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Emulsifiers in bread improvers and bakery ingredients

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Introduction

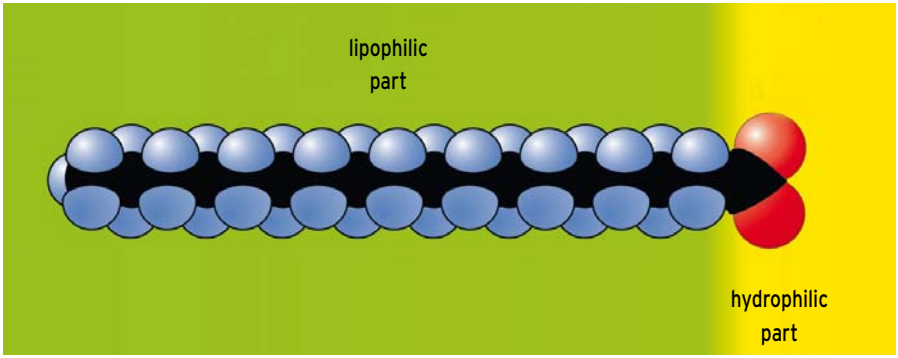
Today, the use of bread improvers and other bakery ingredients for the production of premium baked wheat and rye products has become standard practice worldwide. These products ensure reliable dough preparation for the production of breads, small baked items and fine bakery wares of high quality. For this, the emulsifiers used in these products play a distinctive role. In addition, with emulsifiers, the production of cake batters, fillings and decoration creams becomes much simpler, safer and more innovative.

What are emulsifiers?

Emulsifiers are substances which stabilise emulsions or allow their production in the first place. The best known natural emulsion is milk in which the milk fat is finely distributed in water. However, fat tends to settle on the surface which is known as creaming. The reason for this phenomenon is the repelling force formed between oil and water. The area where oil and water come into contact is known as "interface" in scientific language.

Emulsifiers attach to these interfaces and thus "link" the two "repelling" substances, oil and water. This characteristic of emulsifiers allows a homogeneous distribution of oil and water in the product, as for example in milk. The special structure of the emulsifiers makes this so-called emulsifying effect possible:

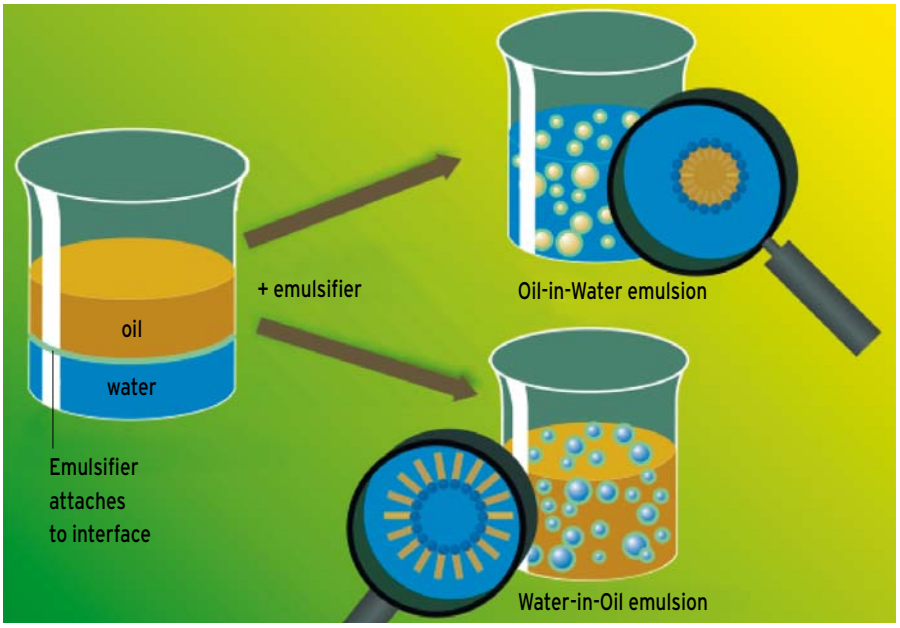
Figure 1: Structure of an emulsifier



All emulsifiers are composed of a hydrophilic part and a lipophilic part. Some of the lipids (fats) which are naturally present in flour also have this typical structure.

