Food emulsions: an important mix

Food emulsions are everywhere in today’s food industry. From the milk poured with a bowl of cereal in the morning to the margarine used to flavor rolls at dinner, food emulsions are something that an individual will encounter on a daily basis. By formal definition, a food emulsion is defined as, “ a colloidal dispersion of two liquids, usually oil and water, that are immiscible. ” (Murano 2003). To better understand what this definition is stating, a colloidal dispersion must also be defined. A colloidal dispersion is a dispersion of food colloids, a dispersed phase, into a continuous phase such as water or oil.

Keep in mind, however, that a colloidal dispersion is not a solution, and the two liquids are said to be immiscible, meaning unmixable. Food colloids are too large to be dissolved into a solution and are thus suspended in a continuous phase, similar to a mixture, but the particles are still small enough that they will not settle out like in a suspension. In a colloidal dispersion, the food colloids are each approximately 10 – 100nm in diameter, smaller than food particles contained in a suspension, but larger than those that can dissolve into a solution (Murano 2003). Some people regard foams as a type of emulsion, but this is not true.

Foams are similar to emulsions, but occur when a gas is dispersed in a liquid, such as in whipped cream. Other dispersions similar to emulsions are gels, which are a liquid dispersed in a solid, and sols, which are solids dispersed in a liquid, an example being gravy. The history of food emulsions starts with milk. Milk is the oldest known food emulsion and can be dated back to 8000 BC with the domestication of sheep and cows in India, the Middle East, and

Sub-Saharan Africa. The classification of oil-in-water and water-in-oil emulsions originated from a 1910 paper by Wolfgang Ostwald (Becher 1991).

Milk, butter, and cheese were the pioneering emulsions and were created long before other emulsions such as margarine, mayonnaise, salad dressings, gravy, certain meats (frankfurters), and ice cream. Butter and cheese emulsions were discovered shortly after milk, when the domestication of goats and cows became more popularized. Mayonnaise is an emulsion that is made using lecithin as an emulsifier. Using a previous recipe from the town of Mahon in Spain, the French created the emulsion we now know as mayonnaise in the mid 1700's. Margarine was also discovered in

France and was produced shortly after in the early 1800's. Today, emulsions can be very complex with the pasteurization of milk and the various types of cheeses, butters, and dressings produced using emulsions. The most typical types of emulsions found in foods that we consume on a daily basis are the O/W (oil-in-water) and W/O (water-in-oil) emulsions. An O/W emulsion occurs when oil particles are dispersed in a continuous phase of water. Some of the most common examples of O/W emulsions include products like milk, cheese, vinaigrettes, mayonnaise, and other dairy products.

Milk, is a quite unstable when unpasteurized. Due to its instability it needs an emulsifier to create the emulsion. Once the milk passes through the pasteurization process, fat globules decrease in size and no longer clump together, creating a stable emulsion with no separation. Likewise, W/O emulsions occur when water particles are dispersed in a continuous phase of

oil. W/O emulsions that we use on a daily basis and as ingredients in common foods are butters, margarines, and some specific oil products like cod liver oil.

In addition to both O/W and W/O emulsions, two forms of more complex food emulsions exist. These emulsions are of the oil-in-water-in-oil form (O/W/O) and the water-in-oil-in-water-form (W/O/W). They are simply emulsions within emulsions, acting to stabilize the “ multiple emulsion”. For instance, water droplets containing smaller oil droplets within them may be dispersed in a continuous phase of oil, thus creating an O/W/O emulsion. Most multiple emulsions are still not widely used in food processes, but the main use so far is to incorporate fat-soluble vitamins into various foods and beverages.

Emulsifiers are used to hold emulsions together, whether they are of the O/W, W/O, W/O/W, or O/W/O variety. Some examples of emulsifiers are Lecithins, monoglycerides, and diglycerides. A few more specific emulsifiers are Calcium Stearoyl Di Laciate (CSL), PolyGlycerol Ester (PGE), Sorbitan Ester (SOE), PG Ester (PGME), Sugar Ester (SE), Monoglyceride (MG), Acetylated Monoglyceride (AMG), and Lactylated Monoglyceride (LMG). All of these emulsifiers are amphiphilic molecules with an oil-friendly (hydrophobic) head and water-friendly (hydrophilic) tail.

