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EMULSIFIERS IN AERATED FOOD

TO THE CONSUMER, THE QUALITY OF FOOD IS ALL ABOUT THE TEXTURE AND APPEARANCE. AIR PRESENT IN FOODS OFTEN CREATES CRITICAL SENSORY PROPERTIES, SO HOW CAN FOOD MANUFACTURERS MAKE FULL USE OF THIS 'INGREDIENT'? BY **LAIYEE LEE**, ASSISTANT MANAGER—TECHNOLOGY, FUTURA INGREDIENTS

FOOD systems are sophisticated matrixes. This is the result of processing a combination of ingredients with different properties. Food products in which air is incorporated during processing to produce a foamy or porous structure, is called aerated food. The matrix for aerated foods is more complex with a greater number of ingredients used and processes introduced to incorporate and maintain aeration.

Air is often present and inconspicuous but creates critical sensory properties such as texture and appearance in many food products. Some common examples of aerated food products are breads, cakes, breakfast cereals, ice creams, carbonated soft drinks, pop corn, rice cakes, chocolate mousse, whipped cream, milk shakes, macaroons, and meringue.

AIR IN FOOD

The sources of air in aerated food could be atmospheric air, compressed air, and gases such as carbon dioxide and nitrogen. Air in food is present in the form of air cells, which are also called air bubbles.

Air cells could be introduced into food structure through actions such as whipping or beating and gas injection. Air cells could also be generated in situ by ingredients added to release gases, for examples yeast (biochemically) and baking powder (chemically). Air could also be incorporated during processing, for example the application of heat during baking and carbon dioxide evaporation on pressure release.

In addition to the creation of a foamy structure, it is critically important to maintain and stabilise these foams to develop the ideal structure of aerated food. Therefore, the production of aerated food is a two-step process, first to create the aerated system, and next to stabilise the foamy structure. The stabilisation of foam matrix then preserves the quality and texture of the aerated food product through its shelf-life.

EMULSIFIERS IN AERATED FOOD

The use of food emulsifiers in aerated foods help to ensure that air cells are uniformly and finely distributed within the food matrix and is stable through the duration of its shelf-life. Emulsifiers are commonly used in:

- baked products for crumb softness and volume;
- edible oils and fats products to create stable emulsions and to help with volume enhancement where applicable;
- dairy and non-dairy products such as ice creams and frozen desserts to impart air cell stabilisation and improve sensorial characteristics.

A wide range of emulsifiers could be used to impart functionalities described above.

Emulsifiers are comprised of hydrophilic and lipophilic parts, and are classified as non-ionic, anionic, cationic and amphoteric. Each class of emulsifiers have individually unique surface active properties and can be present in various formats from solid to paste to liquid, depending on its raw material characteristics.

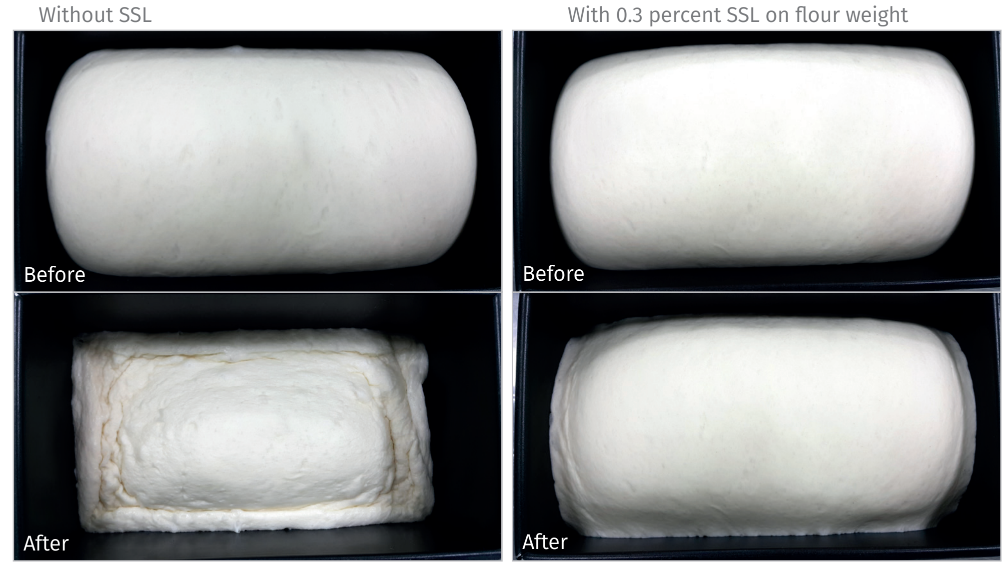

Figure 1: Dough with and without 0.3 percent sodium stearoyl lactylates (SSL) on flour weight, before and after dough tolerance test conducted immediately before baking. Dough tolerance test is conducted by dropping the dough in the bake tin twice from a height of five cm.

BREADS & BUNS

In breads, buns and baguettes, distilled monoglycerides (DMG) is a common crumb softener which helps with the formation of fine and uniformly distributed air cells. For volume enhancement and air cell stabilisation, sodium stearoyl lactylates (SSL) and diacetyl tartaric acid esters of mono- and diglycerides (DATEM) are typically used.

