A Guide to Lecithin

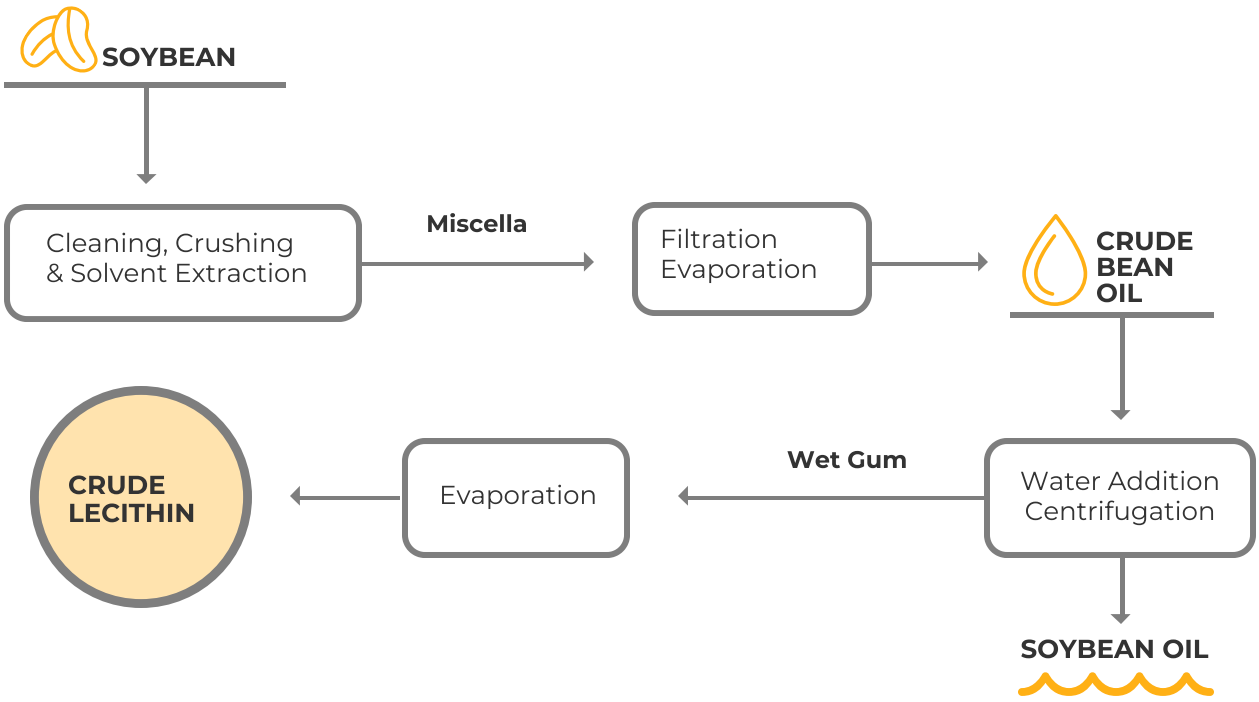
Lecithin is a natural emulsifier that has been used in the food industry for decades. It is present in appreciable amounts in eggs, soybean, sunflower, and many other vegetable sources. It is widely used for making chocolate, bread, sweet goods, margarine, spreads, processed cheese and many other value added products.

Lecithin was discovered in 1846 by the French chemist Maurice Gobley. He first isolated an orange-colored substance from egg yolk, which he called lecithin after the Greek name for egg yolk. A key characteristic of this isolated substance was that it contained phosphorus, which was somehow naturally bound to a lipid-type structure.

It took other researchers several years to discover that the isolated compounds from egg yolk were not of a uniform chemical structure but were a group of components that are now classified as phospholipids or phosphatides.

Lecithin Production

Vegetable lecithin is manufactured exclusively as a by-product of the vegetable oil refining process. In that process, lecithin must be removed because it interferes with downstream bleaching, hydrogenation and deodorization of the oil.



Understanding Lecithin

One of the most interesting aspects about lecithin is that it is far from being a uniform, pure, or standardized material. Instead, it is a natural mixture of surface-active components, known as glycero-phospholipids and galactolipids (glycolipids), that contribute to the overall emulsifying performance of lecithin.

