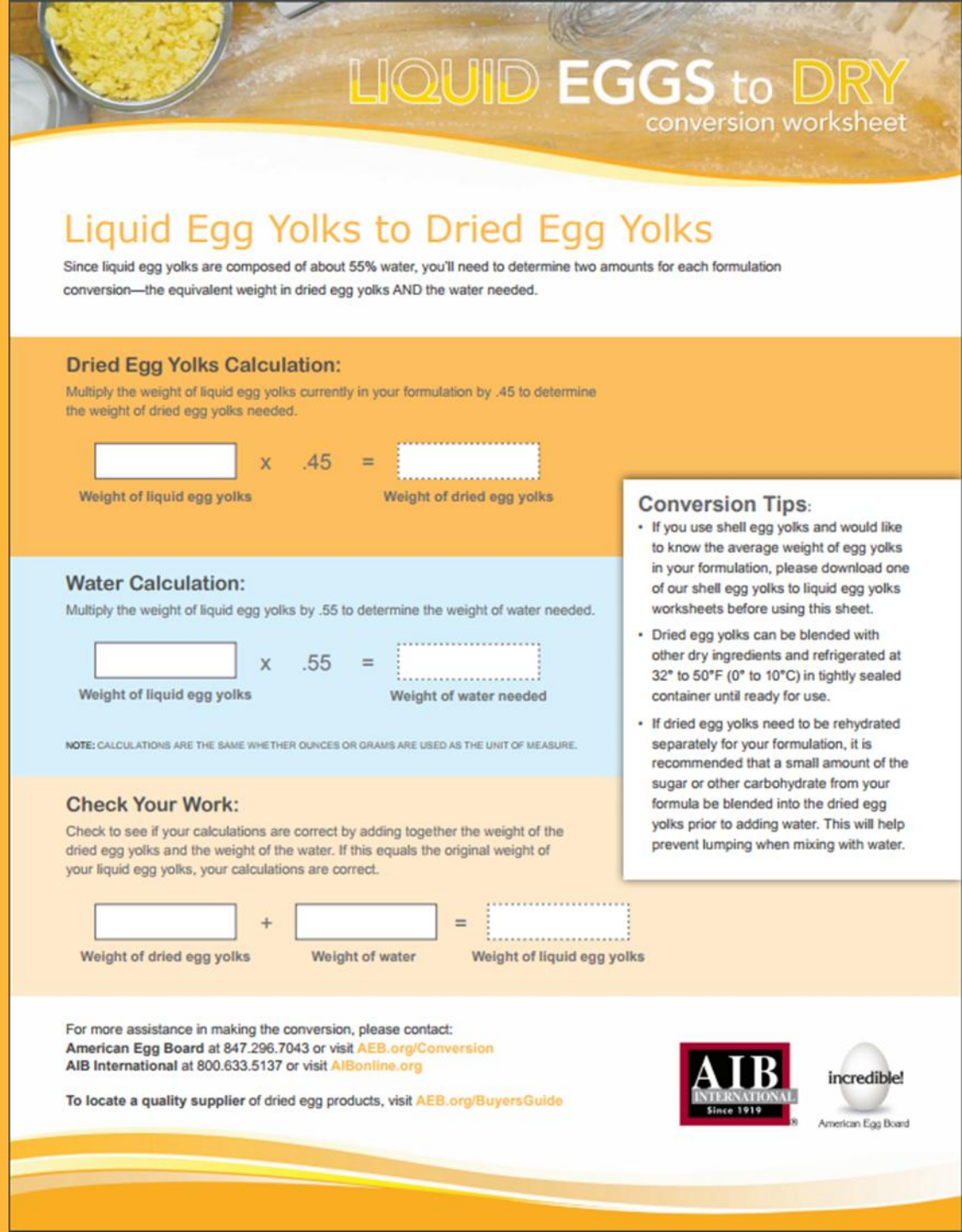
Shell Egg to Liquid Egg

- Weight for Weight equivalency

Shell Egg to Dry Egg

- Whole Egg = 1 part powder + 3 parts water
- Egg White = 1 part powder + 7 parts water
- Egg Yolk = ~ 1 part powder + ~ 1 part water

