

QUICK
REFERENCE
GUIDE

Food Formulators Guide to Egg Products



the
INCREDIBLE EGG

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Egg Product Formats Include

- Liquid Refrigerated
- Liquid Frozen
- Dried
- Pre-Cooked, Specialty and other value-added convenience products



Operational Advantages of Egg Products

Liquid Egg Products

- Quick and easy to use
- Can be added with liquid ingredients
- No need to adjust moisture in formula
- 12-week shelf life at 39°F or frozen for 1+ years (unopened)
- For foaming, select high-whip egg whites, which are pasteurized differently than other egg products

Dried Egg Products

- Reduce cold storage space – no refrigeration required
- Increased shelf life – simplifies inventory tracking
- Control or reduce moisture in product
- For foaming, select high-whip egg whites, which are pasteurized differently than other egg products
- For successful dispersion, dried egg products are best mixed with sugar or starch before adding liquids, or alternatively can be pre-hydrated with water

LIQUID EGG PRODUCTS (REFRIGERATED/FROZEN)

EGG PRODUCT	SOLIDS CONTENT - %	PH
PLAIN LIQUID WHOLE EGG	24 +/-0.5	6.8 – 7.9
PLAIN LIQUID YOLK	43.0 – 45.0	5.6 – 7.0
PLAIN LIQUID EGG WHITES	12 +/-1.0	8.0 – 9.5
PLAIN DRIED WHOLE EGG	95	7.9 – 9.3
DRIED WHOLE EGG W/FREE-FLOW AGENT *	97	7.5 – 9.0
PLAIN DRIED EGG YOLKS	95	5.6 – 7.0
EGG YOLKS WITH FREE-FLOW AGENT *	97	6.0 – 7.0
SPRAY DRIED EGG WHITES	92	6.0 – 8.8

* Egg Products with Free-Flow typically contain less than 2% sodium silicoaluminate

AVAILABLE LIQUID & FROZEN EGG PRODUCTS

<p>WHOLE EGGS</p> <p>Whole Eggs Whole Eggs & Yolks with Corn Syrup Whole Eggs with Citric Acid Whole Eggs with Corn Syrup Whole Eggs with Yolk Added Enzyme Modified Whole Egg Extended Shelf Life Whole Eggs Scrambled Egg Mix Salted Whole Eggs Sugared Whole Eggs</p>	<p>EGG YOLK</p> <p>Egg Yolk Enzyme Modified Egg Yolks Extended Shelf Life Egg Yolks Salted Egg Yolks Sugared Egg Yolks</p>	<p>SPECIALTY PRODUCTS, CERTIFICATIONS & CLAIMS</p> <p>Cage-Free Products Free-Range Products Kosher Products Organic Products Halal Products</p>
	<p>EGG WHITE</p> <p>Extended Shelf Life Egg Whites High-Gel Egg Whites High-Whip Egg Whites Salted Egg Whites</p>	<p>PRECOOKED & VALUE ADDED</p> <p>Hard-Boiled Eggs Omelets Patties IQF Scrambled Eggs</p>

AVAILABLE DRIED EGG PRODUCTS

<p>WHOLE EGGS</p> <p>Blends of Whole Egg and/or Yolk with Carbohydrates (sugar or corn syrup added) Dried Egg Mix Extended Shelf Life Scrambled Egg Mix Free-Flowing Scrambled Egg Mix Stabilized (glucose-free) Whole Egg Solids Whole Egg Solids Whole Egg Solids (with free-flow agent added)</p>	<p>EGG YOLK</p> <p>Egg Yolk Solids Enzyme Modified Egg Yolk Solids Enzyme Modified Whole Egg Solids Free-Flowing Egg Yolk Solids (with free-flow agent added) Stabilized (glucose-free) Egg Yolk Solids</p>	<p>SPECIALTY</p> <p>Certifications & Claims Cage-Free, Free-Range Kosher Organic</p>
	<p>EGG WHITE</p> <p>High-Gel Egg White Solids High-Whip Egg White Solids Instant Egg White Solids Pan Dried Albumen Spray-Dried Egg White Solids</p>	

CONVERTING FROM SHELL EGG TO LIQUID EGG OR DRIED EGG PRODUCTS

	FROZEN PRODUCT (LB)	SHELL EGG* (QUANTITY)	EGG SOLIDS (LB)
WHOLE	1	9	0.25 Solids + 0.75 Water
YOLKS	1	26	0.45 Solids + 0.55 Water
WHITES	1	14	0.12 Solids + 0.88 Water

* Based on 56g shell egg (25.8 oz. per dozen) yielding 50g whole, 17g yolk, and 33g white per egg.

