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Process Bulletin

Orange Oil Emulsions

Description

There are generally two types of cloud or beverage emulsions containing orange oil. One is an orange oil emulsion, and the other is a flavor (or orange) cloud emulsion.

As the name implies, an orange oil emulsion consists of orange oil emulsified into water. This emulsion is used as a concentrate to provide cloud and flavor to carbonated or non-carbonated beverages. Orange oil or citrus oil consists mostly of the terpene d-limonene along with other compounds. When the concentrate is diluted 1 to 1000, the emulsion imparts a cloud (turbidity) and flavor to the drink.

A flavor cloud emulsion contains less orange oil (or other flavoring oil) than an orange oil emulsion but also contains vegetable oil to produce a cloud in the beverage.

Objective

The oils (flavoring and cloud) must be emulsified in water so that the droplet size of the oil is less than 2.0 micrometers. The oil droplets should not be so small that light scattering is diminished and the cloud or turbidity is eliminated. If the oil droplets are too large, stability of the emulsion is adversely affected, and oil ringing of the diluted emulsion can occur. (Ringing describes the formation of an oil ring around the inside neck of the container, due to the creaming of the oil phase.) These low-density oils (specific gravity of 0.845 – 0.890) are usually weighted with an ingredient to increase the oil density and, thereby, decrease the rate of creaming of the oil droplets. Some weighting agents are ester gum (glycerol ester of wood rosin), damar gum and sucrose acetate isobutyrate (SAIB). [C. Tan, “Beverage Emulsions,” in **Food Emulsions**, Second Edition, eds. K. Larsson and S.E. Friberg (New York: Marcel Dekker, 1990), 445 – 478.]

Formulations

1. A typical formulation of an orange oil emulsion using gum arabic (acacia gum):

10%	orange oil
10-20%	gum arabic
0.3%	citric acid
0.1%	sodium benzoate
	Remainder water

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The orange oil is often weighted with an ingredient such as ester gum to increase the density of the oil. The ester gum is dissolved in the oil. The gum, with a specific gravity of about 1.08, is added in an amount that will raise the specific gravity of the oil/ester gum mix close to the specific gravity of the sugar solution in which it will be dispersed. The amount of ester gum used may not exceed the maximum permissible amount allowed by law in the finished emulsion. The gum arabic is dissolved into the water and functions as a surface-active agent, which stabilizes the oil against flocculation and coalescence. The sodium benzoate is used as a preservative, and the citric acid is used to enhance the flavor of the beverage and to aid the preservative action of the sodium benzoate. According to the reference cited above [**Food Emulsions**], the pH of the beverage emulsion, due to the citric acid, should be less than 4.5.

a. A formulation using a cold water soluble starch in replacement of gum arabic is:

11.0%	Purity Gum BE (National Starch & Chemical)
11.0%	orange oil or flavor oil blend
0.3%	citric acid
0.1%	sodium benzoate
77.6%	water

Formulation is given by National Starch & Chemical Corp. (Technical Service Bulletin). As mentioned above, the orange oil is usually weighted with an added ingredient.

b. A formulation of a flavor cloud emulsion is:

10.5%	Purity Gum BE
15.0%	vegetable oil (with orange oil flavoring or terpenes)
0.3%	citric acid
0.1%	sodium benzoate
74.1%	water

The vegetable oil used may be a weighted coconut oil. The orange flavoring oils, also weighted, are sometimes put into the emulsion separately, rather than blended with the vegetable oil.

3. Patent 4,084,012 describes another replacement for gum arabic:

1-20%	water-soluble hydroxypropylmethyl cellulose ether
5-30%	propylene glycol
1-30%	flavor oil
0.1%	citric acid
0.1%	sodium benzoate
	Remainder water

The propylene glycol increases the compatibility of the edible flavor oil and cellulose ether. The cellulose ether acts as a stabilizer for the flavor oil.

Processing Conditions

When using gum arabic, the quality of the gum must be carefully monitored. In the past, some low quality gums contained impurities, such as sand, which can be highly abrasive with respect to the homogenizer valve parts. After hydration of a gum containing impurities, incorporation of any sediment into the final solution should be avoided. Most gums available today are highly purified products. (Product Data Sheet, TIC Gums, Inc., Belcamp, Maryland) Also, formulation may need to be adjusted, if the source of the gum is changed, because of the variations in quality. The hydration of gum arabic is another important parameter to be considered. The gum works best when it is hydrated in the water for many hours. The premix to the homogenizer should be prepared in such a way that droplet size distribution should be narrow and the average droplet size as small as possible. By generating a good premix, uniformity in batches can be maintained and successful reduction of oversized particles can be obtained by homogenization. A good premix should have most emulsion droplets less than 10 micrometers.

The emulsion is homogenized at a total pressure of 3000-5000 psi using a two-stage homogenizing valve. The second-stage pressure should be 10 to 15% of the total homogenizing pressure. It is usually necessary to homogenize the emulsion more than once to obtain a uniform size distribution of the oil. These multiple passes reduce the population of oversized particles, thereby, decreasing the possibility of ringing. Simply going to higher pressure does not usually eliminate the necessity of multipassing, and this course of action may lead to overworking the emulsion.

When the emulsion is overworked, the number of submicron droplets is increased to such an extent that the stabilizer cannot handle the total surface area generated. This results in a clustering or flocculation of the droplets and the subsequent deterioration of the emulsion (see reference in **Food Emulsion** given above). The quality or concentration (too low) of the stabilizer can also bring on the formation of droplet clusters in emulsions not overworked.

Testing

Orange oil emulsions can be evaluated by microscopic examination, shelf life and turbidity. The Gaulin EQA™ can be used to monitor emulsion quality by means of light transmission.

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