Feature

Confectionery Fats—For Special Uses

The U.S. confectionery industry, which produced approximately 3.8 billion pounds of candy worth over $5.5 billion in 1982, provides an annual market for approximately 100 million pounds of vegetable fats and oils, according to the U.S. Department of Commerce's Confectionery 1982 report issued in August 1983. These fats and oils are used as specialty fats in confectionery coatings, candy centers and chips in cookies; for roasting nuts for confectionery use; and in bakery and nondairy products.

One function of fat in chocolate and confections is to hold the other ingredients together in an acceptable form before eating. The fat content of chocolate or of a coating is approximately 33%. In the U.S., the only fats allowed in products labelled chocolate are cocoa butter and butter fat.

Cocoa butter is comprised of predominantly symmetrical triglycerides with oleic acid in the 2-position. Cocoa butter has a melting range of 32-35 C (90-95 F) and softens around 30-32 C (86-90 F). The completely liquid fat displays a tendency to supercool, an important factor in chocolate enrobing and molding. Cocoa-butter characteristics include a brittle, nongreasy texture at room temperature, quick meltdown at mouth temperature, excellent keeping qualities such as resistance to oxidation and a high coefficient of contraction on crystallization, explained Steve J. Laning, director of research and development for the Industrial Products Group at Stokely-Van Camp, Columbus, Ohio.

Cocoa butter can solidify into a number of crystal forms, depending on cooling conditions. Although cocoa butter provides excellent qualities for eating, products containing cocoa butter are subject to bloom, are difficult to temper, and may melt in summer heat. For these reasons, cocoa butter is not always the ideal fat for every confectionery application.

An uncertain cocoa-butter supply and volatile prices, dependent on the fluctuating cocoa-bean market, encouraged confectioners to seek a possible alternative or substitute for cocoa butter. As early as the 1930s, confectioners attempted to use fats other than cocoa butter in their formulations. Usually, such fats originally were designed for other uses and produced mixed results in confections. Early attempts using partially hydrogenated vegetable oils, for example, were not successful because the fats were softer than cocoa butter. When the two were mixed, the incompatibility resulted in discoloration and fat bloom. However, a market for cocoa butter-type fats could materialize in the industry became apparent from these early experiments.

Finally, oil chemists and researchers developed new technology to provide fats with characteristics more closely resembling those of cocoa butter. These fats are known today as hard butters, developed from domestic vegetable oils and such oils as palm kernel, coconut, palm and more "exotic" sources—shea, sal and illipe—indigenous to other parts of the world. The industry thus can use less expensive fats with cocoa-butter characteristics to provide consumers with a variety of snack items, chocolate-type candies and cookies, and chocolate-type coatings that otherwise might not be available or affordable (Table I).

Hard butters typically are used by 3 industries: the biscuit and cracker industry, the confectionery industry and dairy applications industry (for such items as whipped toppings).

Table I

Comparisons of Various Typical Hard Butters to Cocoa Butter

	Cocoa butter	Fractionated palm kernel oil	Partially hydrogenated nonlauric CBS[b]				Partially hydrogenated fractionated nonlauric CBS[c]	Nonhydrogenated fractionated nonlauric vegetable fat used as a center cream	Typical cocoa-butter equivalent
Solid fat index[a]									
at 50 F	76	73	54 min.	59 min.	60 min.	60 min.	69 min.	55 min.	80%
at 70 F	73	72	39 min.	47 min.	50 min.	50 min.	59 min.	31 min.	76%
at 80 F	62	62	29 min.	39 min.	43 min.	44 min.	53 min.	12 min.	64%
at 92 F	10	9	12 max.	20 max.	25 max.	28 min.	22 min.	3 max.	8%
at 100 F	0	0	1 max.	5 max.	12 max.	16 max.	5 max.	1 max.	0
Wiley melting point	92 F	94 F	94-97 F	100-103 F	104-107 F	108-110 F	99-103 F	87-93 F	–

[a]Determined using AOCS Method Cd-10-57.
[b]Prepared from partially hydrogenated soybean and cottonseed oils.
[c]Prepared from partially hydrogenated, fractionated soybean and cottonseed oils.
[d]Determined using British Standard Method of Analysis BS 684, Section 1.12 (1976).

Hard butters offer versatility to the candy manufacturer, who can combine and blend specific fats to achieve the physical and chemical properties he desires. Hard butters with different melting points give a confectioner the capability to produce summer and winter formulas. Lower melting point fats, for example, can be chosen for quicker melting and smooth palatability and higher melting fats may be sought to hold up in summer heat or in the tropics.

