VETERINARY ToDAY

Multiple Emulsions and Its Applications in Food - An Overview

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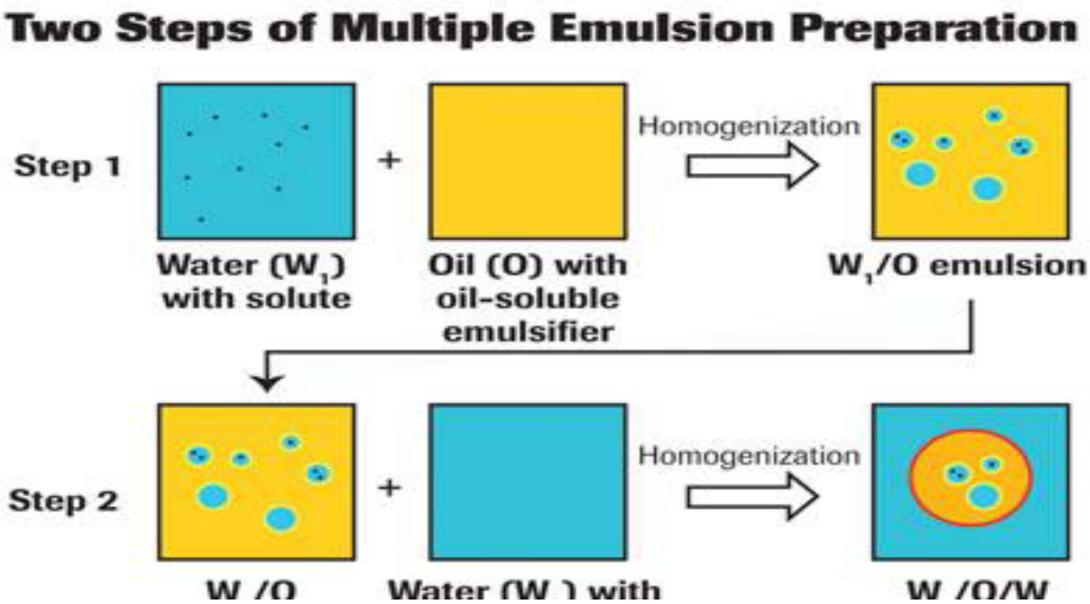

Abstract

An emulsion of an emulsion" is how multiple emulsions (also known as double emulsions) are described. Water-in-oil-in-water (W/O/W) and oil-in-water-in-oil (O/W/O) are the two basic varieties of multiple emulsions. Multiple emulsions have far more intricate structural make ups than simple emulsions, which has numerous benefits but also some application challenges. The potential uses of numerous emulsions in food have recently attracted a lot of attention. The encapsulation of bioactive components, the regulation of scent and flavor release, and the manufacture of low-calorie and reduced-fat foods are all recognized benefits of multiple emulsions in food applications. Multiple emulsions have also found use in commercial food production processes, such as several patented novel products (salted creams, fragrant mayonnaises, etc.), in addition to these advantages. Therefore, given that multiple emulsions promise a forward-thinking strategy for the food sector, there should be a significant potential and growing interest in their use in numerous alternative food products

Introduction

Generally, an "emulsion" is defined as a structure formed when one of two immiscible liquids (often oil and water) is dispersed within the other. While multiple emulsions can be referred to as "double emulsions" in publications, they can also be called "emulsions of an emulsion". When there are several emulsions present, an emulsion structure is created where the water-in-oil (W/O) and oil-in-water (O/W) forms coexist. Water-in-oil-in-water (W/O/W) and oil-in-water-in-oil (O/W/O) are the two basic forms of multiple emulsions (Dickinson, 2011).

In investigations done by Siefriz in 1925 on the phase inversion of a petroleum O/W emulsion stabilised with casein proteins, multiple emulsions were first unintentionally identified (Siefriz, 1925). Herbert described one of the earliest concrete uses of the therapeutic benefits of double emulsions in 1965 (Dickinson, 2011). Utilising numerous emulsions in food applications serves two tactical goals:

The primary goal is to encapsulate different scents, medicinal substances, or complex dietary ingredients. The second is to enable the manufacturing of food items with less fat and better nutrition. Since customers have become more aware of food goods, their expectations have changed, they have a propensity to seek out healthier products, and they have a tendency to lessen their risk of contracting various diseases, oil-reduced products are becoming more and more in demand. Multiple emulsions are thus a novel strategy in the studies of fat-reduced products.

Several emulsions Particularly W/O/W multiple emulsions have also been examined effectively for a variety of food applications, including the encapsulation of vitamins and minerals, aroma and taste release, and the manufacture of low-calorie foods, such as low-fat dressing (Sapei et al., 2012).

Basic structure of multiple emulsion

According to thermodynamics, emulsions can be categorized as macro, micro, and nano emulsions. Thermodynamic features can be added to conventional and complicated emulsions during or after manufacture. Additionally, an emulsion must be examined in terms of its various structural variations, including simple (conventional), and complex (multiple emulsions, firm material emulsions, filled hydrogel elements, etc.)

Oil-in-water (O/W) and water-in-oil (W/O) emulsions are the two categories into which emulsions are traditionally split in the food processing industry. Foods like ice cream, milk, cream, butter, margarine, juice, soup, cake, pastries, mayonnaise, cream liqueur, and coffee creamer could be used as examples.

