EMULSIFIERS

BAKERpedia
Pocket Guide

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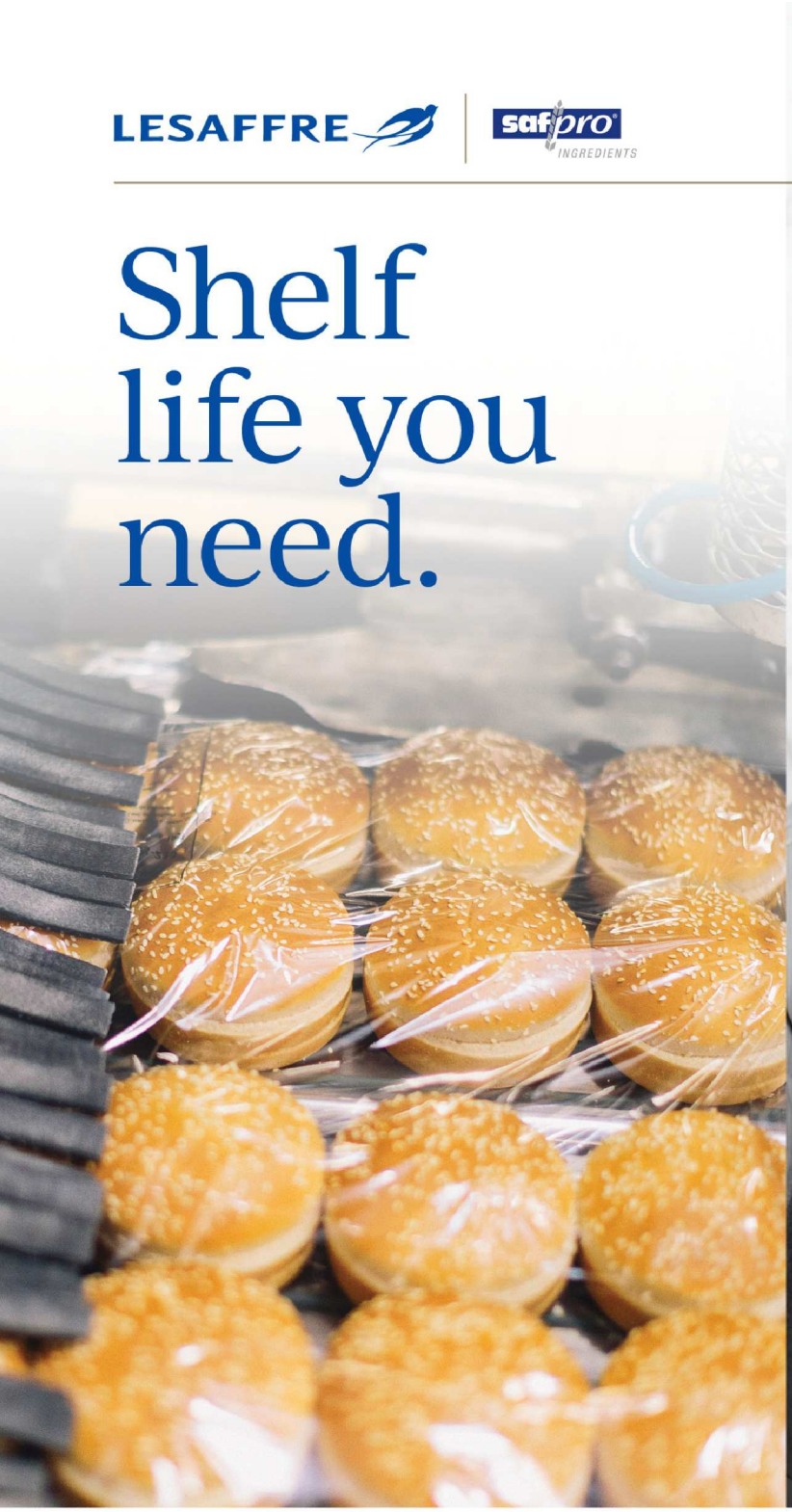

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MORE THAN YEAST

Table of Contents

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WHAT ARE EMULSIFIERS?