A good alternative to cocoa butter would be brittle and solid up to about 25 C, have a relatively narrow melting range, and be completely liquid about 35 C. Such melting characteristics contribute to excellent mouth feel, absence of stickiness and suitable confectionery molding. Desirable specifications for all-purpose coating fats include stability at 10-25 C and a melting range of 25±1 C to 35±1 C.

Quality coating fats have a relatively high solid-fat content at room temperature. This level should be near or above 50%, as lower levels can lead to a greasy or tacky feel. Fats that melt away quickly and completely at mouth temperature, typically near 34 to 37 C, are sought for many chocolate-type applications. According to Lon Wilson, a technical service representative for Durkee Foods, there are many hard butters, some of which nearly match cocoa butter, whereas others have melting points and SIF's different from cocoa butter. For instance, some of the most widely used hard butters, he said, have melting points closer to body temperature. The most widely used are in the range of 35-39 C. One feature that is desired, however, is blandness.

J. John Pease, confectionery and specialty fats sales manager for Stokely-Van Camp's Industrial Products Group, said the various companies closely guard hard-butter formulas. "This is still as much an art as it is a science," Pease said.

Processes used to make hard butters include hydrogenation, interesterification, solvent or dry fractionation and blending. The more elementary hard butters are created through hydrogenation. The goal is to obtain fats with physical properties and functionalities —solid fat indices and melting point— similar to cocoa butter.

According to Wilson, vegetable oils are usually hydrogenated between 34 and 45 C. Rearrangement is sometimes used with lauric oils to randomly distribute the fatty acid radicals in the triglyceride molecules to produce a lower melting point and to change SFI. Blending sometimes is performed with different hydrogenated fats and fractionated fats to achieve specific requirements.

Hard butters used in coating formulations affect the appearance, texture, mouth feel, flavor release and shelf stability of the finished coating. Mixing incompatible fats results in melting point and solid fat profile alteration, the appearance of crystal bloom and development of undesirable textural variations affecting mouth feel and, possibly, flavor release.

In center applications and in coatings, all sources of fat play a role in the product's final characteristics. When making a confectionery coating, for instance, the confectioner must consider the levels of cocoa butter added via cocoa powder or chocolate liquor. The presence of some cocoa butter is unavoidable as both cocoa liquor and cocoa powder contain cocoa butter. The level of milk fat helps determine which cocoa-butter substitute would be preferred. Chocolate-type products with high milk fat require a better quality, more expensive cocoa-butter substitute than products with a low amount of milk fat.

Industry suppliers use a variety of terms to categorize hard butters, with the most commonly accepted terms being cocoa butter equivalents or extenders (CBE), nonlauric cocoa butter substitutes (nonlauric CBS) and lauric cocoa butter substitutes (lauric CBS). Other terms used include cocoa-butter substitutes, partial replacers, total replacers, modifiers and extenders.

CBE

CBE are nonhydrogenated specialty fats containing the same fatty acids and symmetrical unsaturated triglycerides as cocoa butter. They often are regarded as fully compatible with cocoa butter. Of tropical origin, they are produced from illipe butter and shea nut oil, which may be supplemented with the fractionated stearines of palm oil, sal fat and mango-kernel oil or with fats not requiring fractionation, such as kokum and allanblackia. Fats requiring fractionation before blending—palm oil, shea oil, sal fat and mango-kernel oil—are partially crystallized, with the liquid separated by filtration or pressing. Careful blending of fractions can yield hard butters with chemical and physical properties closely matching those of cocoa butter.

The most significant difference between illipe butter and cocoa butter is the temperature where crystals first appear. If illipe fat is used in chocolate-type products in appreciable quantities, such as in Easter eggs, the tempering must be altered to a higher temperature range with a longer mixing time, or the risk of fat bloom is possible. The melting point of illipe butter is slightly higher than cocoa butter and it is miscible with cocoa butter in all proportions. Because the plant grows wild, it has a variable supply. Its market price is usually somewhat lower than that of cocoa butter.

According to Bailey's *Industrial Oil and Fat Products,* 3rd Edition, illipe butter is obtained from kernels of the plant *Bassia longifolia* of India. Some companies, however, commonly use the term illipe butter for borneo tallow, from the plant *Shorea stenoptera,* which grows in East India and Malaysia.

Palm oil comes from Malaysia and Indonesia. Shea butter is obtained from the nut of an African tree, *Butyrospermum parkii.* Palm and shea oils are significantly softer than cocoa butter because of their di- and trisaturated glycerides, must be fractionated for use in chocolate-type products.

Cocoa-butter equivalents can be mixed with cocoa butter without altering the final product's melting characteristics. When all cocoa butter is replaced by a CBE, up to 25% CBE, the product is called a supercoating. "It remains to be seen if these relatively expensive coating products will make advances in today's market," Laning said.