www.AEB.org/Conversion



Liquid/Frozen Egg Product Equivalency

Product	# of Large Size Shell Eggs	# of Cups	Pound Equivalent	Kilo Equivalent
Liquid/Frozen Whole Egg	9 eggs	2 cups	1 lb	0.45 kg
Liquid/Frozen Egg Yolk	22 eggs	2 cups	1 lb	0.45 kg
Liquid/Frozen Egg White	14 eggs	2 cups	1 lb	0.45 kg

Dried Egg Product Equivalency

One Kilo* Dried Eggs =	Whole Eggs	Egg Whites	Egg Yolks
	83	257	111

* based on 50 grams large whole egg, 17 grams large egg white, 33 grams large egg yolk

Product	Amount of dried product to equal 1 unit from fresh	Amount of water needed to reconstitute
Dried Whole Egg Standard	12.1 g	37.9 g
Dried Egg Yolk Standard	9.0 g	8.4 g
Dried Egg White Standard	3.9 g	28.6 g
Dried Egg White High Whip (Angel)	3.9 g	28.6 g

www.AEB.org/Conversion

Dried Egg Products

- Whole egg solids
- Fortified whole egg solids
- Egg yolk solids
- Egg white solids

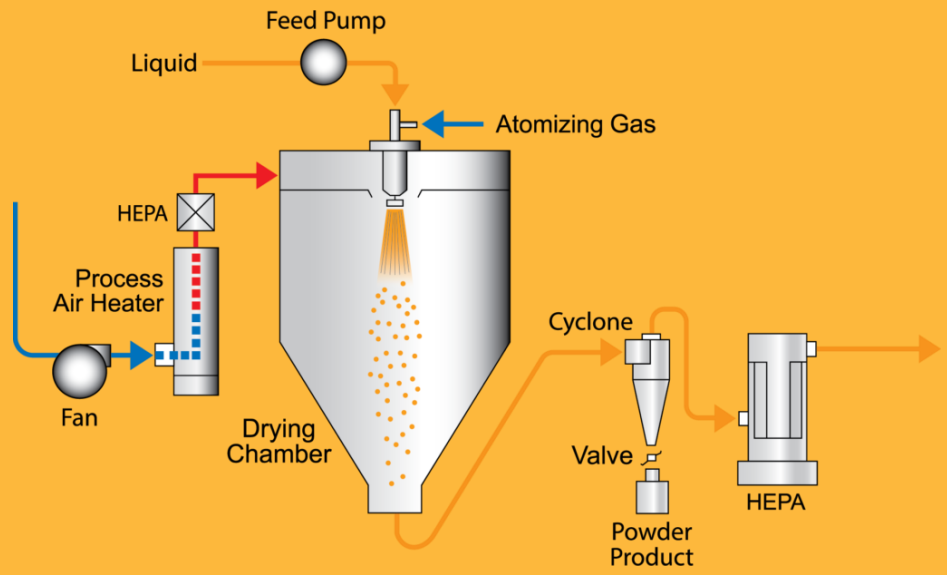
Dried Eggs

Advantages
Long shelf life (>1 year), stable and mixable

Storage & Handling
Keep in dry storage away from extreme temperatures and strong odors
May be mixed with other dried ingredients

Spray Drying

- No significant differences are found between binding properties of dried whole egg and yolk and fresh liquid eggs
- Whole Eggs & Yolks are pasteurized BEFORE drying
- Egg Whites are pasteurized AFTER drying to preserve foaming functionality



Best Practices - Dried

By having most of the moisture removed, dried egg products have a longer shelf life and are shelf stable. Dried egg products readily reconstitute and easily blend with other dry ingredients.

- Dried whole eggs should be kept cool, less than 50°F (10°C) to maintain quality.
- Unopened dried eggs have a one year shelf life.
- Once containers of dried eggs have been opened, reseal tightly to prevent contamination and absorption of moisture.
- To hydrate dried egg whites, it’s best to mix together dried egg whites with sugar or starch, from the recipe, before adding water.