Emulsifiers play a key role in the baking industry, influencing the physicochemical properties of baked goods. Functioning as stabilizers, these compounds facilitate the dispersion of water and fat phases within the dough or batter matrixes, as well as in frosting and fillings. The emulsifying action ensures the formation and stabilization of emulsions, a critical factor influencing the textural attributes, shelf life, and sensory profile of the final product. In bakery products, emulsifiers contribute to improved structural integrity, influencing parameters such as crumb structure, volume, and softness. Additionally, their molecular interactions play a pivotal role in enhancing mixing efficiency during the production process, influencing the rheological properties of dough. Emulsifiers play an essential role in the manufacturing and shelf- life of bakery products and this pocket guide will help you understand its applications. [1,2]

There are emulsifiers that occur naturally. They are found from plant or animal sources such as lecithin present in egg yolks, and soy bean.[1]

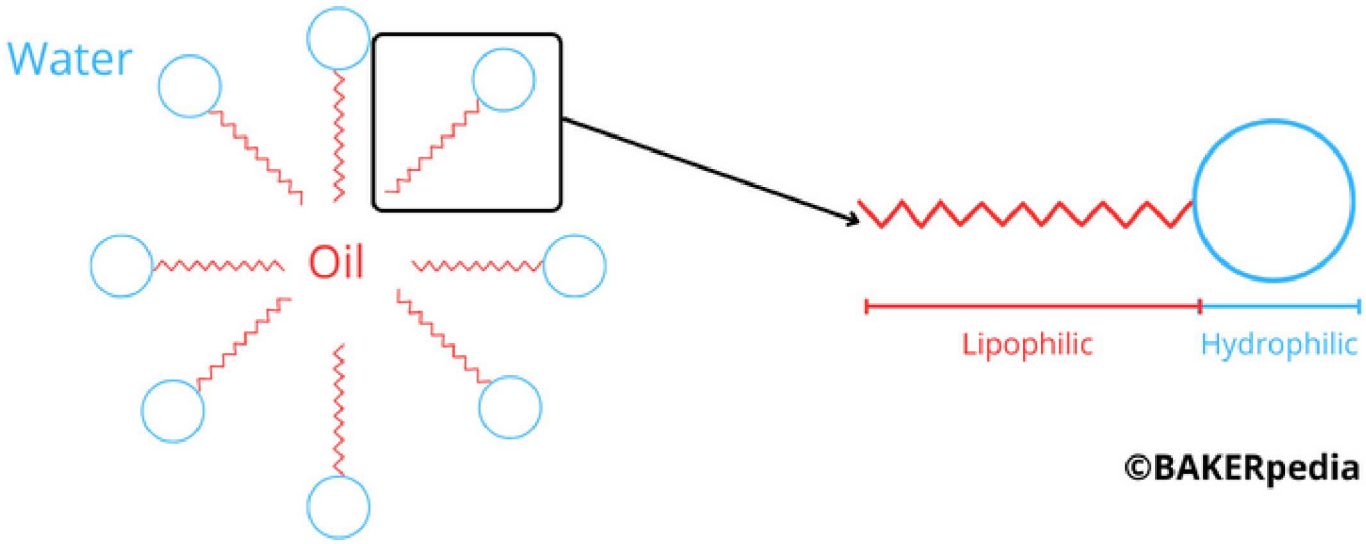


Figure 1: an overview of an oil - water emulsion

Emulsifiers in the Baking Industry

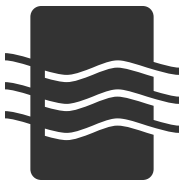
Emulsifiers are molecules possessing hydrophilic (water-loving) and lipophilic capabilities (oil-loving). Think of emulsifiers as adaptors, with one end connecting to water-loving molecules, and the other end connecting to oil-loving molecules. Emulsifiers play a fundamental role in stabilizing and facilitating the formation of emulsions, colloidal systems in which immiscible liquids, such as oil and water, are finely dispersed. The hydrophilic portion of the emulsifier interacts with water molecules, while the lipophilic portion interacts with oil or fat, reducing interfacial tension and preventing phase separation.[2,3]

This property enables emulsifiers to form and maintain homogeneous mixtures of two immiscible phases (oil and water), enhancing the stability, texture, and overall quality of bakery products. Emulsifiers find application in diverse fields due to their ability to modify the physicochemical properties of interfaces between immiscible phases, making them essential ingredients in formulations where the dispersion and stabilization of oil-in-water or water-in-oil systems are critical.[2,3]

One enzyme-based emulsifier replaces 5 common chemical emulsifiers under consumer scrutiny. The best part? You only need to label it as "enzymes and yeast." See the label-friendly replacement from Lesaffre.