Functional Properties of Egg Products



Foaming

Egg Whites, Egg Yolk, Whole Egg

Aeration
Foaming

Leavening
Whipping



Aeration & Crystallization Control

Egg Whites, Egg Yolk, Whole Egg

Crystallization Control
Freezability



Flavor, Aroma, & Taste

Egg Yolk, Whole Egg

Aroma
Flavor
Richness

Taste & Sensory
Experience



Nutrient Fortification

Egg Whites, Egg Yolk, Whole Egg

Fortification / Protein
Enrichment



Emulsification

Egg Yolk, Whole Egg

Emulsification
Shelf Life Extension
Tenderization

Texture



Adhesion, Coating & Glazing

Egg Whites, Egg Yolk, Whole Egg

Adhesion
Coating

Glossy Finish
Insulation



Coagulation

Egg Whites, Egg Yolk, Whole Egg

Binding
Coagulation

Structure
Thickening



Color & Browning

Egg Whites, Egg Yolk, Whole Egg

Appearance
Browning

Color

Other Functional Properties

Antimicrobial
Egg White

Humectancy
*Egg Yolk
Whole Egg*

Clarification
Egg White

Moisturizing
*Egg Yolk
Whole Egg*

Drying
Egg White

Edible
Packaging
Egg White

pH Stability
*Egg White
Egg Yolk
Whole Egg*

Foaming

INGREDIENTS	EFFECT
WATER	Increases initial foam volume, decreases stability
ACIDS	Increase protein denaturation, aid initial foaming
SALT	Decreases foam stability by weakening the latticework structure of the protein bonds and causes the foam to lose moisture and dry out. Add salt with other ingredients
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; aid in foaming, reduce surface tension
FATS	Contamination from yolks or residue on equipment decreases volume



Aeration

Methods of Aeration & Egg Products

1. **Beating** of an aerating agent with air and other ingredients, for example, marshmallows
2. **Pulling** hard or chewy candy, such as taffy
3. **Vacuum or pressure change** to expand tiny bubbles, such as in aerated chocolate and marshmallows
4. **Chemical change** by adding salts, acid and/or other leaveners, such as the use of sodium bicarbonate (baking soda) in some peanut brittle and caramel corn recipes

Emulsification

EFFECTS OF ADDITIONAL INGREDIENTS ON EMULSIFICATION OF EGG PRODUCTS

VARIABLE	EFFECT
INCREASED YOLK	More viscous, stable emulsion. Overuse of egg yolk can lead to flavor and color issues. This is product dependent
ENZYME-MODIFIED YOLKS	Enhanced emulsification and stability in high-heat applications, increases viscosity. Requires label declaration
FREEZING	Gelatinizes the yolk proteins into an irreversible gel. The addition of salt or sugar before freezing helps retard yolk gelation. Emulsification properties of yolk are unchanged whether they're frozen plain, or with the addition of salt and sugar. Frozen, thawed plain yolk can be a challenge to incorporate into food matrix due to excessive gelation
DRYING	Delays initial foaming, stabilizes foams during heating.
HEAT	High heat can speed emulsification, but continued or high heat can break the emulsion
SALT	Increases emulsion stability
INCREASED VISCOSITY	Increases emulsion stability
HIGHER SHEER	Decreases droplet size, increasing emulsion stability

HOW TO FIX A BROKEN EMULSION

VISUAL ASSESMENT	CAUSE	SOLUTION
TOO THIN	Too much oil and/or water was added	Add more of the emulsifying ingredient, such as lecithin-rich egg yolk or another emulsified product, such as prepared mayonnaise to hold all the liquid together thoroughly
	Needs more emulsifier	Add more oil or cook longer (if applicable) to increase drive off moisture and coagulate protein, both of which increase viscosity
TOO THICK	Too much oil or emulsifier was added	Whisk in a small amount of water or other continuous phase ingredients to loosen the viscosity and lighten the texture
	Temperature too hot or too cold	Try to warm up or chill down the sauce slightly. While continuing to mix, see if you can bring the emulsion back. If not, the broken emulsion may be beyond repair; start over
SEPARATED & OILY	Time & temperature abused, or not enough liquid was added	Continue mixing and adjust temperature first, if that does not work add more liquid and/or emulsifier; may be beyond repair
CURDLED	Premature or excessive protein coagulation	The broken emulsion may be overcooked or overly acidified; beyond repair; start over

