

Lecithins and Phospholipids

A SIMPLE GUIDE
TO USE AND SELECTION



ALC 
AMERICAN LECITHIN COMPANY

About Lecithins

Lecithins are prepared by extracting and purifying phospholipids from naturally occurring products such as soybeans, eggs, sunflower and canola seeds. Lecithins are amphiphilic (they have different affinities for oil and water), and their low production costs make them invaluable in a broad range of manufacturing processes.

Lecithins help make chocolate smooth and powdered baby formula dissolve easily in water. They help ink flow from ball-point pens, spray paints provide even coatings and cooking sprays keep food from sticking to hot surfaces.

American Lecithin Company offers a wide range of standard, refined and fractionated lecithins. Sold under the ALCOLEC® brand name, they are available in liquid, granular and powder form.



Natural and Organic Lecithin

Lecithin is the unique all-natural emulsifier. American Lecithin also offers organic lecithins under the Natural Organic Program (NOP).

Chemical characteristics, product attributes, classifications and labeling criteria in this brochure refer to American Lecithin soy-based products. To learn about American Lecithin products derived from other sources, contact us at 203.262.7100.



How Lecithins Work

Lecithins are used mainly as emulsifiers. They are surface-active; simultaneous hydrophilic (water-loving) and hydrophobic (water-repelling) properties enable lecithins to make stable blends of materials that otherwise do not mix easily and tend to separate. The amount of lecithin needed to blend substances such as the soybean oil and water in margarine, or the pigment and latex in paint, depends on the overall fat content in the end product.

Lecithins also have characteristics that help:

- Disperse and suspend powders into liquids
- Control the viscosity of liquids and semi-liquids
- Prevent foods from sticking to contact surfaces
- Prevent adhesion of food products to one another

Lecithins can be:

Emulsifiers

Emulsions are produced by dispersing normally unmixable material into another by mixing, colloidal milling or homogenization. The surface-active qualities of lecithins make them effective emulsifying agents that reduce mixing time and maintain the stability of the dispersion.

Wetting and Instantizing Agents

Lecithins provide fast, complete wetting of powders into aqueous systems. Low-

fat powders require lecithins with lower HLB values (see explanation on page 8) to retard wetting rates; fatty powders require higher HLB values.

Viscosity Modifiers

Lecithins greatly reduce the surface tension of fats, enabling particles of chocolate, sugar and milk products, for example, to be coated, improving flow and mixability. Typical usage levels are 0.2-0.6% of total product weight.

Release Agents

Lecithins promote separation of food from contact surfaces

in dip tanks and spray applications. Water-filled dip tanks usually contain up to 10% de-oiled lecithin; pan or belt-release applications consist mainly of vegetable oil with approximately 2% lecithin.

Separating Agents

When applied directly to products such as processed cheese slices, lecithins help form a stable film barrier that prevents them from sticking together. When used directly in products such as baked goods, they enhance the ability to cut and shape products and reduce sticking to mixing vessels.

Extrusion Aids

Extrusion technology uses lecithin as a processing aid to enhance extrusion rates and throughput, resulting in more economical production. Examples of extruded products include fat-free pretzels, reduced fat snacks and pastas.

Anti-Dusting Agents

Inclusion of ALCOLEC lecithins enhances wettability by reducing static interface.



Shelf- Life Aids

Incorporation of ALCOLEC lecithin with the amylose portion of wheat flour slows starch retrogradation. This process in effect extends shelf life.

Nutritional Supplements

Lecithins have nutritional value of their own. The phospholipids they contain, such as phosphatidylcholine (PC), phosphatidylserine (PS) and derivatives such as glycerophosphocholine (alpha-GPC) have been widely acknowledged by nutritionists, and substantiated by numerous human clinical studies, as beneficial to the function of the liver, brain, heart, and other organs. American Lecithin Company offers three products, ALCOLEC® PC, ALCOLEC® PS and ALCOLEC® GPC, specifically for use in softgel, tablets, and hardcap nutritional supplements.