Function of Emulsifiers in the Baking Industry

Stabilizer

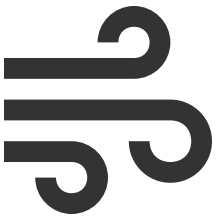


These compounds act as stabilizers, ensuring a uniform dispersion of water and fat in dough or batter. For example, water and oil do not mix well. By forcing them to mix in a system, they will naturally separate over time. Emulsifiers become the 'connectors' of this oil and water system, creating a stable environment for the water and oil to exist with each other without separating out into layers. By fostering the formation and stabilization of emulsions, emulsifiers improve the texture, volume, and shelf life of baked products.[1,4]

Improves Machinability

By working as dough strengtheners, emulsifiers impact the physical properties of the dough, making it easier to handle and machine. For example, for emulsifiers like Diacetyl Tartaric Acid Ester of Mono- and Diglycerides [DATEM], it has the capacity to interact with gluten proteins, promoting protein aggregation, making it more resilient through the dough pump and divider.[1,5]

Improves aeration



In batter aeration, emulsifiers enhance the stability of the air-water interface, promoting the incorporation and retention of air bubbles during mixing. This results in a lighter and fluffier texture in the final product, such as cakes or muffins. Emulsifiers achieve this by reducing the surface tension between air and water, facilitating the formation of a stable foam structure within the batter.[1,6]

In creaming, they assist in the uniform dispersion of fat globules and the formation of a stable emulsion. This ensures better incorporation of air during creaming, leading to a smoother and more aerated mixture, that is more stable over shelf life.[1,6]

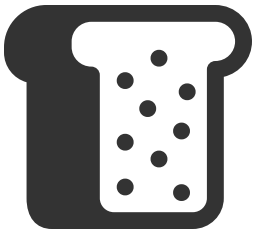
Improves volume

By improving aeration, and stabilizing emulsions within the dough or batter, emulsifiers lead the way in introducing more air cells into the system. This increased quantity in air cells results in a higher volume. Together with volume expansion during baking, the use of emulsifiers results in an improvement of volume.[1,6]

Emulsifiers' interaction with both water and fat phases ensures a uniform distribution, enhancing the dough's gas-holding capacity and contributing to a lighter texture in the final product. Additionally, the improved machinability of dough, facilitated by emulsifiers, allows for better incorporation of air during processing, further enhancing the overall volume and quality of bakery goods.[1,6]

Improves crumb softening

Emulsifiers improve the softness of the crumb in baked goods by interacting with starch and gluten proteins. They form complexes with these components, modifying the structure of the bread and cake matrix. This altered structure impedes the staling process, leading to a softer and more desirable texture in the crumb over an extended period. Emulsifiers achieve crumb softening by enhancing water retention and reducing the propensity of starch and gluten to crystallize, thus slowing down the staling process.[1,6]



Additionally, emulsifiers interfere with the starch retrogradation process by forming a protective barrier around starch granules. This barrier inhibits the reassociation of starch molecules, reducing the rate of retrogradation and, consequently, slowing down the staling of the bakery product. By impeding this molecular rearrangement, emulsifiers contribute to an extended shelf life and help maintain the freshness of the product.[1,6]

