Production of Specialty Edible Fats

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TO HELP BRING the subject of specialty edible fats into proper perspective, production figures might be cited. In 1959 the United States factory consumption of fats and oils in all edible products amounted to about 5.6 billion pounds. All except about 0.3 billion pounds of this amount was used in six major types of products. Hence the volume of specialty fats currently being produced is relatively small, well below 0.3 billion pounds per year. The outlook for the future should not however be judged by present production.

A casual review of the history of the fat and oil industry reveals an accelerating tendency toward more sophisticated production. Monoglycerides first became commercially important about 27 years ago. More recently interesterification (1) and directed interesterification (2) of triglycerides have been adapted to plant-scale operations. Also a number of new edible products, including fat-based emulsifiers and cocoa butter-like fats, have appeared on the market.

The present discussion will be confined to several more or less arbitrarily selected products and processes. Products which have been commercialized as well as products which are still in the investigative stage will be discussed. The discussion will be concerned only to a limited extent with emulsifiers, which are being treated under another title.

Cocoa Butter-Like Fats

Composition and Characteristics of Cocoa Butter. Through the years numerous groups and individuals have prepared or attempted to prepare by economically feasible processes fat products, the characteristics of which resembled those of cocoa butter, the prized confectionery fat. The component fatty acids of cocoa butter and their approximate mole percentages are oleic, 37; stearic, 35; palmitic, 26; and linoleic, 2 (3). These fatty acids and their proportions differ little from those found in mutton tallow, which bears little resemblence to cocoa butter. The difference lies in the glyceride structures. Cocoa butter apparently has the following composition (3):

Glyceride	Mole percentage
Fully saturated triglycerides	2.6
Oleodipalmitin	3.7
Oleopalmitostearin	57.0
Oleodistearin	22.2
Palmitodiolein	7.4
Stearodiolein	5.8
Triolein	1.1

The oleoyl group of the oleopalmitostearin and oleodistearin has only recently been shown to occupy the 2-position (4,5).

The probability exists that the 2-oleopalmitostearin and 2-oleodistearin form mixed crystals and in many ways behave as a single compound. Their relative proportions in cocoa butter correspond approximately to that of an eutectic mixture, according to the Hildebrand equation (6).

This relative homogeneity of cocoa butter, the resulting short plastic range, and the fact that the point of complete melting lies several degrees below body temperature are prized characteristics. Cocoa butter appears to be hard and brittle at room temperatuure; but when eaten, it melts completely in the mouth and produces a pleasing, cooling sensation.

The short plastic range is illustrated by the micropenetration curves reproduced in Figure 1. Cocoa butter has an almost constant plasticity between 10 and 26° C. As the temperature is raised above 26°C., the cocoa butter softens and melts abruptly. All-hydrogenated shortening and blended or compound shortening, on the other hand, have a much longer plastic range. At 10°C. both are softer than is cocoa butter while at 30°C. they are firmer.

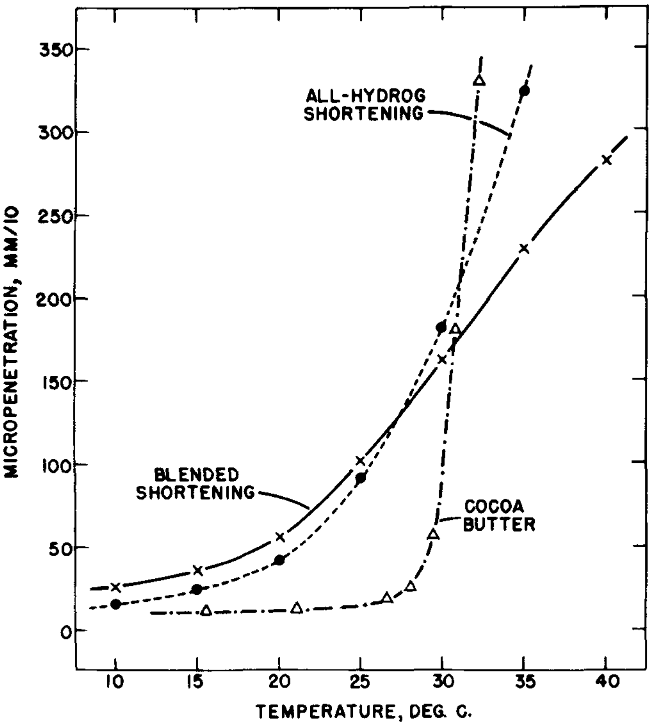

FIG. 1. Consistency curves of cocoa butter and two types of shortening.