Liquid / Frozen Product Packaging

Liquid/Frozen Egg Products

- Aseptic – sterile environment –provides extended shelf-life without refrigeration
- Non-aseptic – clean environment – yolk, whole egg, egg white – refrigerated

Bags/pouches – 8 oz, 1 lb, 2 lb, 5 lb, 8 lb,

Boxes/barrels - 10lb, 40 lb, 100 lb, 200 lb, 400 lb

Totes - 1000 lb, 2000 lb, 3000 lb

Tankers/rail cars – 10,000 lb – 120,000 lb

Other Frozen Egg Packaging

Best Practices - Frozen

- **Store** frozen egg products **up to one year** at 0 °F (-17°C) or lower. After thawing, do not refreeze.
- **Thaw** frozen egg products in the refrigerator or under cold running water. DO NOT THAW ON THE COUNTER. Once thawed, product must be **stirred well** before using.
- **Observe** "use-by" dates.
- For liquid products without an expiration date, store **unopened containers** at 40°F (4°C) or below for up to 7 days (not to exceed 3 days after opening).

How to Thaw Frozen Eggs

- **Thaw** frozen egg products in the refrigerator or under cold running water.
- DO NOT THAW ON THE COUNTER.
- Once thawed, product must be stirred well before using.

Refrigerator Thawing

Running Cold Water Thawing

Functional Egg Ingredients

1. Enzymatically Modified Egg Yolks: Egg yolks that have been treated with enzymes to alter their properties, often resulting in enhanced emulsification capabilities and improved stability in various culinary applications.

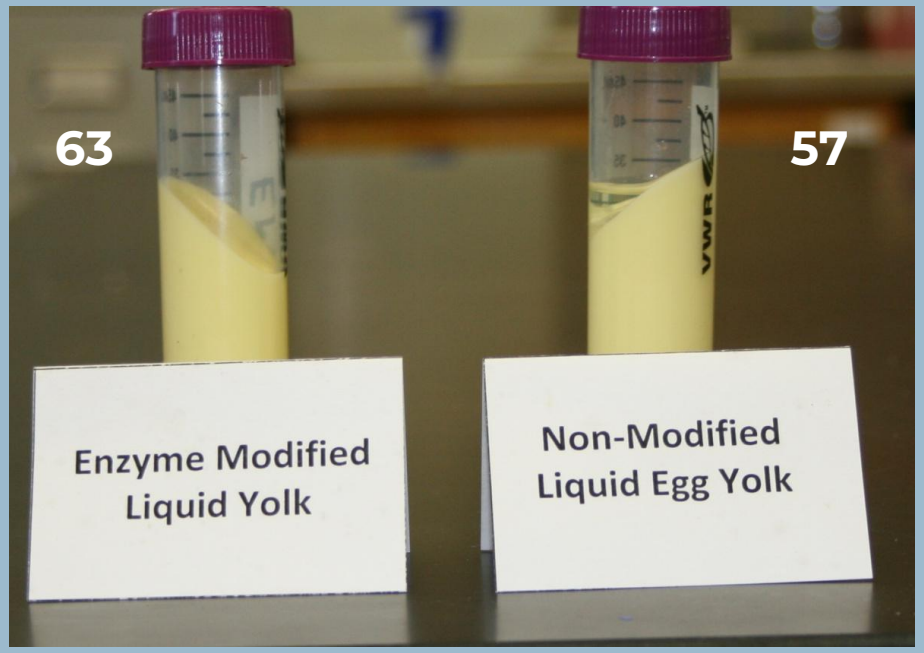
2. High-Whip Egg Whites: Heat treated egg whites, characterized by a high volume and stable foam structure, commonly used in baking and confectionery for leavening and lightening effects.

3. High Gel Egg Whites: Egg whites that have been heat-treated to induce gelation, resulting in a firm and stable gel structure suitable for applications such as binding ingredients in formulations like meringues or soufflés.