Coagulation



TEMPERATURE OF COAGULATION ON EGG PRODUCTS

EGG PRODUCT	TEMPERATURE OF COAGULATION
WHOLE EGG	144° F - 158° F (62° - 70° C)
EGG WHITE	144° F - 149° F (62° - 65° C)
EGG YOLK	149° F - 158° F (65° - 70° C)

EGG PRODUCTS & TEMPERATURE OF COAGULATION ACTIVITY

TEMPERATURE	RESULT
BELOW 140° F / 60° C	No coagulation occurs; raw egg
140° F / 60° C	Proteins start to uncoil
145° F / 63° C	White begins to thicken and turns milky white, jelly-like
150° F / 65° C	Yolk begins to thicken
155° F / 68° C	White becomes a tender solid, though still soft and moist
158° F / 70° C	Yolk becomes firm, can hold its shape enough to be cut Appearance is dark and translucent, fudge-like texture
165° F / 73° C	Whole egg becomes firm, moist solid
170° F / 77° C	Yolk becomes pale yellow and starts to get crumbly
180° F / 80° C	White becomes firm solid as heat-resistant proteins coagulate
ABOVE 180° F / 80° C	White becomes firm, dry, and rubbery. Yolk becomes dry and crumbly, can develop grey/green tinge and an overcooked egg flavor & aroma

EFFECTS OF INGREDIENTS & OTHER VARIABLES

VARIABLE	EFFECT
HEAT	Denatures protein, more coagulation as temperature increases
MIXING	Denatures protein, more coagulation as beating continues
EGG AGE	Fresher shell eggs produce stronger gels
SALT	Increases rate of coagulation, decreases coagulation temperature
ACID	Decreases temperature of coagulation, increases rate of coagulation, prevents over-coagulation
ALKALI	Induces gelling of the white, translucent gel at pH of 11.9
LIQUID	Increases coagulation temperature, delays coagulation
SUGAR	Increases coagulation temperature, slows rate of coagulation
STARCH	Reduces curdling, prevents over-coagulation

Adhesion



SELECTING EGG PRODUCTS FOR COATINGS & GLAZES

EGG PRODUCT	APPLICATION	GEL STRENGTH	BROWNING	COLOR	SHINE
EGG WHITE	<ul style="list-style-type: none"> • Form strong dough seams/ edges • Act as moisture barrier in pastry with high moisture fillings • Adhere particulates without contributing color or excessive browning (although with high levels of starch, browning will occur) 	High	Low	Transparent, Dull Brown	Low
WHOLE EGG	<ul style="list-style-type: none"> • Sometimes thinned with liquid • Contributes color and shine • Adhere particulates 	Medium	Medium	Golden Brown	Medium
EGG YOLK	<ul style="list-style-type: none"> • Needs to be thinned with liquid for most applications • Acts as protective coating • Strong moisture / oil barrier, prevents sogginess • Glaze wash for baked goods 	Low	High	Intense Golden Yellow	High
PREPARED EGG WASH	<ul style="list-style-type: none"> • Ready to use, no mixing required • Packaged in spray bottles for easy application by hand or in bulk • Formulated for specific functionality and ingredient declaration requirements 	Varies	Varies	Varies	Varies

Adhesion *(continued)*

EFFECTS OF OTHER INGREDIENTS & VARIABLES						
EGG PRODUCT	OTHER	VISCOSITY <i>(Thickness)</i>	SPREAD- ABILITY	BROWNING	COLOR	SHINE
EGG WHITE	-	Thinner than whole egg alone	Easy	Depends on food matrix	Low: Transparent, lighter than whole egg	Very Low: Matte, crisp, dry surface
	Water	Thinnest	Easy	Lowest	Lowest: Transparent, very light	Lowest: Matte, dull, crisp
	Milk	Thinner Easy to spread	Easy	Lower	Lower: Transparent, light brown	Medium: Low Hint of shine
	Cream	Medium Thin	Easy	Medium Low	Medium: Slightly more browning	Medium: Some gloss
WHOLE EGG	-	Medium	May be too thick	Medium	Medium: Golden brown	Medium: Glossy shine
	Salt	Thinner	Easier	Medium	Medium: Golden brown, dull	Low: Less glossy shine
	Water	Thinner	Easier	Medium	Medium: Golden brown, slightly less intense yellow	Medium Low: Slightly glossy, less than whole egg alone
	Milk	Thinner	Easier	Medium	Medium: Dark brown	Medium: Shinier than whole egg
	Cream	Thicker than whole egg	May be too thick	High	Medium High: Darker brown	High: Very glossy & shiny
EGG YOLK	-	Thickest	May be too thick	High	Higher: Intense golden yellow	Higher: Very glossy & shiny, less so than with dairy
	Water	Thinner than yolks alone	Easier	High	High: Golden yellow	High: Glossy & shiny, less so than with dairy
	Milk	Thinner than yolks alone	Easier	High	Higher: Deep, dark golden brown	Higher: Intense glossy shiny
	Cream	Very Thick	Difficult to spread neatly	Highest	Highest: Deep, dark golden brown	Highest: Intense glossy shiny