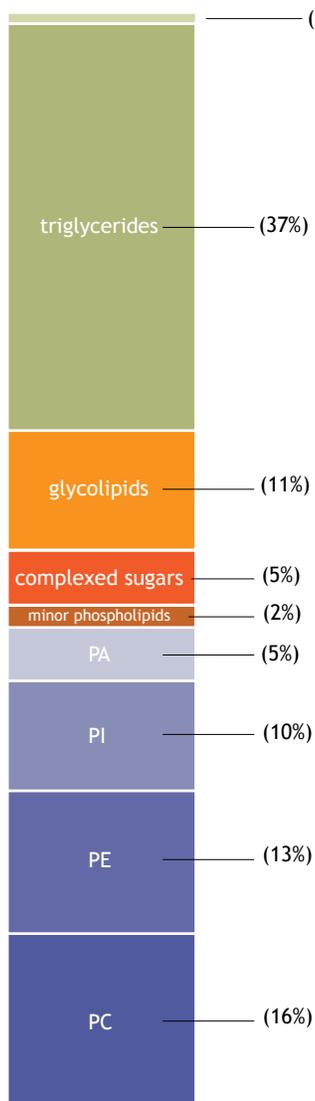
Chemistry

Most of the performance benefits of soybean-based lecithins come from the unique hydrophilic and hydrophobic surface-active properties of phospholipids, their primary component.

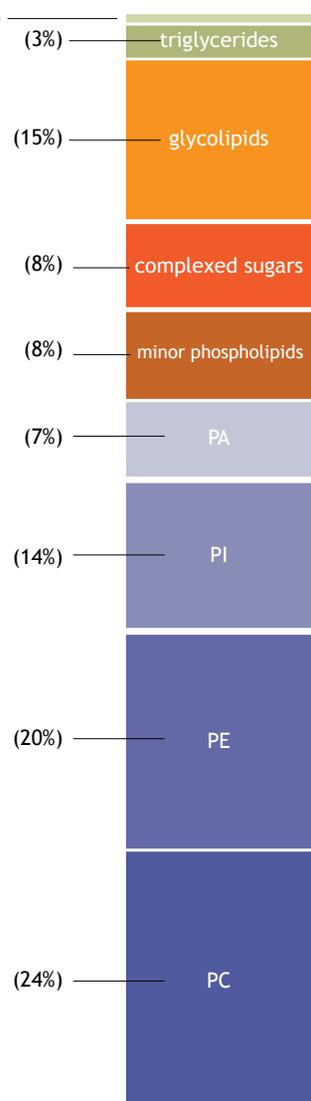
These phospholipids are present in liquid lecithin:

- Phosphatidylcholine (PC, 14-16%)
- Phosphatidylethanolamine (PE, 10-15%)
- Phosphatidylinositol (PI, 10-15%)
- Phosphatidic acid (PA, 5-12%)

Standard Liquid Lecithin



De-Oiled Lecithin*



* Granular or powdered form; most triglycerides and free fatty acids are removed.

Soybean lecithins also contain triglycerides, sterols, small quantities of fatty acids and carbohydrates. De-oiling lecithin enhances the typical phospholipid composition as shown in the accompanying charts. Fractionating (breaking up) these complex mixtures, or adding elements such as refined oils or surfactants, can create new products tailored for specific applications. Fractionated phospholipid products are enriched in phospholipid content. Very delicate applications require the purest lecithin emulsifier that contains more than 80% phosphatidylcholine.

As emulsifiers, lecithins can be added to the oil phase or the water phase during processing. Fluid lecithins tend to disperse more easily in oil; de-oiled (powdered) lecithins more easily in water. Heating to 120°F helps the dispersion and can improve handling and mixing characteristics.

Classification

Lecithin products are classified using attributes such as color, viscosity, and the percentages of certain components. The terms used when specifying lecithins are:

Phosphatidylcholine (PC)

Amphiphilic molecule and main emulsifier in lecithin. PC is the major component of biological membranes and supplements the diet with natural choline.

Acetone Insolubles (AI)

Expressed as a percentage. This is a measure of the surface-active portion of a lecithin, comprised mainly of phospholipids and glycolipids.

Acid Value (AV)

Expressed as meq KOH/kg. This is a measure of total acidity

Oil-in-water emulsions typically include lecithin at 5-10%, and water-in-oil emulsions at 1-5% of the oil's weight.

Most food products contain 1-2% salt; higher levels may affect lecithin functionality.