The composition of an emulsion can be determined by taking into account a variety of factors, including the concentration of particular atoms (H. C, O, N, and Na, among others), molecules (water, sucrose, amylase, and B-lactoglobulin), molecule groups (proteins, lipids, carbohydrates, minerals), and components (powder, milk, salt, egg, and so on) (McClements, 1999). The basic components of a food emulsion are lipids, water, carbohydrates, and proteins, as well as other components such emulsifiers, minerals, gums, fragrance and colourants, preservatives, and vitamins (McClements, 1999). Surfactants and emulsifiers are some of the minor ingredients that are becoming more important in order to address stability issues. Lipids and water phases are some of the key ingredients.

Preparation of multiple emulsion

A two-step process is commonly used to create several emulsions. Multiple emulsions are referred to as W1/O/W2 or O1/W/O2 in basic investigations to simplify the process. Applications in the food industry often use multiple emulsions in the W1/O/W2 configuration. Since many food emulsions contain a continuous aqueous phase, choosing hydrophilic emulsifying agents that are suitable for use in foods is important.

Similar emulsification techniques to those used to create conventional emulsions, such as high shear homogenizers, membrane homogenizers, colloid mills, and ultrasonic homogenizers, are typically used to create W1/O/W2 emulsions. To prevent the disruption or expulsion of the W1 or O1 droplets, the homogenization conditions utilised in the second stage should be less vigorous than those used in the first stage (McClements et al., 2007).

By adjusting the first-stage homogenization settings (such as energy intensity and duration), emulsifier type, and emulsifier concentration, it is possible to regulate the size of the water droplets in W1/O and O1/W emulsions. The first homogenization step allows for the arrangement of or oil droplets, whereas the second homogenization step allows for the control of the concentration of final emulsion particles by using a different ratio of W1/O and O1/W emulsion to W2 and O2 phases, depending on the type of emulsion being used. Because of this, there is a lot of potential for adopting this method to produce several emulsions with various compositions and microstructures (McClements et al., 2007).

Application of multiple emulsion in food products

- While W/O/W emulsions are typically better suited for the encapsulation, protection, and release of hydrophilic components, they may have certain advantages over traditional O/W emulsions as delivery systems for bioactive lipids.
- n a W/O/W emulsion, bioactive components may be found in a variety of distinct molecular and physical settings. Hydrophilic components can be mixed into the inner water phase before the first homogenization stage or into the outer water phase before or after the second homogenization process by dispersing them in the W: phase.

- Before or after the initial homogenization stage, lipophilic components can be dispersed in the oil phase to be integrated into the oil droplets. Depending on when they are added into the emulsion preparation process, surface-active components may be found at the W/O or O/W interfaces.
- B-carotene and omega-3 fatty acids are two of the few instances when W/O/W emulsions have been employed to encapsulate lipophilic bioactive components, according to the scientists. Although there are many technological uses for W/O/W emulsions, there aren't many examples of them being used in functional foods. By adding water droplets to the oil phase of food products that are often made of oil-in-water (O/W) emulsions (such as dressings, mayonnaise, dips, sauces, and desserts), the overall fat content of these goods may be lowered.
- It is possible to create a W/O/W emulsion with a lower fat content while maintaining the same overall dispersed phase volume fraction and droplet size distribution as a typical O/W emulsion. Therefore, it ought to be possible to create reduced-fat goods that have physicochemical and sensory qualities (such as appearance, texture, mouth feel, and flavour) that are comparable to those of full-fat products.
- Despite the fact that vegetable oils, particularly O/W type emulsions, have been used to create meat products with healthier lipids and food that adheres to health recommendations, there hasn't been enough research on the use of multiple emulsions in the production of meat products. Along with reducing fat, W/O/W emulsions can be utilised to prevent light and enzyme-induced oxidation of the emulsion, release bioactive components through solution, shear, and mixing, and trap unpleasant odours and aromas in the inner water phase.

- as previously indicated, numerous new products have been patented as W/O/W emulsions up to this point, including salted creams (salt encapsulation), aromatic mayonnaises (encapsulation of aroma), etc. (Garti, 1997). W/O/W2 emulsion-based food delivery systems have recently attracted greater attention.
- Using a W/O/W emulsion that included canola oil and was stabilised with certain hydrocolloids, Lobato-Calleros et al. (2008) produced white cheese with less oil than the control group without significantly affecting the sensory, textural, or rheological qualities. The oil rate in the white cheeses made with numerous emulsions was reduced by up to 26%.

Conclusion

Over the past few years, there has been an increase in interest in how eating affects human health. Food is useful not just because it contains necessary nutrients, but also because it contains other bioactive chemicals. It has been discovered that enhancing food functioning and reducing undesirable substances like fat are crucial for promoting good health and preventing disease. Numerous emulsions, whose new applications are attracting growing interest in the food business, can be credited with these positive impacts.

The target product must be considered while choosing an emulsion type and component concentration. While O/W/O multiple emulsions excel at utilizing essential fatty acids and encapsulating bioactive components that are oil-soluble, W/O/W multiple emulsions are frequently employed in studies that look at how much fat and calories are removed from food as well as how to encapsulate and regulate the release of bioactive components that are water-soluble.

have been a number of effective research conducted up to this point on the blending and interactions of the primary and minor components of numerous emulsions. There are patented studies on the use of W/O/W emulsions in industrial applications, such as the production of reduced fat yoghourt and cheese, salty creams (salt-encapsulated), aromatic mayonnaises (aroma-encapsulated), and probiotics in edible multiple emulsions, which can be described as limited laboratory scale applications.

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