Color & Browning

SELECTING EGG PRODUCTS FOR COLOR & BROWNING

EGG PRODUCT	RAW APPEARANCE	COOKED APPEARANCE	GEL STRENGTH	BROWNING	SHINE
EGG WHITE	Clear, with a slightly yellowish green cast	Opaque white to dull brown	High	Low	Low
WHOLE EGG	Light yellow to deep golden yellow	Opaque yellow to golden brown	Medium	Medium	Medium
EGG YOLK	Deep yellowish orange to reddish orange	Opaque intense golden yellow to deep, dark golden brown	Low	High	High

EFFECTS OF OTHER INGREDIENTS & VARIABLES

EGG PRODUCT	OTHER	BROWNING	COLOR	SHINE
EGG WHITE	-	Low	Low: Transparent, lighter than whole egg	Very Low: Matte, crisp, dry surface
	Water	Lowest	Lowest: Transparent, very light	Lowest: Matte, dull, crisp
	Milk	Lower	Lower: Transparent, light brown	Medium Low: Hint of shine
	Cream	Medium Low	Medium: Slightly more browning	Medium: Some gloss
WHOLE EGG	-	Medium	Medium: Golden brown	Medium: Glossy shine
	Salt	Medium	Medium: Golden brown, dull	Low: Less glossy shine
	Water	Medium	Medium: Golden brown, slightly less intense yellow	Medium Low: Slightly glossy, less than whole egg alone
	Milk	Medium	Medium: Dark brown	Medium: Shinier than whole egg
	Cream	High	Medium High: Darker brown	High: Very glossy & shiny
EGG YOLK	-	High	Higher: Intense golden yellow	Higher: Very glossy & shiny, less so than with dairy
	Water	High	High: Golden yellow	High: Glossy & shiny, less so than with dairy
	Milk	High	Higher: Deep, dark golden brown	Higher: Intense glossy shiny
	Cream	Highest	Highest: Deep, dark golden brown	Highest: Intense glossy shiny



Flavor, Aroma, & Taste

- **Egg Yolks** contain all the fat and associated rich flavors in an egg. Adding more yolks contributes characteristic egggy, custard-type flavors and a rich, creamy mouthfeel due in part to the lecithin in egg yolk.
- **Whole Eggs** contain fat and associated rich flavors and will contribute to flavor development and rich mouthfeel. Whole eggs act as a more neutral flavor carrier when used at low levels and contribute their own “egggy” flavor when used at higher levels. Whole egg can create a creamy, custard-like flavor profile and eating experience, though less rich than with egg yolks alone.
- **Egg Whites** contain no fat and associated rich flavors of their own. Egg white contributes little to aroma or flavor compared to yolks. Egg white can act as a mostly neutral, functional background for other flavors in high protein/low-fat foods.

Nutrient Fortification

- **Egg Yolks:** Use for calorie, fat, protein, and micronutrient enhancement / fortification. Concentrated nutritional content and functionality makes egg yolks rich, and therefore not necessarily applicable to every food category nor dietary pattern.
- **Whole Eggs:** Use for protein fortification. Due to the yolk content, whole eggs are higher in fat than egg whites but have more diverse applications without affecting texture.
- **Egg Whites:** Use for protein fortification, calorie, and fat reduction without affecting the flavor. Due to the high protein content, coagulated egg whites may have a considerable impact on texture if used at too high in formulation. Pay attention to coagulation temperatures and the effects of other ingredients.



Processing Aids used in Egg Products

- **Gums** can be used to thicken whole egg
- **Phosphates** make it possible to pasteurize at a lower temperature, which causes less denaturation of proteins, enhancing functionality
- **Triethyl citrate** improves the whipping properties of egg white

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