The action of an emulsifier can be best depicted by the emulsification of water and oil.

Figure 2: Emulsification of water and oil



The same principle, as for water and oil is also applicable to other substances which are not soluble in each other, e. g. gases (air bubbles) and solid substances (flour components) or air and water. This means, interfaces are also present between these substances.

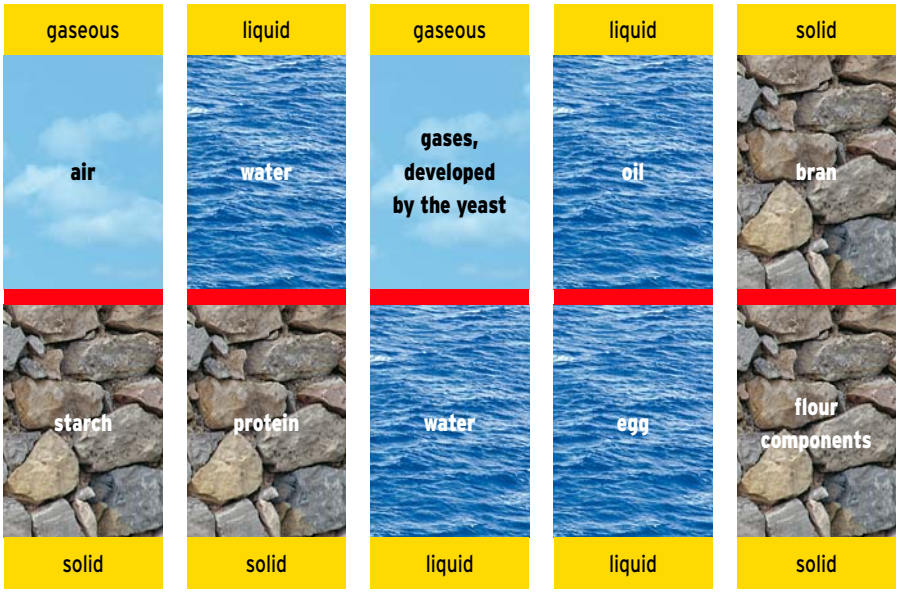


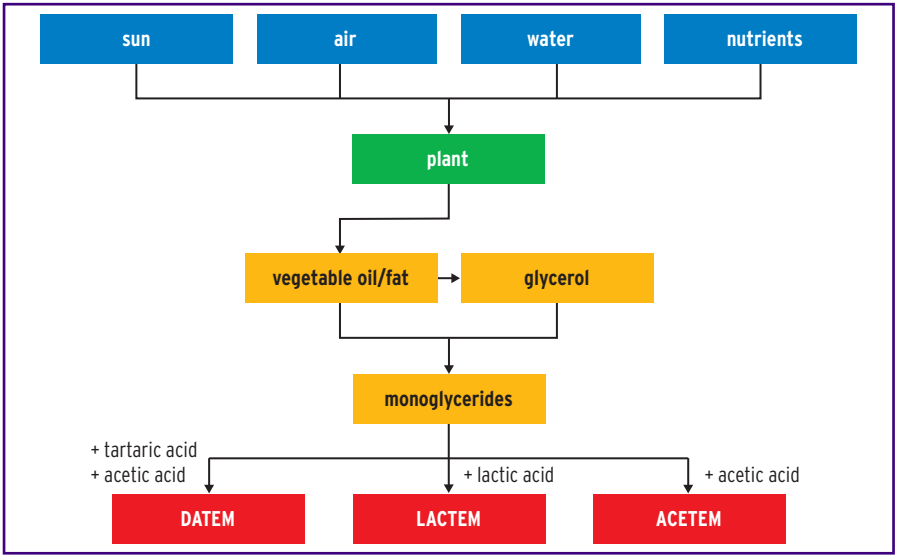
Figure 3: Schematic depiction of possible interfaces in bread dough or cake batter

Where can emulsifiers be found and how can they be produced?