Particle size affects lecithin requirements in wetting and instantizing applications. Larger particles have less surface area and usually require up to 0.25% lecithination; smaller particles typically require up to 2%.

Lecithin can be derived from various sources. Soybean-derived lecithins have become the industry standard. For nutritional, functional or labeling purposes, American Lecithin has developed products from alternate sources such as egg yolk, canola, and sunflower. Such lecithins have distinct phospholipids and fatty acid composition that allow for an array of new applications.

afforded by ionizable groups of phospholipids and free fatty acids added to some liquid lecithins to stabilize viscosity.

Color

Measured against the Gardner scale. Most lecithin products range from having a light honey (11 on the scale) to dark amber (17 on the scale) color.

Hexane Insolubles (HI)

Expressed as a percentage (usually under 0.1%). Measures residual

continued

Classification continued

non-fatty material, composed mainly of soybean meal fines.

Moisture (H₂O)

Measured by the Karl Fisher method, a potentiometric titration specific for water. Powder and liquid lecithins typically contain approximately 1% water.

Viscosity

Reported in centipoise (cP) at 25°C/77°F, after evaluation with a Brookfield rotary viscometer.

Peroxide Value (PV)

The vital nutritional benefits of lecithins arise from their compositions based on unsaturated fatty acids. The integrity of these nutritional components requires gentle processing technologies and regulated storage conditions which prevent oxidation. Absent these precautions, unsaturated double-bonds can stimulate an auto-oxidation process.

Oxidation creates the radicals that most diets attempt to neutralize. Modern nutritional diets are intentionally enriched with radical scavengers. Peroxides create reactive oxygen species and the most reactive of radicals that can, for example, change DNA, cause inflammation, stress cells and lead to arteriosclerotic plaque.

The likelihood of unwanted oxidation of lecithin is best measured through a measurement of the Peroxide Value (PV). Nevertheless, the degradation of lecithins through oxidation enters a hidden phase after the auto-oxidative reaction. In that phase, the PV can even be reduced and the radicals formed can create non-physiological molecules that can be detrimental and are not easily analyzed. Therefore, the PV is reliable only if appropriate storage is ensured throughout the supply chain. American Lecithin specifies the lowest possible PVs and handles its products with greatest care.

HLB Value

Emulsification properties of different lecithins are a function of their water- or fat-loving qualities, known in the industry as Hydrophilic-Lipophilic Balance or HLB.

Product	Physical State	PC	AI min	AV max	Color max	HI max	Moisture max	Viscosity cP max	PV max	HLB
ALCOLEC® Standard Fluid Grade										
S	Fluid	14%	62%	32	17	.1%	1%	12,000	10	4
BS	Fluid	14%	62%	32	14	.1%	1%	12,000	100	4
XTRA-A	Fluid	14%	66%	25	17	.1%	.8%	15,000	10	2
ALCOLEC® De-Oiled										
Granules	Granular	24%	97%	36	tan	.02%	1%	N/A	4	7
F-100	Powder	24%	97%	36	tan	.02%	1%	N/A	4	7
FF-100	Fine Powder	24%	97%	36	tan	.02%	1%	N/A	4	7
ALCOLEC® Encapsulation Grade										
SGB (bleached)	Fluid	14%	60%	36	13	.02%	.8%	6,000	10	4
SGU (unbleached)	Fluid	14%	60%	36	17	.02%	.8%	6,000	10	4
ALCOLEC® Heat Resistant										
Phospholipon 80H	Powder	70%	97%	—	off-white	—	2%	N/A	1	2
ALCOLEC® Easily Sprayable										
Aquasperse A	Fluid	10%	47%	21	14	.02%	.8%	2,500	N/A	12
LV-30	Fluid	11%	50%	26	14	.01%	.8%	1,500	100	4
ALCOLEC® PC Enriched										
40-P	Powder	40%	97%	28	tan	N/A	1.2%	N/A	3	8
PC35	Fluid	35%	55%	35	16	.01	1.5%	6,000	15	7
PC50	Agglomerate	50%	97%	N/A	yellowish	N/A	1.5%	N/A	10	8
PC75	Agglomerate	70%	97%	N/A	yellowish	N/A	1.5%	N/A	10	9
ALCOLEC® Enzyme-Modified										
EM	Powder	24%	97%	36	tan	.3%	1.5%	N/A	10	9
C LPC 20	Agglomerate	45%	97%	N/A	tan	N/A	1.5%	N/A	10	12
C LPC 20H	Agglomerate	45%	97%	N/A	off-white	N/A	1.5%	N/A	N/A	11
ALCOLEC® – Gums										
Lexin K	Solid	16%	75%	36	14	.1%	1%	N/A	50	N/A

water in oil oil in water

Labeling

ALCOLEC® soy lecithins are all-natural and certified as generally safe for use in food under various compliance standards worldwide. The inherent nutritional value in soy and its association with good health add value when source-labeling products.