Improves mouthfeel

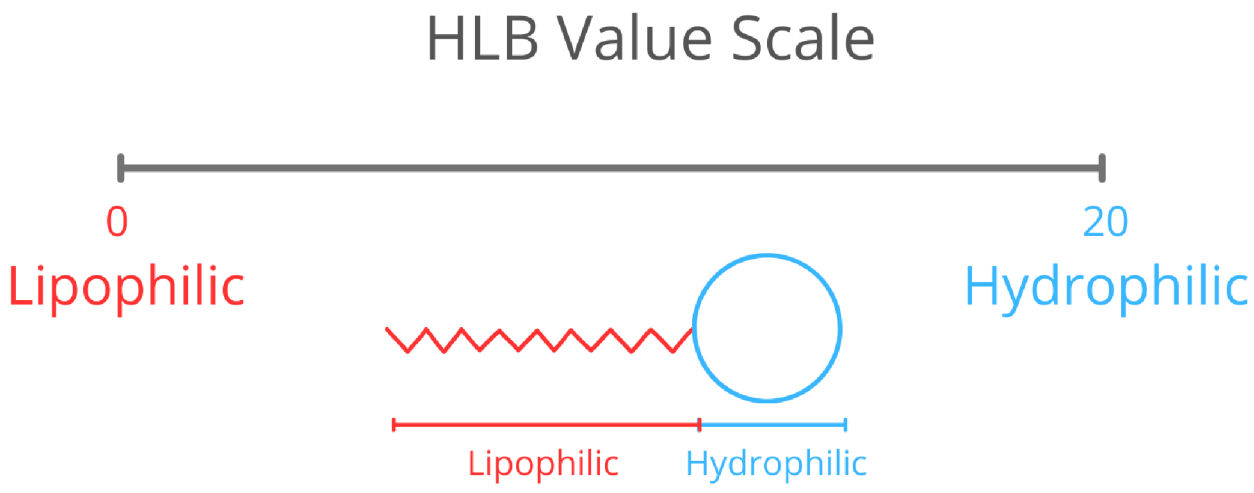
Since emulsifiers stabilize the air/water interface, they create a uniform cell structure. This contributes to the development of a consistent crumb structure and influences sensory aspects such as taste and mouthfeel. [1,6]

What is HLB?

An essential characteristic of emulsifiers is their Hydrophilic-Lipophilic Balance (HLB), which serves as a measurement of the magnitude and dominance of the emulsifier's hydrophilic and lipophilic components. The HLB scale spans from 0 to 20, acting as an indicator of the size and potency of these regions within the molecule. [1,6]

A value of zero designates a purely lipophilic molecule, emphasizing an affinity for oil or fat, whereas a score of 20 signifies a wholly hydrophilic nature, highlighting a strong attraction to water. The HLB index thus provides valuable insights into the emulsifier's ability to create a stable and harmonious interface between hydrophilic and lipophilic phases, influencing its suitability for specific applications in various industries.[1,6]

Thus this measurement is of extreme importance when choosing the right emulsifier or emulsifier mixture for a particular application. The type of emulsifier as well as the quantity of the additive requirements may vary depending on product formulation. [1,6]



Emulsifiers in the Baking Industry

A wide variety of emulsifiers are available for bakery use, some of the most common[1,6] ones used in yeasted dough applications are:

Polysorbate 60
Ethoxylated mono-glycerides (EMG)
Succinylated mono-glycerides (SMG)
Mono and di-glycerides
Calcium stearoyl lactylate (CSL)
Sodium stearoyl lactylate (SSL)
Diacetyl tartaric acid esters of monoglycerides (DATEM)

When using certain emulsifier in baked goods, some consideration may need to be taken into account, in the following table some common usage levels and application of the most commonly used emulsifiers in the bakery industry are shown in Table 1.

Emulsifier	Usage level	HLB	Application
Lecithin	0.2% - 0.5%	4-7	Used in cakes, bread, and pastry for improved aeration and crumb softening. Provides dough conditioning.
Diacetyl Tartaric Acid Esters of Monoglycerides [DATEM]	0.2% - 0.5%	8-10	Enhances dough strength, often used in bread and rolls to improve volume, texture, and machinability.
Sodium Stearoyl Lactylate[SSL]	0.2% - 0.5%	3-5	Commonly utilized in bread and cake mixes to improve volume, texture, and emulsification.
Calcium Stearoyl-2-Lactylate[CSL]	0.2% - 0.5%	5-10	Acts as a dough conditioner, enhancing volume and texture in bread, rolls, and cakes.
Mono- and Diglycerides	0.2% - 0.5%	Varies	Widely used in various baked goods, including bread, cakes, and cookies, for emulsification, texture improvement, and shelf-life extension.

