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SOFTER FOR LONGER

IN BAKERY PRODUCTS, SOFTNESS IS ONE OF THE KEY QUALITIES THAT CONSUMERS LOOK FOR. HOW CAN MANUFACTURERS IMPROVE THE APPEAL OF BAKERY PRODUCTS? BY **ELYNNE KAM**, PRODUCT & APPLICATION INNOVATION, FUTURA INGREDIENTS

EMULSIFIERS have traditionally been described as ingredients that assist in formation and stabilisation of emulsions. The definition can be expanded to include mixing of mutually insoluble phases. The first emulsifiers were naturally occurring surface-active proteins such as egg or casein. With advances in chemical and engineering technologies, the variety of emulsifiers has been greatly expanded and its applications into food products have enabled the widespread distribution of packaged foods.

More than just stabilisers of simple oil and water mixtures, food emulsifiers are employed for crystal modification and to form starch and protein complexes. Today, emulsifiers are used to modify the rheology of chocolate; for dough strengthening, crumb softening and retard staling of baked goods; to stabilise protein, fat and water emulsions in processed meat products; and for modifying the rheology of sorbet, ice cream and other dairy products.

In the baking industry, emulsifiers have long been used as important functional ingredients to:

- Improve the baking quality of flour,
- Prevent mechanical damage in fermented dough in automated factories,
- Aid in lengthening the shelf-life of bread, and;
- Improve volume, stability and texture of various bakery products.

The most widely used emulsifiers in bakery applications are distilled monoglycerides (DMG) and sodium stearoyl lactylates (SSL) which can trace their commercial use over decades. Today, many variants of DMG and SSL are available in the market to cater for different bakery functionality requirements which will be addressed here.

FUNCTIONALITIES OF DISTILLED MONOGLYCERIDES (DMG)

DMG are most commonly used in starch-based foods including wheat bread and other bakery products, cereals, pasta and potato products. The shelf-life and texture of baked goods is primarily influenced by the interaction of monoglycerides with amylose to form amylose complexes. DMG essentially extends the crumb softness or 'freshness' of baked products to enable it to stay softer for longer.

Starch (comprising amylose and amylopectin) is a polysaccharide that comprises glucose monomers joined in α 1,4 linkages. The simplest form of starch is the linear polymer amylose, while amylopectin is in a branched form.

During the process of baking, the starch granules will swell up and it will start to absorb water, allowing the amylose to transfer from an amorphous state into a soluble state and the amylopectin from a crystalline state into a gelatinised state. In the cooling stage of the freshly baked bread, the amylose will retrograde immediately by forming a complex with another amylose molecule, or form a complex with a polar lipid (the monoglycerides) thus producing softer crumb structure.

When wheat bread is stored, it becomes increasingly firm, partially due to the crystallisation process of the free amylose and partially due to the retrogradation (realigning) of the amylopectin of wheat starch.

When monoglycerides are added, they complex primarily with free amylose, significantly reducing the amount of amylose available for the retrogradation process. If the concentration of monoglycerides are high enough, a complex with amylopectin may be formed reducing amylopectin retrogradation.

The complexing effects of various emulsifier types will vary according to the fatty acid chain length of the emulsifier, degree of unsaturation, the degree of esterification (content of diacyl and triacyl esters) and the dispersibility of the emulsifiers in water.

SATURATED DMG VERSUS UNSATURATED, WATER DISPERSIBLE DMG

Although the manufacturing process of different baked goods may differ from one to the next, in general all of them require some form of mixing.

The functionalities of monoglycerides in bakery depend on the dispersion properties of emulsifiers during dough mixing. It is evident that if emulsifiers do not disperse during the dough kneading process or batter mixing, they will hardly show any functionality throughout the rest of the baking process.

The perfect balance between the particle size, the hardness or unsaturation, and melting point of the monoglycerides are the factors that influence the dispersibility of this class of emulsifiers.

In general, finer particle sizes will have a bigger surface area which improves the dispersibility and functionality of the emulsifiers in dough. The hardness of the monoglyceride is mainly determined by the saturation of edible fat from which the monoglyceride has been produced. Fatty acid unsaturation in a monoglyceride is indicated as Iodine Value (IV). The higher the IV, the higher amount of unsaturated fatty acids is present.

Monoglycerides with finer particle sizes and higher IVs have superior dispersion properties in dough and batter mixes. Therefore, they show better functionality in terms of crumb softening in baked products, and are far better than saturated DMG which is the most common monoglycerides found in the market today. Some emulsifiers do not exhibit desired characteristics unless its particle size has been sufficiently reduced.

WATER DISPERSIBLE DMG HAS BEEN SHOWN TO IMPROVE THE CRUMB SOFTNESS OF WHITE BREAD BY ABOUT 20 PERCENT, IN COMPARISON TO SATURATED DMGS.

Studies have shown significant improvement in crumb softness through the addition of water dispersible DMG against saturated DMG in baked products. The application of a like-for-like dosage of DMG in white sandwich bread has demonstrated that water dispersible DMG improves the crumb softness of bread by about 20 percent in comparison to saturated DMGs.