Plasticity of cocoa butter at a given temperature is related, of course, to the proportion of liquid oil at that temperature. An average curve of liquid content *vs.* temperature for six samples of cocoa butter is reproduced in Figure 2 (7). The percentage of liquid increases rapidly as the temperature rises above 26°C. However small and relatively constant percentages of liquid are present over the temperature range of 5 to 20°C. Melting starts well below 0°C.

While cocoa butter is said to be hard and brittle at room temperature and below, its exact hardness varies markedly with small changes in temperature, as shown in Figure 3 (8). In common with most other substances the crystals of cocoa butter change

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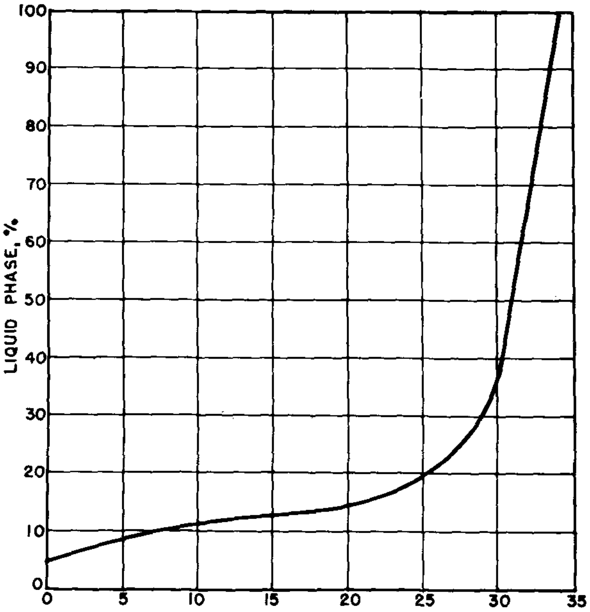

FIG. 2. Percentage of liquid oil in cocoa butter at various temperatures.

in hardness as the temperature changes, and this change is pronounced as the melting point of the crystals is approached.

Requirements of Cocoa Butter-Like Fats. As mentioned previously, a very short softening range and complete melting below body temperature, 37°C., are prized characteristics of cocoa butter and are highly desired in any cocoa butter-like fat. Claims are frequently made that the melting point of cocoa butter is too low for products to be used in the summertime. However experience has shown that raising the melting point of a cocoa butter-like fat so that the main portion melts several degrees above the melting point of cocoa butter is undesirable. A waxy product results. Adding emulsifiers reduces but does not eliminate the waxiness. Of course, waxiness is less of a problem if the fat is to be used in coating compositions for baked goods.

Because cocoa powder contains 12% or more fat, any cocoa butter-like fat, which undoubtedly would be used extensively with cocoa powder, should be compatible with cocoa butter; that is, one fat should not cause the premelting of the other. To be entirely compatible, the glycerides would have to be identical with those of cocoa butter in amount, type, and configuration. The melting point of 2-oleopalmitostearin can be depressed by adding to it the positional isomer 2-palmito-oleostearin. In practice the making of a fat which is completely compatible with cocoa butter has proven to be extremely difficult. Various degrees of compatibility have been achieved. On a theoretical basis a given weight of a lauric acid-containing fat depresses the melting point of cocoa butter more than does an equal weight of fat composed of glycerides of C_{18} fatty acids. Unfortunately information on the actual compatibility of various glycerides is meager. Research toward obtaining such information is under way.

A good cocoa butter-like fat should contain little or no liquid oil at ambient temperatures. The presence of a liquid phase undoubtedly contributes to the problem of bloom, which is best defined as the formation of a mottled or whitish surface on chocolate or the chocolate type of confections. As the storage temperature of such confections varies, crystals of solid fat are dissolved in the liquid phase, then some are redeposited in a relatively coarse structure on the surface. Obviously the less liquid phase which is present, the less serious will be the damage from this type of bloom.