The interaction between these emulsifiers with wheat protein during kneading helps to improve the development of gluten network. This forms dough that is more pliable and extensible, which enables the dough to expand even more once carbon dioxide is released from yeast, thereby boosting the volume of the baked product.

The improved dough extensibility from emulsifiers also protects it from deformation as a result of mechanical shock (Figure 1). The use of emulsifiers show improved shock stability and imparts increased volume compared to products without emulsifier (Figure 2).

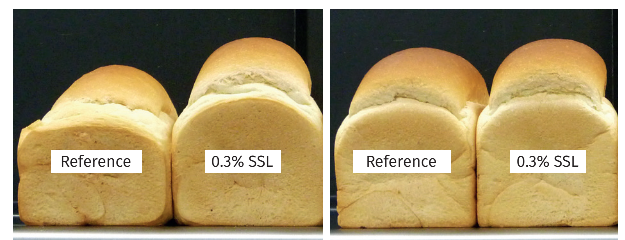

Figure 2: Bread baked with and without sodium stearoyl lactylates (SSL) under shocked (left) and normal (right) condition.

CAKE PRODUCTS

According to a study conducted by Campbell and Mougeot in 1999, air comprises of 30-50 percent of cake batter and 68-72 percent of baked cakes. This converts into specific volumetric air content of 40-100 percent and 200-250 percent respectively.

Air is incorporated by the whisking of ingredients at cake batter stage, while chemical leavening and heat during baking fully expand cake volume. Sponge cakes are typically more airy with lighter density, therefore also softer. And air content of sponge cakes are around 70-80 percent, or a specific volumetric air content in the range of 230-400 percent, reported the same researchers.

INCORPORATED BY THE WHISKING OF INGREDIENTS AT CAKE BATTER STAGE, AIR CAN COMPRISE 30-50 PERCENT OF CAKE BATTER AND 68-72 PERCENT OF BAKED CAKES.

Sponge cake batter is conventionally prepared in two stages—first to incorporate maximum amount of air and second to blend remaining ingredients to obtain the final batter.

In industrial processing, sponge cake batter is done in a single stage all-in method through the addition of cake emulsifiers. DMG, polyglycerol esters (PGE) and propylene glycol mono esters (PGME) are key emulsifiers for improved aeration in cake products.

In conventional cake products, the use of cake emulsifiers improves the aeration rate significantly and helps impart a smoother and finer crumb structure.

ICE CREAMS & FROZEN DESSERTS

Ice cream is formed as a matrix of fat, water and air. Depending on the fat content and the source of fat, the product may be termed a frozen dessert, frozen novelty or ice confection instead of ice cream.

Air is introduced by simultaneously whipping and freezing the mix. The specific volumetric air content, or overrun, in ice cream can range from 25 to 150 percent. Apart from tiny air cells, there are also fat globules, fat aggregates and ice crystals being dispersed in the unfrozen liquid phase in ice cream.

The aerated structure is created as air cells are stabilised by the partially agglomerated fat network and also from the water frozen into ice crystals.

The entire ice cream matrix is preserved by maintaining the ice crystals in its frozen form. Changes in the freezing temperature affects the ice crystals and hence the ultimate quality of the ice cream.

Ice creams and frozen desserts are one of the very few food products that are served frozen. The cold and creamy sensation of ice creams and frozen desserts comes from the unique structure developed during processing.

While the ageing and freezing process creates the partially agglomerated fat network which supports the air cells within the ice cream matrix, the use of emulsifiers enhances and stabilises the matrix.

Emulsifiers function at the interfaces between fat and water (emulsion), and fat and air (foam). A commonly used emulsifier in ice cream is mono- and diglycerides (MDG) or otherwise known as glycerol monostearates (GMS).

AS AIR IS INTRODUCED INTO THE FOOD SYSTEM DURING PROCESSING, IT NEEDS TO BE STRCTURALLY STABILISED, AND THIS CAN BE DONE THROUGH FOOD EMULSIFIERS.

WHIPPING AND WHIPPED CREAM

The foam structure of whipped cream is similar to ice cream but is devoid of ice crystals. A large amount of air cells is introduced during the whisking process which creates a foam matrix. The overrun in whipped cream can reach as high as 250 percent to 300 percent. This could be higher in imitation whipped cream, up to 400 percent.

Whipping cream and imitation whipping cream have different compositions, and require emulsifiers to stabilise the foam matrixes. Lactic acid esters of mono- and diglycerides (LACTEM) and MDG are the examples of emulsifiers used in the dairy-based whipping cream.

Vegetable fat based imitation whipping cream typically needs more emulsifiers to stabilise its cream and whipped cream structure. Some examples of emulsifiers used in imitation whipping cream are LACTEM, MDG, and SSL, which are often used in combination with foaming hydrocolloids such as hydroxypropyl methylcellulose (HPMC).

Apart from boosting aeration capabilities and foam stability, emulsifiers are also added to impart freeze thaw stability and help prevent serum separation in dairy-based products.

As air is introduced into the food system during processing, it needs to be structurally stabilised. Food emulsifiers interact with the ingredients to give desired functionality while supporting the development of foamy matrix in aerated products. This aerated structure is then stabilised through processes such as baking, freezing, chilling, etc. Now, would you define air bubbles as a food ingredient? APFI

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