In the U.S., most ALCOLEC soy lecithins are Generally Recognized as Safe (GRAS) by the Food and Drug Administration as a multiple purpose food ingredient under the Code of Federal Regulations (21CFR Sec 582.1400) and specifications of the Food Chemicals Codex. The FDA designation is Lecithin.

In the European Union, most American Lecithin products conform to EC-Directive 96/77 EC Lecithin (No. E322). Most are also approved by the World Health Organization as a food additive under Codex Alimentarius Standard INS 322.

Chemically modified lecithins sometimes require special labeling. When enzymatically modified, for example, labels

read Enzymatically Modified Lecithin.

ALCOLEC lecithins are Kosher and HALAL approved.

Source of Origin

ALCOLEC lecithin products from non genetically modified sources provide customers with two labeling options. PCR negative may be used when a material has tested negative for genetic modification by an independent laboratory using the PCR (Polymerase-Chain-Reaction) Roundup Ready method. IP (Identity Preserved) may be used when soybeans are produced without the aid of genetic engineering, with documented identity preservation at each stage of processing, independent third-party certification of conformance to defined IP procedures and a maximum of 0.9% adventitious residual GM DNA.

Labeling Lecithins

This chart shows typical nutritional information associated with various sources of lecithin.

Nutritional Summary (per 100 grams product)	Liquid		Granular			Egg ALCOLEC E-25
	Soy ALCOLEC S	Sunflower ALCOLEC H	Soy ALCOLEC F100	Sunflower ALCOLEC H-20	Canola ALCOLEC C-20	
Calories	790	790	700	700	700	463
Calories From Fat	620	595	480	480	480	225
Total Fat (g.)	69	66	53	53	53	25
Saturated Fat (g.)	14	10	12	6	4	12

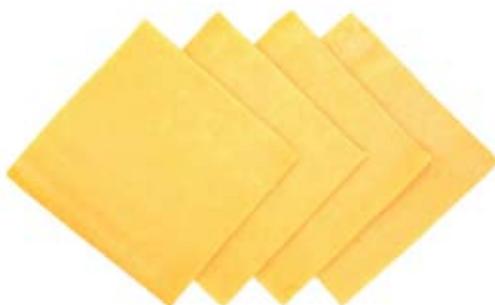
Approximate Fatty Acid Composition (in percent of total fatty acids)

Monounsaturated	12	17	10	14	56	27
(oleic, 18:1)	12	17	10	14	56	27
(erucic, 22:1)	<1	<1	<1	<1	<1	<1
Polyunsaturated	61	60	66	70	33	23
(linoleic, 18:2)	55	60	60	70	29	17
(linolenic, 18:3)	6	—	6	—	4	—
(arachidonic, 20:4)	—	—	—	—	—	4
(docosahexaenoic, 22:6)	—	—	—	—	—	2
Saturated	21	19	24	15	8	47
(palmitic, 16:0)	17	13	20	11	7	33
(stearic, 18:0)	4	5	4	3	1	14
(arachidic, 20:0)	—	1	—	1	—	—
Trans Fatty Acid	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

Primary Acetone Insolubles (per 100 grams product)

Phosphatidylcholine (g.)	16	15	24	24	24	19
Phosphatidylethanolamine (g.)	13	7	20	9	12	5
Phosphatidylinositol (g.)	10	10	14	18	13	—

Please inquire about nutritional profiles for specific products.



Selection

The chart on these pages and pages 14-15 can help you determine which ALCOLEC® products are best suited for your applications.

More information follows in the Solvent Solubility Index on page 18.