The polymorphism of the cocoa butter-like fat should resemble that of cocoa butter. Procedures for the melting and temperature treatment of the latter have been worked out carefully and are based on many years of experience. Tempering equipment and enrobers have been devised to cope with the complicated polymorphism which is encountered. Confectioners tend to avoid using fats which differ from cocoa butter.

Cocoa butter or chocolate which has been heated to well above the melting point of the fat and then quickly solidified in the *alpha* form will undergo changes in crystal structure for weeks when held at room temperature (9). On the other hand, it has been stated (10) that when properly tempered chocolate is cooled after molding or enrobing, the cocoa butter solidifies initially in the *beta* prime form but the transformation to the *beta* form starts at once. After 0.5 hr. at 7–15°C. half will be in the stable *beta* form. Complete transformation to the *beta* form is claimed to occur after an additional 0.5 hr. at room temperature. Possibly the transformation from the *beta* prime to the *beta* form enhances the contraction of the chocolate and makes possible the easier demolding of molded goods.

If confectioners could be induced to change their operating techniques, the use of fats which undergo polymorphic transformation more rapidly and fats which contain a larger number of components might

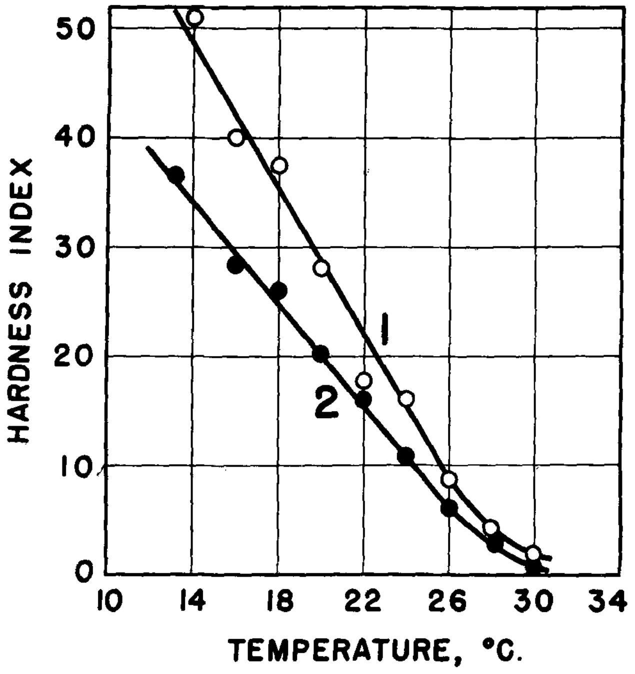

FIG. 3. Hardness curves for cocoa butter: (1) bars molded by manufacturer and stored at room temperature (24–28°C.) for several months before testing; and (2) test samples obtained by melting some of the bars, seeding the melt as it resolidified, and tempering the resolidified cocoa butter for 24 hrs.

be preferred. Such fats should be easily solidified in a firm, fine structure relatively resistant to bloom.

Cocoa Butter-Like Fats from C_{16} and C_{18} Acid Oils. Even though oils and fats whose component glycerides contain essentially C_{16} and C_{18} fatty acid groups would logically be the raw materials for making cocoa butter-like fats, such oils have not been used much in the past. Few natural products contain the desired triglycerides in large quantities, and chemical modification in the form of hydrogenation or interesterification or both is required. This not only increases the cost but introduces additional problems.

Kraemer *et al.* (11) described the experimental preparation of a cocoa butter-like fat by selectively hydrogenating cottonseed oil and then fractionating the reaction product. The cottonseed oil was hydrogenated to an iodine value of approximately 25, dissolved in commercial hexane (1:4 by weight), the solution was cooled, and the cocoa butter-like fat was collected over the temperature range of 24 to 2°C. The yield was about 28%, based on the weight of the hydrogenated oil. Consistency data, cooling curves, and dilatometric data indicated that the physical properties of the product differed from cocoa butter in only minor respects. The product had a slightly longer plastic range than did cocoa butter, it supercooled less strongly and contracted slightly less upon solidification, and it exhibited the phenomenon of polymorphism to a less pronounced degree. The product differed somewhat in composition from cocoa butter because of an unavoidable content of iso-oleic acid glycerides.