According to Vig Babayan, formerly vice-president of science and technology at Stokely-Van Camp and now with Harvard Medical School, such formulations currently can only be used as confectionery coatings.

Wilson added that such supercoatings are more common outside the U.S.

CBE can be used in chocolate-type and nonchocolate-type confections, in coatings and molded products, as cool melting center fats, or as an extra coating layer below a chocolate coating to protect the outer layer from center fat migration. The major fat used in CBE is fractionated palm oil, according to Doug Chapman of Monarch Fine Foods, Canada, and Evert Timme of Crocklaan, Holland.

Vegetable fats, including CBE based on symmetrical triglycerides, legally can replace cocoa butter up to 15% of the fat phase (5% of the total weight) in chocolate in Denmark, the United Kingdom and Ireland, and, in coatings only, in Switzerland. In the U.S., Canada, and other parts of Europe, however, products containing CBE cannot be labelled as chocolate.

In the U.S., FDA regulations for chocolate products allow the use of hard butters and confectionery coatings under the optional ingredient clause, identified as compound or confectionery coatings, or "sweet cocoa and vegetable fat (other than cacao fat) coating."

Meanwhile, legislation proposed in the EEC and drawn up by CAOBISCO —the chocolate and biscuit manufacturers group of EEC—would allow up to 5% addition of vegetable fats, primarily of CBE type, in chocolate.

Even if the EEC adopts the CAOBISCO proposal, whether, or when, the U.S. might act similarly is uncertain. Industry spokesmen agree that it would require support from the Chocolate Manufacturers Association, whose members would be directly affected.

"CBE could make a good compound coating, but the price differential is just not worth it, particularly when you lose the right to call the product chocolate," according to Joseph Monteleon, vice-president of operations of Ambrosia Chocolate Co. in Milwaukee.

Monteleon said he doesn't believe U.S. chocolate manufacturers are going to push for a change in identity standards. "They're very successful with chocolate. Why lobby for a change when pure chocolate is so popular?" he asked.

Babayan agreed. "The chocolate industry has a good thing in the restricted standard of identity. It has no reason to see other fats equated with chocolate. Why spoil a lucrative market? It appears to hold even when the price differential has widened."

Wilson said Durkee Foods is the only U.S. manufacturer of cocoa-butter equivalents. Other companies that market CBE in the U.S. include Unilever, through its Loders-Croklaan subsidiary; Friwessa Inc., oil division of Wessanen; and Fuji of Japan. Unilever currently has three CBE factories—in England, Holland and Canada.

"The biggest users of CBE are in England," Timme of Croklaan, Holland, said. Chapman, of Monarch Fine Foods, Canada, said CBE are well received in Canada as well.

"Because of the chocolate legislation in the U.K., there is a substantial usage of CBEs in that country. For the same reason, there is a sizeable market in Japan. In countries where the legislation does not permit the use of fats other than cocoa butter, the market for CBE is, of course, smaller. Nevertheless, in some parts of the world, CBE are used in nonchocolate products, in supercoatings, due to the satisfaction of the producers and the consumers," Andre Cormeau, president of Loders-Croklaan, explained.

Chapman and Timme said a major concern voiced in the EEC over the CAOBISCO proposal centers on how to monitor the amount of CBE used in a product. "Some question how they can be sure the CBE used is 5% and not 10%," Timme said.

Although Unilever researchers have developed analytical methods for determining the level of a noncocoa-butter fat in chocolate to protect against abuses, U.S. chocolate manufacturers are concerned the methods are not adequate, particularly as CBE are so closely matched chemically to cocoa butter. "There are feelings some

Turning triglycerides into candy

The Industrial Products Group of Stokely-Van Camp in Columbus, Ohio, operates a pilot plant and small confectionery laboratory to test the products Stokely-Van Camp designs and markets.

"Here we try out confectionery fats to see if they perform as intended," Bob Wainwright, group leader for confectionery and specialty fats research and development, explained to a visitor. Wainwright said analysis of the fat blend used in a confection is only one portion of a full study.

In fact, lab researchers replicate all the steps of a confectionery-making operation. First, raw ingredients and some fat are blended into a paste. This mixture is milled on a 3-roll refiner mill to reduce particle size and eliminate graininess. Then the remainder of the fat and lecithin are added and the batch is conched several hours. Depending on the type of fat used, the mixture may be tempered.

The resulting coating is tested by enrobing various substrates and by casting products into small candy molds. Pieces are stored in a controlled environment and monitored for gloss, bloom and overall appearance. Other criteria include mouth feel and flavor release, snap and mold release.

"Sometimes a product works out well in our laboratory but when it's given to a customer, who may have different conditions in his operation, it doesn't behave the same," Wainwright said, explaining that is what makes research and development in confectionery fats an art as well as a science.