Emulsifiers are fat-like substances and can be found naturally in fats and oils of animal or vegetable origin. Lecithin for example is present in soy beans (soy flour, soy oil) or eggs (Lekithos (greek) = egg yolk). Monoglycerides are present for example in lard. Lecithin is obtained mainly from soya or rape by solvent extraction.

Raw materials for the production of emulsifiers are natural fats and oils, glycerol as well as edible acids such as tartaric acid, acetic acid or lactic acid.

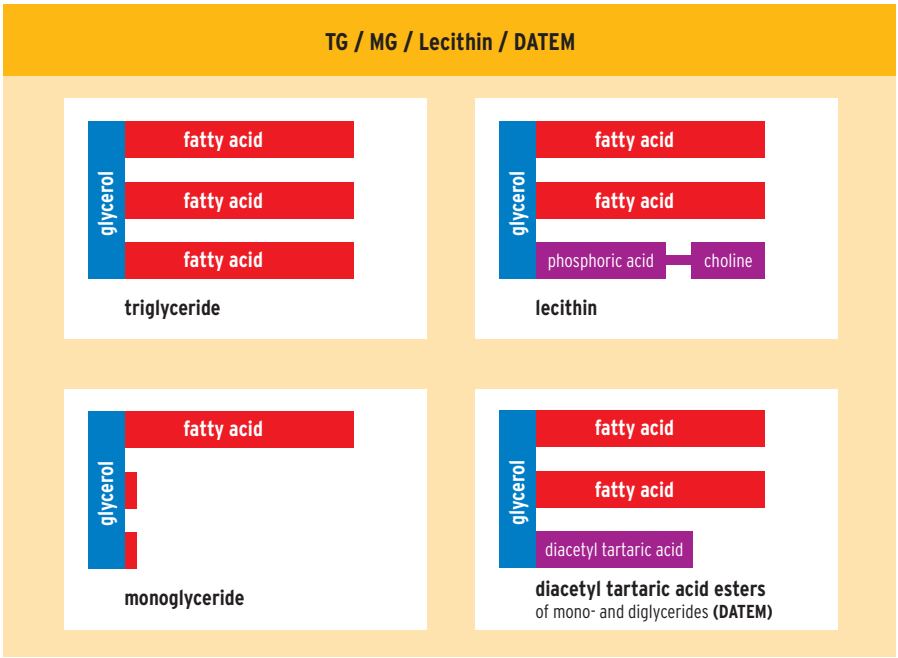
Figure 4: Production of emulsifiers



Firstly, a monoglyceride is produced from fat and glycerol. This monoglyceride can either be used as an emulsifier itself or be further processed into refined products such as DATEM. Monoglycerides are treated with tartaric and acetic acid to yield this emulsifier. It is the most important emulsifier used for bakery ingredients, for the production of bread and small baked items.

The following schematic depiction shows the similarity between the structure of naturally occurring fats and oils or the naturally occurring emulsifiers, monoglyceride and lecithin and the structure of the tailor-made emulsifier DATEM.

Figure 5: Structure of fats/oils and emulsifiers



Industrially produced emulsifiers must have a defined composition and purity. Prior to its approval as a food additive, the substance is thoroughly tested to show no harmful effects to human health. Furthermore, purity criteria have been defined which must be met precisely. Such emulsifiers are defined by a respective E-number (please refer to the table at the end of this booklet).

Next to the emulsifiers already mentioned, there are also SSL and CSL (sodium and calcium stearoyl lactylates), used for special applications (e.g. toast bread).

Which emulsifiers are used in improvers and bakery ingredients for bread and rolls and how do they act?

When producing baked goods, a uniform high quality must be constantly ensured. For this, it is important that the dough is stable prior to baking and does not collapse if subjected to vibrations, other mechanical strain or too long resting time. The flour quality is also of decisive importance. It is subject to annual changes depending on the climate in Europe. The gas produced by the yeast during the proofing process should be maintained inside the dough as much as possible in order to achieve a high volume, good porosity and uniform structure of the baked item.

Emulsifiers have been used for many centuries for the production of baked goods even when the bakers did not know why egg or lard improved the product. The main reason for that is that there are not always flour-inherent emulsifiers available in sufficient quantities in the flour. The industrial production of emulsifiers started in the 1920s. Monoglycerides have been produced since 1934, DATEM from 1960.

