FATS AND PROTEINS RESEARCH FOUNDATION, INC.

Director's Digest

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Newer Fractionation Methods for Tallow

The United States is the largest tallow and grease producer in the world, producing in excess of 7.8 billion lbs. in 1978, with an anticipated annual growth rate of 3.7%. At the present time, approximately 800 million lbs. or slightly more than 10% of the total tallow production is used in domestic edible products. Meanwhile, about 42% of all United States tallow is exported at relatively low prices when compared to other fats and oils. Concurrently, cocoa butter, palm oil, coconut oil and palm kernel oil have been imported into the United States in increasing amounts during recent years for use in foods generally and confectionery particularly. An evaluation of tallow and tallow fractions as potential replacements for the more expensive imported fats and oils has elicited considerable interest in both industrial and government laboratories.

The technology now exists whereby beef tallow can be separated into fractions which are compatible with, and in some instances are replacements for, imported fats and oils. Three industrial methods have been used to fractionate lipids such as palm oil and tallow. They include dry or thermal fractionation (which is a slow crystallization from a melt, usually in an open kettle), solvent fractionation and aqueous fractionation with the aid of surface active agents. The latter method had been used for some time in various foreign countries while permission to use sodium lauryl sulfate for this purpose was granted by the United States Food and Drug Administration as recently as May of 1978.

The dry fractionation method is the oldest of the three but is simply too inefficient and labor intensive with resulting high costs under today's conditions. In solvent fractionation, the filtration rate is higher and much more efficient separation of the individual fractions is possible. Edible beef tallow has been effectively fractionated via an acetone crystallization procedure by the Eastern Regional Research Center of the United States Department of Agriculture to yield three functionally distinct portions. The first portion, or stearine, representing about 14% of the total, is a largely saturated fat. It can be used to harden shortenings and margarines without the necessity of the hydrogenation step often required with vegetable oils. The second portion, which is semisolid in consistency, is very similar in composition and properties to cocoa butter. It is compatible with cocoa butter and can be mixed with chocolate liquor or powder as an extender or substitute for cocoa butter in chocolate-type products. While this portion represents only 20% of the starting material, it is a potentially very important segment commercially. Cocoa butter is the most expensive edible fat and a suitable substitute for it or a fat which is compatible with it and will not promote or cause chocolate bloom will have considerable commercial value. The third portion, a liquid trivially called "beef-oil", consists largely of unsaturated oleates and shows promise as a salad oil. However, the use of solvents in fractionation has two cardinal drawbacks: energy costs for solvent recovery are high and the equipment must be explosion-proof, requiring extensive capital outlays.

In the aqueous fractionation procedure a semi-solid fat is mixed with an aqueous solution of a surface active material and an electrolyte. The surfactant serves to wet the fat crystals in the aqueous phase, and to wash them free of adherent oil. The water suspension of fat crystals is then separated from the lighter oil phase by centrifugation. This procedure avoids the filtration step of the solvent fractionation method. The fat crystals in the aqueous phase are subsequently melted and the phases again separated by centrifugation. While little has been reported on detergent fractionation of tallow in the U. S., the method has been known in Europe and Australia for some years.

Recently Dr. James I. Gray of the Dept. of Food Science and Human Nutrition, Michigan State University, with grant support from the Fats and Proteins Research Foundation, successfully separated tallow into 5 different fractions which are now being analyzed and evaluated. The initial fractionation, using the aqueous detergent method with sodium lauryl sulfate as the surfactant, was carried out at 40°C. This yielded equal amounts of a hard stearine fraction and an oil. The oil was further separated into 5 additional fractions by step-wise cooling (thermal procedure) and the formed fat crystals were collected by centrifugation at each step. In this way solid and liquid fractions were obtained at 22, 15, and 4°C, respectively. The functional characteristics of these fractions are now under investigation with the collaboration of Prof. Mary Zabik.

The stearine fraction obtained in the first step shows potential as a hardening agent for margarine and shortenings. At this time, for applications in the confectionery industry, hard butters produced by hydrogenation and interesterification or fats and oils offer economic advantages over those obtained by the solvent fractionation of fats. Dr. Gray anticipates that a fraction compatible with cocoa butter and suitable as an extender or substitute can be isolated by the combined detergent and dry fractionations or that a recombination of fractions can be made to "create" such a fat. The liquid fractions obtained at 15 and 4°C. are clear, pale yellow oils without a tallow flavor and have characteristics similar to those of a high quality vegetable oil.

Several favorable factors appear to have developed simultaneously. With the availability of a commercial continuous detergent fractionation system for the separation of fats, a new regulation permitting the use of a detergent in the United States in the processing of edible fats and oils and the high cost of cocoa butter and similar fats, the time appears propitious for the development of a new separation procedure for the fractionation of tallow into more valuable components for food and confectionery uses.