PHYSICAL STABILITY IMPROVEMENT OF LIQUID NUTRITIONAL PRODUCTS

This is a continuation of application Ser. No. 07/933,630 filed Aug. 24, 1992, now abandoned, which is a continuation of application Ser. No. 07/596,140 filed on Oct. 10, 1990, now abandoned.

TECHNICAL FIELD

The present invention relates generally to liquid nutritionals, and more particularly, to a physical stability improvement for use in liquid nutritional products.

BACKGROUND ART

The liquid nutritional industry is a multi-billion dollar a year business. Two of the major components of the industry are infant formula and medical nutritionals. These types of liquid nutritionals contain an appreciable amount of minerals suspended in a liquid medium. The presence of these minerals is vitally important to the efficacy of the liquid nutritionals, however, the presence of the minerals and high levels of protein and fat causes a number of problems.

For decades, the usage and marketing of liquid nutritionals traditionally have been confronted with two major problems. The first problem is known as creaming, whereby the fat globules in the liquid nutritional float to the top of the product. A problem can arise if these fat globules harden, effectively forming a seal across the top of the liquid nutritional's container. Additionally these hard, fatty deposits can block or clog feeding tubes or nipples.

The second problem associated with liquid nutritionals is sedimentation, whereby minerals come out of solution and settle to the bottom of the product container. The problem of sedimentation is made more acute where the sediment hardens into a cementous type of material known as "nondispersible sediment" The problem with nondispersible sediment is two-fold. First, the liquid nutritional is now subject to nutrient deficiency, since the nondispersible sediment often refuses to go back into solution upon the shaking of the container. The second problem with nondispersible sediment is that it, along with hardened creaming deposits, can plug feeding tubes or nipples.

Modified stabilizer systems have been proposed to address the sediment problem, however, they have met with limited success. These systems permit the minerals to be suspended longer, but nevertheless they ultimately fall from solution. In this modified system iota-carrageenan is combined with kappa-carrageenan in a ratio of 2:1. However, a new problem exists with such modified systems. The phenomenon known as "sag" occurs in these stabilizer systems as the components of the liquid nutritional flocculate and separate over time. "Sag" is a separation of the product matrix in which flocculent and clear areas develop. The resultant liquid nutritional looks "curdled" or the victim of bacterial spoilage. Another alternative solution to the problem of the physical stability of liquid nutritional products is the micronization of the salts or minerals in the liquid nutritional. This approach is costly, and any creaming or sedimentation which occurs is typically not able to be disposed of by shaking the container.

Still another approach to the problem involves the use of soluble calcium in an attempt to avoid problems with the calcium minerals coming out of solution. However, the problem caused by creaming remains and potential plugging of the feeding tubes or nipples is still a possibility.

Obvious problems exist in the marketing of the liquid nutritionals discussed above inasmuch as consumers are reluctant to buy product that appears to be spoiled, even if in point of fact there is nothing nutritionally wrong with the product. Heretofore, this problem has been addressed by the packaging of liquid nutritionals in cans or opaque containers which do not permit the consumer to visually inspect the product prior to use.

One of the key components of liquid nutritionals with respect to product stability is carrageenan. Carrageenan is a group of highly sulfated high molecular weight linear polysaccharides. The functionality of carrageenan can be attributed to its chemical structure, especially the ester sulfate group content and molecular size. There are three main types of carrageenan: kappa, lambda, and iota.

When heated in water, dissolved carrageenan molecules exist as random coils. Upon cooling and in the presence of appropriate cations, kappa and iota carrageenan molecules form double helix domains and aggregate to form gels of different textures. Kappa carrageenan forms a strong rigid gel through ion-bridging between negatively charged sulfate groups. Iota carrageenan forms elastic gels in the presence of calcium ions due to the higher sulfate group content which imposes higher electrostatic repulsive force and keeps molecules and helices from getting too close to form a tight and rigid gel. Lambda carrageenan will not gel because of the high sulfate group content and corresponding strong repulsive force which keeps molecules from forming double helices and gel.

Carrageenan has heretofore been used as a thickening agent in the food industry, for such products as cheese, mayonnaise, pudding, frozen dairy desserts, and pet food. The use of carrageenan in connection with solid food products is disclosed in U.S. Pat. Nos. 4,427,704; 4,623,552; 4,282,262; 3,544,333; 4,389,426; 4,609,554; 4,684,533; 4,748,026; and 4,479,973.

The use of a mixture or a reaction product of at least one carrageenan and at least one glucomannan in foods products, and especially as part of a gelling systems for use in the preparation of gelled or thickened food products is disclosed in U.S. Pat. No. 4,427,704 to Cheney et al. Although the carrageenan is disclosed as being any form of carrageenan or a mixture thereof, the preferred carrageenan types contain some kappa-carrageenan.

The use of kappa-carrageenan, iota-carrageenan and mixtures thereof in a pudding composition is disclosed in U.S. Pat. No. 4,623,552 to Rapp. Typically the total carrageenan content is in the range of from about 0.05% to about 1.0% by weight; preferably from about 0.1% to about 0.5%, and most preferably from about 0.1% to about 0.3% by weight. In the three examples illustrating the U.S. Pat. No. 4,623,552 invention, kappa-carrageenan is used exclusively or in greater concentrations than are associated with iota-carrageenan.

The use of carrageenan as a stabilizer gum in a dairy based dessert mix composition, which upon aeration can be statically frozen to provide aerated frozen desserts, is disclosed in U.S. Pat. No. 4,282,262 to Blake. The only specific type of carrageenan mentioned is kappa-carrageenan.

The use of iota-carrageenan in the preparation of a nonfat milk macaroni product is disclosed in U.S Pat. No. 3,544,333 to Glabe et al. Preferably the iota-car-