Table 1. Common emulsifier used in yeasted dough bakery products[7,8,9]

Emulsifier	Usage level	HLB	Application
Lecithin	0.2% - 0.5%	4-7	Used in cakes, bread, and pastry for improved aeration and crumb softening. Provides dough conditioning.
Polysorbates (60,80 and 85)	0.2% - 0.5%	Varies	Widely used in cakes, cookies and frosting to extend shelf life, emprove crumb color and improve volume
PGME [Propylene Glycol Monoesters]	0.2% - 0.5%	3-5	Used for cakes and non-dairy whipped products. They improve volume and texture. Provide stability against syneresis.
PGE [Polyglycerol Esters]	0.2% - 0.5%	3-14	Commonly used in cake batter with little or no oil or fat content. They help aeration and aid in the stabilization of foams.
Ethoxylated Monos	0.2% - 0.5%	Varies	Used to improve the aeration of cake batters
Alpha Dextrins	0.2% - 0.5%	Varies	Usually added to icings, cake batters and sponge cakes. They can also be added in gluten free and egg free bakery products. They stabilize emulsions and they can control the solubility

Table 2. Common emulsifiers used in chemically leavened products and frostings[7,8,9]

Problem Solving with Emulsifiers

Instead of DATEM, what can be used in my refrigerated dough typically used by pizza chains?

Fermentation for up to 4 hours enhances dough strength and machinability. However, longer fermentation time makes it more acidic and creates a more unstable dough. Therefore, suitable emulsifiers like DATEM are usually used to stabilize the system. The best way to replace DATEM in this situation would be with enzymes, depending on the formula. If cutting the fermentation time is an option, please do so. Clean label systems are not tolerant to extremely long fermentation times.[10]

Enzymes can be used to modify the dough behavior and improve the volume, texture and structure of baked goods. These enzymes catalyze cross-linking between proteins and starch chains, releasing the sugars. This will also help improve yeast fermentation. Glucose oxidase is an enzyme which catalyzes the oxidation of glucose to hydrogen peroxide and D-glucono-δ-lactone. The removal of glucose through the catalyzation allows free glucose for better fermentation. Lastly, ascorbic acid can also be used similarly.

We are cleaning up our bread labels. Besides using an enzyme-based dough conditioner blend, what else can we do for ingredients and our process?

Cleaning up labels requires more than switching out the emulsifiers to an enzyme based solution. Have you looked into aged flour, or flour from railcars? Aged flour is naturally oxidized, making them stronger and more resilient to pressure points at the dough pumps, divider and rounder. In addition, the use of a bulk fermentation system would also help. A sponge and dough system that is 40% sponge, with a bulk ferment of longer than 4 hours would naturally oxidize the dough and produce enzymes that help with machinability. Together with a lower dough temperature, and a longer final proofing time, so that your delicate dough can expand and stay relaxed without losing strength, you can really be successful at cleaning up your label.[10]

What common bread emulsifiers are used in high volume bakeries?

High volume or industrial bakeries have high pressure pumps and dividers that require SSL, DATEM and Mono & Diglycerides. The above emulsifiers improve structure, help with machinability and thereby produce a higher volume. A higher volume would increase the softness of the product. Many consumers perceive a softer product as a fresher product.[10]

What emulsifiers can I use to make sliced bread remain fresh?

Freshness of bread is prolonged by fat, sugar and a higher moisture content, therefore, don't over bake your breads! Emulsifiers function as anti-staling agents and can be added in the dough for softening and moistening the bread. Common emulsifiers used in sliced bread to remain fresh include hydrocolloids such as mono & diglycerides.[10]

How can I improve the flexibility of my flat bread without DATEM or SSL?

Cracking is caused by staling and moisture migration which is a result of staling. Firstly, thermal profile your flat bread product and make sure that you are not overbaking it. Emulsifiers can act as anti-staling agents through increased dough stability and crumb softening. DATEM and SSL are typically used for this function in bread. Modified wheat proteins that have a flexible nature can be used together with 2% increase in vegetable fat. Enzyme blends from ingredient suppliers can do the same. Gums (gum arabic, carboxymethyl cellulose, xanthan gum) are also helpful since gums can retain moisture which keeps the bread flexible.[10]

SUMMARY

Emulsifiers have become a primordial element for today's high speed bakeries that required quick and clean label solutions to maintain quality and consistency of the products while keeping the desired organoleptic properties of the beloved baked goods. Current market trends require clean label solutions that can keep up with consumers demands without compromising in functionality of the industry while keeping cost down. Thus, emulsifiers represent a promising bakers option to successfully accomplish this task.

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