Enzymatically Modified Egg Yolks and Whole Eggs

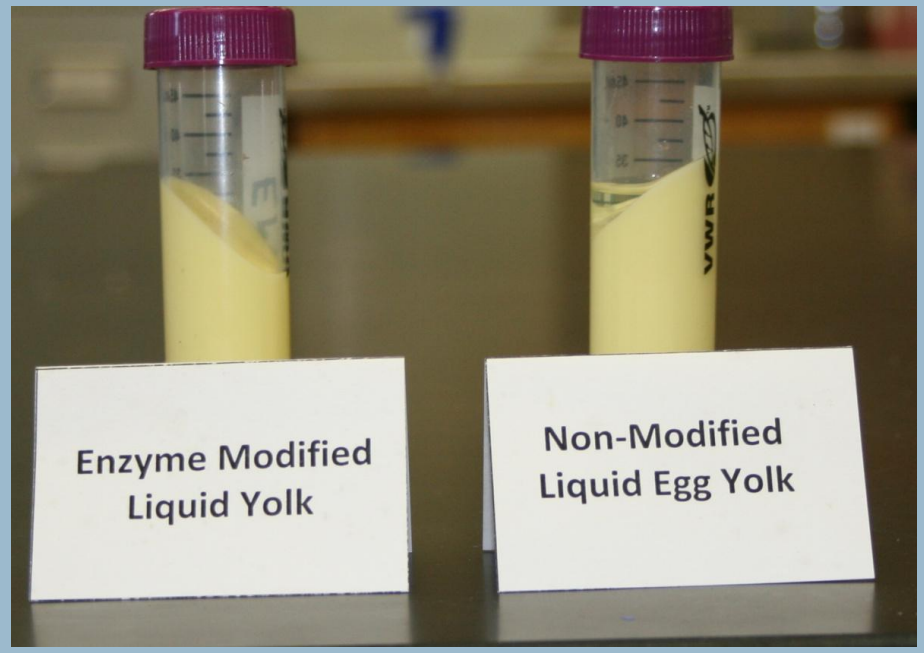
- **Improved Emulsification:** Enzymatic modification can enhance the emulsification properties of egg yolks. Emulsifiers help stabilize mixtures of two or more liquids that typically don't blend together, such as oil and water. Enzymatically modified egg yolks may create more stable emulsions, making them valuable in products like mayonnaise, salad dressings, sauces, and baked goods.
- **Enhanced Stability**: The enzymatic treatment can increase the stability of egg yolks, allowing them to withstand various processing conditions, including temperature changes, shear forces, and storage. This improved stability can lead to better texture, appearance, and shelf life in food products.
- Overall, enzymatically modified egg yolks play a crucial role in food processing and product development by providing improved functionality and stability, as well as offering clean label options for formulators and consumers alike.
- **Customized Functionalities**: Depending on the desired application, the enzymatic modification process can be tailored to achieve specific functionalities. For example, it can adjust the viscosity, foam stability, or gelation properties of egg yolks to meet the needs of different food formulations.
- **Clean Label Options**: Enzymatically modified egg yolks may offer a clean label alternative to traditional emulsifiers and stabilizers, as they rely on natural enzymatic processes rather than synthetic additives. This can be appealing to consumers seeking simpler ingredient lists and more natural food products.
- **Versatile Applications**: Enzymatically modified egg yolks find use in a wide range of food products, including dressings, sauces, desserts, bakery items, and processed meats. They contribute to the desired texture, mouthfeel, and sensory experience of these foods while providing functional benefits to manufacturers.

Enzyme Modified Egg Yolk



Brookfield Viscometer Results

⬆ viscosity = ⬆ thickness



Oil separation after centrifuge

High-Gel Egg Whites

- **Gelation Process:** High-gel egg whites undergo a specific heat treatment process that induces gelation, resulting in the formation of a firm and stable gel structure. This process typically involves heating the egg whites to a specific temperature for a certain duration.