Product	Adds Lubricity	Crumb Softener	Dough Conditioner	Mixing/ Blending Aid	Surface Coating	O/W Emulsifier	W/O Emulsifier	Release Agent	Viscosity Modifier	Wetting Agent	Anti- Staling	Softgels	2 piece hard caps	Tablets
ALCOLEC® Standard Fluid Grade Stable, unrefined fluid blends of soybean oil and phospholipids.				•			•	•	•					
S				•			•	•	•					
BS				•			•	•	•					
XTRA-A				•			•	•	•					
ALCOLEC® Standard Deoiled Grade Oil-free powders or granules for enhanced water dispersibility and easier handling.	•	•	•	•		•		•	•	•				•
Granules	•	•	•	•		•		•	•	•				•
F-100	•	•	•	•		•		•	•	•				•
FF-100	•	•	•	•		•		•	•	•				•
ALCOLEC® Encapsulation Grade Developed for soft gelatin capsulation requiring clarity and brilliance.							•					•		
SGB (bleached)							•					•		
SGU (unbleached)							•					•		
ALCOLEC® Heat Resistant Maintain a light yellow color when exposed to high temperatures.					•		•	•						•
Phospholipon 80H					•		•	•						•
ALCOLEC® Easily Sprayable Modified and processed low-viscosity fluids that can serve as dispersants, wetting agents, emulsifiers, release agents and stabilizers.				•		•		•	•	•				
Aquasperse A				•		•		•	•	•				
LV-30				•		•		•	•	•				
ALCOLEC® PC Enriched Modified to provide higher levels of choline, widely recognized as a contributor to good health.						•							•	•
40-P						•							•	•
PC35						•						•		•
ALCOLEC® Enzyme-Modified Especially useful in food as an instantizer and to help maintain freshness.							•			•	•			
EM							•			•	•			
LPC 20							•			•	•			
LPC 20H							•			•	•			
ALCOLEC® – Gums				•				•	•					
Lexin K				•				•	•					
ALCOLEC® – GPC													•	•
GPC Compound												•	•	•
GPC 85F												•	•	•
GPC X												•	•	•
ALCOLEC® – PS													•	•
PS 20													•	•
PS 50													•	•
PS 75													•	•

Use levels are usually 0.2% based on finished product weight. If no specific information is available, we recommend starting with 0.5% of finished product and adjust as necessary.

A Guide to Applications

Use levels are usually 0.2% based on finished product weight.
If no specific information is available, start with 0.5% of finished product and adjust as necessary.

Application	Suggested Products	Usage instructions & effect
Baked Goods		
Bread and other yeast-raised products	ALCOLEC® EM	0.5-1% based on flour in breads. Shelf life, dough conditioning.
Cake	ALCOLEC® F100	Dry, blendable emulsifier for cake mixes. Also improves symmetry, grain, texture.
Cookies	ALCOLEC® F100	1-3% based on flour. Improves creaming. Also release benefits in high sugar batter-type products.
Low fat cookies, crackers, pretzels	ALCOLEC® F100	1% based on flour. For machinability. Improves sheeting, dough lubricity, reduces downtime, better dough extrudability.
Pizza crust	ALCOLEC® F100	0.5-1% based on flour. Controls shrinkage, improves dough handling release.
Waffles, pancakes	ALCOLEC® F100	Improves tenderness in no/low fat products. Reduces batter viscosity.
Caramel Corn	ALCOLEC® LV-30, ALCOLEC® F100	ALCOLEC F100 at 0.5-1.0% can be added to the sugar syrup and 5-15% of ALCOLEC LV30 can be added to the vegetable oil.
Cheese Release	ALCOLEC® LV-30	Spray on surface to promote easy slice separation in low- and high-moisture cheese products.
Cheese Sauces	ALCOLEC® F100	Add into oil at 3-5% based on total fat for smoothness and consistency.
Chewing Gum	Lexin K, ALCOLEC® F100	0.7-3% in the gum base. Enhances product softness and smoothness; reduces tackiness, controls adhesion.
Chocolate	ALCOLEC® F100	Use at 0.2-5% level. Reduces viscosity; reduces fat requirement.
Cocoa	ALCOLEC® Aquasperse A	Wetting agents for cocoa powders.
Colors	ALCOLEC® F100	Oil soluble colors made water dispersible.
Cottage Cheese	ALCOLEC® F100	Enhances curd formation to improve production yields.
Flavors	ALCOLEC® Aquasperse A	Oleoresins made water dispersible.
Frostings	ALCOLEC® F100	Acts in combination with polysorbate to provide excellent emulsification and air entrapment. Use at 2-4% based on the fat.
Griddle/Wok Oils	ALCOLEC® LV-30	0.15-0.5% for release.
Granola Bars	ALCOLEC® F100	Blendable powder; low flavor binding material; high quality dietary fat source.