Gluten, the main protein compound in the wheat dough, is responsible for proper crumb texture and porosity in the baked product.

Almost all improvers for rolls and mostly those for bread contain the emulsifier DATEM (emulsifier E 472e). DATEM can strengthen the wheat gluten due to its specific structure. It improves gas retention and dough stability and provides for the

required kneading and proofing tolerance and resistance against mechanical shear. This results in baked goods with high volume and good crumb structure which are characteristics of high quality. Added to this, the emulsifier also ensures the machinability of dough during make-up.

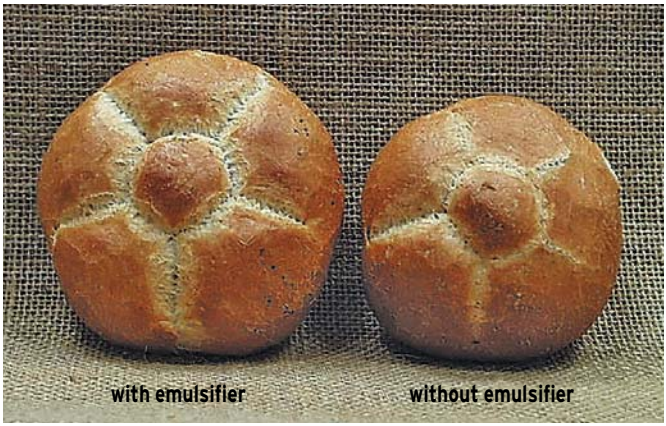


Figure 6: Volume of rolls made with and without emulsifier

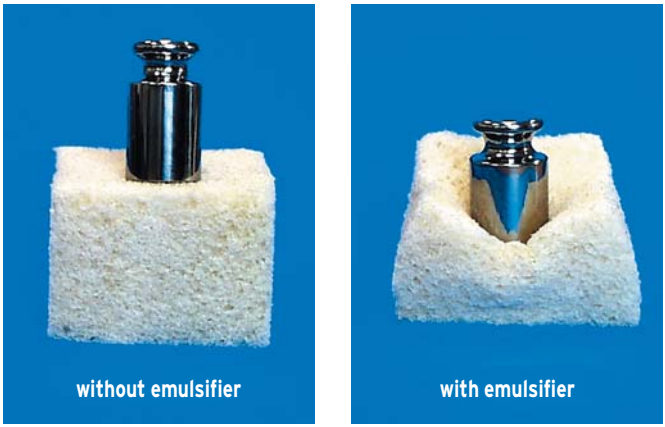
Lecithin is another commonly used emulsifier with a similar but less distinct effect than DATEM.

Another important quality aspect for baked goods is the tenderness of the crumb and the fresh-keeping properties (which does not mean spoilage by moulds or similar). After all, a mixed wheat / rye bread should also be soft and tender the next day.

Monoglycerides are used for improving the softness of the crumb, the tenderness and the fresh-keeping properties. Monoglycerides act upon some flour compounds (starch) and prevent or reduce the hardening of the baked goods. This is a transition process also known as bread staling.

As already mentioned, monoglycerides are contained for example, in lard (up to 2 %). This is one reason why lard can be still a popular ingredient for baked goods which should remain fresh for a prolonged period.

Figure 7: Crumb softness with and without emulsifier



SSL and CSL have similar effects as monoglycerides. However, these emulsifiers also have a certain stabilising effect on the gluten, producing a slightly higher stability and improved volume.

Which emulsifiers are used in improvers and bakery ingredients for fine bakery wares and how do they act?

Cakes, i.e. sponge and pound cakes, are made from batters. For sponge cakes, eggs and sugar are creamed in a first step before in a second step the flour and starch including baking powder, if needed, are carefully folded in. This production method is very sensitive to external influences and disturbances (e.g. vibrations, prolonged resting time prior to baking) and therefore not a reliable basis for a consistent and high end product quality as rightfully expected by the consumer.