In commercial lecithin, phospholipids and galactolipids are of great importance in terms of both quantity and functionality. Unlike triglycerides, phospho- and glycolipids behave as natural surfactants as they have a polar and non-polar moiety in their molecular structure.

These two lipids types and their different forms, have one or two fatty acid chains as their hydrophobic moiety which is capable of interacting with oil (O/W emulsions) and gases (air/liquid foams). The polar region or water-loving moiety of these lipids completes their functionality as surface-active compounds.

Types of Phospholipids & Galactolipids

- Phosphatidylcholine, PC
- Phosphatidylethanolamine, PE
- Phosphatidylinositol, PI
- Phosphatidylserine, PS
- Phosphatidic Acid, PA
- Digalactosyl-diglyceride, DGDG
- Monogalactosyl-diglyceride, MGDG

Forms of Commercial Lecithin

1 **Crude (liquid):** this lecithin contains all the load of oil and non-polar lipids (e.g. triglycerides).

2 **De-oiled (powder):** this lecithin has non-polar lipids removed from its composition and contains almost 100% polar lipids .

SURFACE-ACTIVE MOLECULES FOUND IN SOY LECITHIN

Component / Fraction	Crude Lecithin %	De-oiled Lecithin %
Total phospholipids	Approx. 56	Approx. 86
Phosphatidylcholine (PC)	8.0 – 15.0	16.0 – 21.0
Phosphatidylethanolamine (PE)	8.0 – 11.0	12.0 – 18.0
Phosphatidylinositol (PI)	3.0 – 10.0	7.0 – 11.0
Phosphatidic Acid (PA)	5.0 – 10.0	8.0 – 13.0
Total glycolipids (DGDG, MGDG)	Approx. 6.0	Approx. 10
Total polar lipids	Approx. 62	Approx. 96
Total neutral (non-polar) lipids	38.0 – 44.0	2.0 – 2.5
Triglycerides	35.0 – 40.0	2
Free fatty acids	2.00	0.25
Sterols	1.0 – 2.0	0.25

Function of Lecithin in Baked Goods

Lecithin is virtually the only natural emulsifier available to bakers. Depending on its source, manufacturing process and composition, it can be part of bakery products that are clean label friendly.

Lecithin performs many functions in baked goods, including:

- Emulsification and stabilization of oil-in-water (O/W) dispersions.
- Stabilization of foams during proofing and baking (gas bubble structures found in chemically-leavened batters and yeast-leavened doughs).
- Faster incorporation of oily and hydrophilic ingredients (e.g. fats, flour and water).
- Improve the crumb structure of baked goods by creating a tighter and more even grain.
- When partially hydrolyzed by a lipase, it can become an even more powerful surfactant, promoting protein aggregation thanks to its interaction with glutenins and gliadins.
- When partially hydrolyzed by a lipase, lecithin increases the tolerance of proofed dough pieces to shocks and mechanical abuse during conveying and handling.
- When partially hydrolyzed by a lipase, lecithin lysolipids may form complexes within amylose helix of starch, thus delaying the onset of staling and extending the freshness and softness of packaged bread.
- Stabilization of chocolate mixtures.

CRUDE (FLUID) VS. DE-OILED LECITHIN

Crude lecithin, in its viscous fluid form, differs markedly from the de-oiled version. The latter concentrates all the functional surface-active molecules (all phospholipid and glycolipid fractions). The much higher polar lipid profile, along with its practical powder form, make de-oiled lecithin a more expensive emulsifier.

In most situations, the cost-in-use of de-oiled lecithin, given its lower dosage to obtain equivalent functionality, equals that of crude lecithin.

Parameter	Crude (liquid)	De-oiled
Acetone insoluble (%)	Min. 60.0	Min. 96
Toluene / hexane insoluble (%)	Max. 0.3	0
Acid value (mg KOH/g)	Max. 35.0	Max. 35.0
Moisture content (%)	Max. 1.0	Max. 1.5
HLB value	3 – 4	6 – 7

Crude lecithin is a highly viscous fluid which, depending on bakery's possibilities, scaling and handling technology, may or may not be the most suitable form. It contains the full load of oil from the starting material. Some bakers looking for low-fat bread and buns would rather not add sources of triglycerides to the formulation in order to meet the product concept.