A Guide to Applications continued

Application	Suggested Products	Usage instructions & effect
Ice Cream Cones	ALCOLEC® F100	0.5-1% based on flour. Mold release, viscosity control, emulsification.
Infant Formula	ALCOLEC® EM, LPC 20, E 25	Effective oil-in-water emulsifier for a wide variety of oils. Use at 3-5% of fat level.
Instantizing	ALCOLEC® F100	Control hydration rate of hydrophilic powders. Use at 0.5-1.0%.
	ALCOLEC® Aquasperse A	Promote hydration of fatty/hydrophobic powders.
Margarine	ALCOLEC® Xtra A	Enhanced water-in-oil emulsifier. Use at 0.2-0.5% to prevent spattering.
Meat Sauces, Gravies, Canned Meat Products like Chili	ALCOLEC® F100	Dry, easy to use powder; blends in quickly at 0.25-0.5%; helps control unsightly fat separation. Also lowers fat crystallization temperature to benefit sauce pumpability.
Milk Powders	ALCOLEC® F100	Excellent wetting of whole milk powders. Use at 0.5-1.0%.
Non-Dairy Creamers	ALCOLEC® F100	Acts as an emulsifier to replace mono and diglycerides. Use level 3-5% based on total fat.
Release		
Oil based	ALCOLEC® LV-30	Use at 5-15% level. Good solubility in pump and aerosol-type formulations.
Water based	ALCOLEC® F100	Effective oil-in-water emulsifier for a wide variety of oils. Use at 25-30% of oil/fat level.
Belt release	ALCOLEC® Aquasperse A	Water dispersible for use as a belt release in continuous cooking operations. Use at 10-15% level in water.
Heat resistant	Phospholipon® 80H	For use at high temperature applications at 1% of finished product.



Selection continued

Solvent Solubility Index for ALCOLEC® Lecithins

This chart gives general information about the solubility of various ALCOLEC® products in a wide range of solvents.

- Oil-free lecithin includes ALCOLEC® Granules/F-100/ FF-100.
- Fluid lecithin includes ALCOLEC® S and BS.

	Oil-Free	Fluid
Water	D	I
Acetone	I	I
Chlorodifluoromethane	S	S
Chloroform	S	S
Diethyl Ether	S	S
Dimethyl Sulfoxide	I	I
Ethanol	I	I
Ethyl Acetate	I	I
Glycerine	I	I
Heptanol	S	S
Hexane	S	S
Isooctane	S	S
Isopropyl Ether	S	S
Kerosene	S	S
Methanol	I	I
Methylene Chloride	S	S
Methyl Ethyl Ketone	I	I
Methyl Isobutyl Ketone	S	S
Mineral Spirits	S	S
Petroleum Ether	S	S
Propylene Glycol	I	I
Toluene	S	S

D – Dispersible by use of hot water, slightly alkalized

I – Insoluble

S – Soluble at 10% (w/w) at 25 °C



About American Lecithin Company

American Lecithin is a member of the Lipoid Group of companies. Lipoid is the global leader in the manufacture of the widest range of lecithins and phospholipids for the food, nutritional, pharmaceutical and cosmetic industries.

American Lecithin's ALCOLEC® products are used in food processing and a wide range of industrial applications. For more than 80 years, American Lecithin has continually improved the basic properties of its lecithins, creating new products with better performance in a broad range of uses. We remain committed to providing the very best in quality, consistency and technical support for our full range of products, from standard grade lecithins to high-tech fractionations.

Visit www.americanlecithin.com for additional information, or contact us directly.

Visit the Phospholipid Research Center, www.phospholipids.net, for basic scientific questions on lecithins and phospholipids.



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For information about lecithins used in pharmaceuticals and personal care products, visit www.lipoid.com.



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