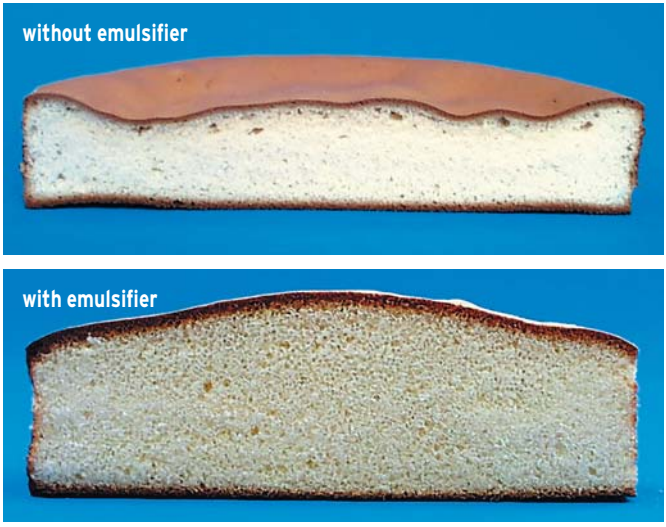


Figure 8: Sponge cake with and without emulsifiers

A reliable production of baked goods is made possible with the use of emulsifiers. Here too, the already mentioned monoglycerides or highly specialized products derived thereof such as e. g. LACTEM, ACETEM (see Figure 4) or other emulsifiers such as polyglycerol esters or propylene glycol esters are applied.

These emulsifiers facilitate the whipping of the batter (foam made of egg, flour, starch, sugar and air), stabilise the batter and thus ensure a constantly high product quality.

Another important benefit is that all ingredients can be mixed and whipped at the same time (all-in method). This way, e.g. ready-to-use baking mixes for the household can be made which are simple and easy to use and deliver reliable product quality.

How much emulsifier is used in the production of baked goods?

Depending on the flour quality and the type of baked goods, the emulsifiers lecithin, SSL/CSL and DATEM are commonly used in amounts of 0.2–0.5 %, for the production of bread and rolls; for monoglycerides the maximum quantity is 1 % (calculated on flour).

Emulsifiers for cake batters such as monoglyceride, LACTEM, ACETEM, etc. are used in quantities of 0.5–2 % of the finished product. It must be noted however, that these emulsifiers are used in respective preparations, for example spray-dried onto a carrier system or as a water-containing paste. This is the only way to ensure the proper reaction.

Where are emulsifiers also used?

Emulsifier-containing preparations are often used for the stabilisation of mousses, fillings and decoration creams, in particular, when milk proteins do not display a sufficient effect, as for example in acidic fruit creams.

Furthermore, emulsifiers are often found in chocolate-containing coatings as well as in shortenings. They should improve the melting behaviour of icings and coatings and increase the creaminess of shortenings.

The emulsifier-containing improvers and bakery ingredients for bread, small baked items and fine bakery wares made it possible in the past decades to produce a variety of flavourful, digestible baked goods in premium quality reliably and efficiently, not only in Germany. Never before has there been such a variety of different products on the market. Not only do current flavour trends or specialties specific to a certain region find their way into newly developed products but also into the latest findings on the use of ingredients beneficial to one's health. Quick implementation of new developments and fulfilling the consumers' quality expectations will remain the prerequisites in the future to maintain the high standards of baked goods. Emulsifiers are therefore indispensable.

How does the Regulation on Use of Food Additives describe emulsifiers?

Official name according to the Directive 95/2/EC	Commonly used abbreviation	E number
Lecithins	Lecithin	E 322
Mono- and diglycerides of fatty acids	Monoglycerides	E 471
Mono- and diacetyl tartaric acid esters of mono- and diglycerides of fatty acids	DATEM	E 472 e
Acetic acid esters of mono- and diglycerides of fatty acids	ACETEM	E 472 a
Lactic acid esters of mono- and diglycerides of fatty acids	LACTEM	E 472 b
Sodium stearoyl-2-lactylate	SSL	E 481
Calcium stearoyl-2-lactylate	CSL	E 482
Polyglycerol esters of fatty acids	Polyglycerol esters	E 475
Propane-1,2-diol esters of fatty acids	Propylene glycol ester	E 477