Crude lecithin is usually added to bread and bun formulations at levels of 0.5 to 1.0% based on flour weight. De-oiled lecithin is used at lower doses to obtain similar results in finished product quality.

Unlocking the full potential of lecithin for DATEM and SSL replacement in breadmaking

Lecithin as a is a cleaner option for synthetically produced emulsifiers, such as DATEM and SSL. As any other natural compound, it has room for functionality improvement. Enzymes can unlock the full functionality of lecithin by modifying the endogenous polar lipids and transforming them into powerful lysolipids. Once phospholipids and glycolipids present in lecithin are partially hydrolyzed by a lipase, they exhibit higher HLB values, higher water solubility, and far superior surface-active properties that highly resemble those of DATEM structures.

Of course, in-situ production of surface-active molecules from lipase action on endogenous flour lipids is one way to navigate the absence of DATEM or SSL in bread and buns. However, in low dough-to-pan ratio breads, the gas phase (CO2 produced) trapped within the gluten network is much higher so the foam is more prone to bubble coalescence. In such instances, it is recommended to add additional emulsification to provide sufficient dough tolerance and robustness. In such circumstances, enzymatically-modified lecithin becomes a powerful ally for keeping product quality consistent, batch after batch.

Does the use of soy lecithin and mixed tocopherols help in increasing the shelf life in gluten-free cookies?

As an emulsifier, lecithin reduces the separation of e fats with both liquid and dry ingredients. This is a desirable functionality which is highly appreciated in any baked products, not just cookies.The use of soy lecithin may help in processing of the gluten-free cookie, and may help keeping the cookies longer, reducing staling.

However, it doesn't help with preventing lipid oxidation. That is why tocopherols are needed. Especially if your cookie goes through conditions that encourage lipid oxidation and rancidity. Like a constant fluctuation in temperature, inadequate packaging, or an extreme long shelf life without oxygen scavengers. Tocopherols are natural antioxidants that can help you reduce the onset of rancidity in the baked goods. Therefore, you should add both of these ingredients into a gluten-free product.

How do I use soy lecithin in powder form? What should be the dosage in cookies?

De-oiled or powdered lecithin can be added, scaled and handled the same way any other dry ingredient is. If you have a minors scaling system, you can add it during that stage. In case you choose de-oiled lecithin for your cookie process, you can always add it at levels of 0.5 to 2.0% (dry flour weight).

Is lecithin dispersible in cold water?

De-oiled lecithin, given its polar lipid composition, is readily dispersible in water. It can be added directly into aqueous solutions and water suspensions without any issues. Crude lecithin, on the other hand, cannot be mixed in water. It is better to incorporate crude lecithin in the creaming stage for the fats and sugar in batter systems. In dough systems, it should be added in when the oils are introduced into the flour and dough.

Are liquid and granular lecithin interchangeable in quantities in dough?

Yes, liquid and powder lecithin can be interchangeable regarding quantities. Lecithin, either crude or de-oiled, can be dosed according to the amount of polar or nonpolar lipids added to the formula. De-oiled lecithin is the best for this instance. You can create dosage ratios based on this parameter in case you want to do it in a more scientific way. Just ask your lecithin supplier to provide this information on the spec sheet.

Can lecithin be added to reduce the amount of eggs in a cake formulation?

Egg replacement or reduction is a challenging task that must be properly addressed. Remember, egg's functionality in baked goods consist of foaming, stabilizing, emulsifying and moistening. As egg yolk has natural emulsifiers, a good way to replace its emulsifying properties is through adding lecithin.

However, the sole addition of either crude or de-oiled lecithin will not be adequate. While de-oiled lecithin is by far a more effective foaming agent than crude lecithin, it will not be enough to make a considerable reduction in the amount of egg used in sweet baked goods.

References

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