FUNCTIONALITIES OF SODIUM STEAROYL LACTYLATES (SSL)

SSL has strong ionic properties which enables the formation of complexes with both protein and starch in bread applications. It is believed to interact with protein in at least two ways. The stearic acid moiety is believed to form hydrophobic bonds with non-polar regions on the protein. Also, ion pairing is believed to occur between the carboxylic portion of the lactylate and charged amino acid residues on the protein.

Protein aggregation is an ability of SSL that happens through the neutralisation of charges on protein. This helps in the formation of a robust gluten matrix, where it helps volume enhancement, improving the dough mixing tolerance and machinability. This creates a distinction between volume enhancement and shock resistance.

The key function of SSL is to produce dough that is more viscous but not overly elastic, as in the case of a dough that is overly oxidised. The dough is also softer than un-emulsified dough and this allows for more abusive mechanical forces without causing irreversible damage to the protein structure. SSL provides the needed stability to the air cells created during fermentation and prevents the dough from collapsing during the manufacturing process when dough is exposed to mechanical abuse prior to baking.

SSL creates better gas entrapment in the dough proofing stage which helps to boost the volume of the baked products, especially in yeast-leavened bakery products. Additionally, the improvement of the gluten matrix using SSL helps to enhance the crumb structure of baked products. In similar mechanism to monoglycerides, SSL improves the crumb softness of baked products by complexing the starch and slows down the retrogradation rate of starch. This significantly aids in extension of shelf-life for baked products, keeping it softer for longer.

VARIETIES OF SSL AVAILABLE

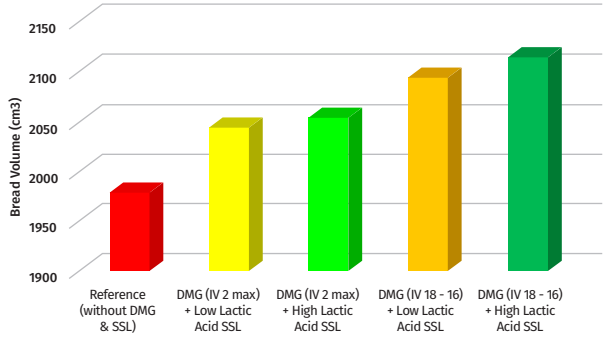
Not all SSLs available in the market have equal functionality. Some technical considerations include:

- **Low versus high lactic acid SSL**
  In general, the higher the lactic acid content in SSL, the greater is the functionality in dough strengthening. A high lactic acid SSL would impart better gas entrapment during proofing stage, better bread volume and oven spring, and thereby provide better crumb softening. The lactic acid content of SSL has a direct relationship with the Ester Value (EV) of SSL. Typically the higher the lactic acid content, the higher the EV of the emulsifier, indicating greater functional ester groups responsible for dough strengthening and crumb softening.

- **C18 fatty acid composition of SSL**
  The fatty acid composition of emulsifiers does exhibit an effect on the functionality of SSL. It is seen that long-chain saturated fatty acid esters (C18:0) gives the best dough strengthening impact and its associated benefits of gas entrapment, volume, oven spring and crumb softening effect.

DEPLOYING DMG AND SSL IN COMBINATION

SSL works synergistically with DMG, boosting the volume and softness of baked products. The combination of SSL and water dispersible DMG shows a superior performance than the combination of SSL and fully saturated DMG to slow down the retrogradation process of baked goods.



CONTEMPORARY EMULSIFIER NEEDS

Emulsifiers have been used for decades in the bakery industry. And as consumers become more health conscious and environmentally aware, a greater demand is placed on food and consumer products that fit their lifestyles. This includes bakery products made from sustainable sources of ingredients and raw materials, and natural or clean label products.

The emulsifier industry has also evolved to reflect this greater demand for sustainability by consumers with the adoption of a uniform, global, green certification process such as the Roundtable on Sustainable Palm Oil (RSPO), and to utilise raw materials sources for a lower environmental footprint.

EMULSIFIERS NEED TO KEEP UP WITH CONSUMER DEMANDS—HEALTHIER, CLEAN-LABELLED, AND SUSTAINABLY-SOURCED, YET STILL PROVIDING GOOD TEXTURE, TASTE AND PRODUCT QUALITY.

For manufacturers, the reality of formulating and producing clean label food products is a challenge. Manufacturers are hampered by limited amount of ingredients to modify texture, taste and improve on overall product quality. A total reformulation away from E numbers or emulsifiers for cost effective baked goods with extended shelf-life will be a difficult challenge, as a great part of the functionality provided by emulsifiers (improvement on product stability, quality, texture, and processing) are irreplaceable by other natural ingredients.

Accordingly, the bakery industry will need to balance the functionality and costs of their ingredients, all the while keeping abreast of the contemporary developments of emulsifiers which is continually evolving to meet today's consumer demands. APFI

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