- **Firm Texture:** The gelation of egg whites leads to the development of a firm texture, which is desirable in various food applications where structure and stability are important. This firmness allows high-gel egg whites to hold their shape well and withstand handling and processing without breaking down.

- **Binding Properties:** High-gel egg whites exhibit strong binding properties due to their gel-like consistency. This makes them valuable as binders in food formulations where cohesion and adhesion are necessary, such as in meat products, baked goods, and certain confections.

High-Gel Egg Whites

- **Leavening Agent:** In baking, high-gel egg whites can serve as a leavening agent, contributing to the rise and texture of baked goods. When whipped and incorporated into batters or doughs, the air trapped within the gel structure expands during baking, helping to create light and airy textures in products like cakes, soufflés, and meringues.

- **Stabilizing Agent:** The gel structure of high-gel egg whites provides stability to food systems by preventing ingredient separation, syneresis, or collapse. This stabilizing effect is beneficial in applications such as mousses, custards, and ice creams, where maintaining a smooth and creamy texture is essential.

- **Extended Shelf Life:** The gelation process can contribute to the extended shelf life of food products by improving their structural integrity and resistance to physical and chemical changes over time. This helps maintain the quality and freshness of the products throughout storage and distribution.

High-Gel Egg Whites

- **Versatile Applications:** High-gel egg whites find use in a wide range of food products, including baked goods, confectionery, processed meats, dairy products, and savory dishes. Their ability to provide structure, stability, and leavening makes them valuable ingredients in both commercial food production and home cooking.

- Overall, high-gel egg whites offer unique functional properties that contribute to the texture, stability, and quality of various food products, making them indispensable in many culinary applications.

High-Whip Egg Whites

- **Definition:** High-whip egg whites refer to egg whites that have been whipped to a stiff peak consistency, resulting in a voluminous and stable foam.

- **Whipping Process:** Achieving high-whip egg whites involves vigorously beating egg whites with a whisk or mixer until they reach a stiff peak stage. This process incorporates air into the egg whites, creating a foam with increased volume and a light, fluffy texture.

- **Stiff Peak Stage:** High-whip egg whites are characterized by stiff peaks that stand upright when the whisk or beater is lifted from the mixture. At this stage, the egg whites hold their shape well and do not deflate easily.

High-Whip Egg Whites

- **Leavening Agent:** In baking, high-whip egg whites serve as a natural leavening agent, helping to lighten and aerate batters and doughs. When folded into cake or soufflé batter, the air trapped within the whipped egg whites expands during baking, resulting in a light and airy texture.

- **Binding Agent:** High-whip egg whites also act as a binding agent, helping to hold ingredients together in recipes such as meringues, mousses, and chiffon cakes. The protein structure of the whipped egg whites provides stability and structure to these delicate desserts.

- **Versatility:** High-whip egg whites can be used in both sweet and savory dishes, offering versatility in culinary applications. They can be flavored with sugar, vanilla, or other extracts for sweet preparations, or seasoned with salt and herbs for savory dishes.

High-Whip Egg Whites

- **Storage:** Whipped egg whites should be used promptly after whipping for best results, as they can lose volume and stability over time. However, they can be stored in the refrigerator for a short period if necessary, though they may deflate slightly upon standing.

- **Tips for Success:** Achieving high-whip egg whites requires clean equipment free from any traces of grease or fat, as even small amounts can inhibit the egg whites from whipping to their full potential. Room temperature eggs whip up more easily than cold eggs, so it's best to let them come to room temperature before whipping.

- Overall, high-whip egg whites are a versatile ingredient prized for their leavening and binding properties, making them essential in a wide range of baking and cooking applications. With proper technique and handling, they can elevate desserts and dishes with their light, airy texture and stable foam

High-Whip Egg Whites

- Spray dried high-whip egg white is pasteurized in a hot-room at 53.9°C/129.2°F for 7-10 days
- **Sodium lauryl sulfate** is added to improve whipping properties
- Liquid/frozen egg whites contain **triethyl citrate** to improve whipping properties

Questions?