An example of the use of an emulsifier is the addition of lecithin to egg yolks when used as an ingredient in mayonnaise. Without the lecithin, the oil in the mayonnaise would rise to the top and create separation of the ingredients, causing an unstable emulsion. This demonstrates the necessity of the emulsifier lecithin used in mayonnaise. A vast array of applications for food

emulsions have been demonstrated, and because of this there is no one company that has a monopoly on this specific industry of food science and production.

That being said, Unilever Inc. enerates significant revenues from products using this technique. Unilever is one of the leaders in world food production with their 11 largest brands combining to reap more than a billion dollars annually in revenues. Some of Unilever's most popular consumer products are created using emulsions, including Best Foods Mayonnaise and Country Crock (a brand specializing in butter and margarine products) (Reece 2000). Strong brand names such as the two previously mentioned are what drive Unilever's ability to be the largest producer of food on the planet (Yahoo! Finance 2010).

Meanwhile, Kraft, the nation's largest and the world's second largest food producer is no less familiar with the use of food emulsions. Kraft has their own popular differentiation of mayonnaise dressing, Miracle Whip, and a French dressing, Hidden Valley French Dressing, and both use egg yolks in order to create a stable emulsion within the product (Thompson 2003). However, it is important to note that while the largest food operations in the world use emulsions in their products, even privately owned farms are capable of producing and marketing emulsion-based food products.

Such is the case with the South Mountain Creamery, which uses emulsions in their dairy products, and is located in nearby Middletown, MD. They claim to market their product only to the Washington DC, Maryland, and Virginia areas, and have been in business for nearly three decades (South Mountain

Creamery 2010). This goes to prove that whether a business is large or small, emulsions can play a key role in a food producer’s ability to provide marketable products. There have been many recent developments in regards to emulsions.

The first is new developments in fat emulsions. These developments deal with the differences between long-chain and medium-chain triglycerides and the effects of their usage. By mixing long-chain to medium-chain triglycerides when making emulsions, companies are able to eliminate some of the risks that are inherent in lipid emulsions. Studies surrounding the mixture of the two triglycerides have suggested that they could offer important advantages as an alternative energy source for total nutrition.

The mixture allows for the reation of fuel, where some is metabolized quickly, while the rest is metabolized slowly (Jiang et al. 1993). By taking advantage of this, there are more and more places where these emulsions could begin to be marketed, such as to athletes and weight trainers, and could have positive externalities on society as a whole. Another development in emulsion technologies is new and improved detecting methods. To begin, new analytical instrumentation has helped in detecting different properties of emulsions.

By making advances in analytical processes and equipment, organizations now have a better ability to predict, understand, and control the properties of their emulsions (Aveyard et al. 2003). The use of microscopy and nanotechnology is a budding technology in regards to producing emulsions. With the use of new transmission electron microscopy, images can be more

easily and readily observed. This allows for more information to be obtained concerning what goes on within emulsions at a molecular level, aiding in producing the most stable and appealing products possible.

Lastly, by continuing to experiment with emulsions, scientists are making strides in learning more about how food emulsions function. They have even recently found new physicochemical and physiological bases for flavor release. This allows for even more opportunities for food manufacturers to use emulsions in their products. With their already well-established presence in popular food culture, and the continued enthusiasm towards improving the uses of them, food emulsions are clearly an important segment for food manufacturers to be involved in.

With the longstanding use of oil-in-water and water-in-oil emulsions providing a basic framework, new technologies such as multiple emulsions and improved detection methods are being developed to refine the uses of emulsions in the food industry everyday. Whether it is milk, or a multiple emulsion, these mixtures are crucially important to the producers and consumers of many foods. Without emulsions, many products would not exist, and the commercial food industry would be undoubtedly less diverse than it is today.