Recently two patents (12,13) have been issued to cover the preparation of butter-like fats by hydrogenation of a liquid oil, followed by fractional crystallization from a solvent. The described techniques should yield good confectionery fats, the components of which differ from those of cocoa butter in that the former contain both positional isomers of the glycerides of cocoa butter and glycerides of iso-oleic acids.

Another patent (14) has been issued on the preparation of a cocoa butter-like fat by fractional crystallization of beef and mutton tallows from acetone solution to obtain a portion that is composed mainly of disaturated triglycerides. Because the disaturated triglycerides of animal fats contain a saturated acyl group in the 2-position, products made by fractionating such fats should consist mainly of the positional isomers of the triglycerides of cocoa butter. The products probably are not as compatible with cocoa butter as might be desired.

Recently in our laboratory a cocoa butter-like fat has been prepared by the random interesterification of completely hydrogenated cottonseed oil and olive oil or a triolein product, followed by fractional crystallization from acetone (15). In such a random interesterification the amount of disaturated triglycerides formed is a function of the relative proportion of saturated and unsaturated acyl groups (Figure 4). Conditions were chosen to produce a theoretical yield of 42.2 mole % of disaturated triglycerides. Most of these triglycerides were isolated in a cocoa butter-like fraction by dissolving the interesterified mixture in acetone and collecting the fraction that precipitated between 25 and 0°C. Cocoa butter-like fractions with the short plastic range and some of the other desirable physical properties of cocoa butter were obtained.

Because the fractions contained triglycerides identical with those found in cocoa butter as well as positional isomers of these glycerides, compatibility with cocoa butter was reasonably good. Subsequent evaluation of cocoa butter-like fats that were prepared by a similar procedure revealed that the acetone fractionation was not as selective as desired. Small percentages of trisaturated glycerides always remained in the cocoa butter-like fat and caused thickening of the fat above the working temperature of chocolate, about 92°F.(33.3°C.). Also the fat contracted only about one-third as much as did cocoa butter when both were molded under the conditions used for chocolate. On solidification the cocoa butter-like fat did not super cool as cocoa butter did.

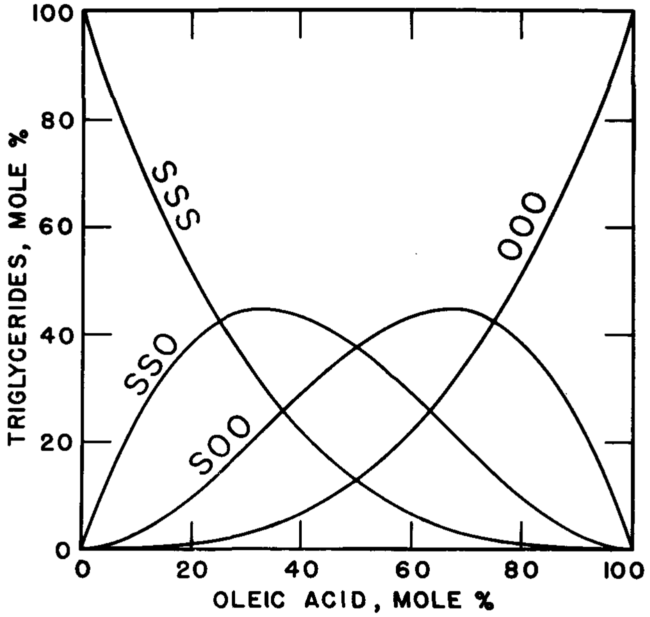

Fig. 4. Theoretical yield of trisaturated (SSS), oleodisaturated (SSO), dioleosaturated (SOO) glycerides, and triolein *vs.* oleic acid in the mixture of oleic acid and saturated acids esterified with an equivalent amount of glycerol.

Possibly a superior cocoa butter-like fat might be produced by substituting directed interesterification, a patented process (16,17), for random interesterification. Fundamentally the two processes differ in that random interesterification is carried out at a temperature well above the melting point of the glyceride mixture while directed interesterification is carried out by lowering the temperature while the reaction proceeds, thus forcing out of solution some of the component glycerides. These could be monounsaturated, disaturated triglycerides if the proportions of reactants are properly selected. According to the principle of Le Chatelier, the monounsaturated, disaturated triglycerides should be in the highest melting configuration; that is, the unsaturated acid group should occupy the 2-position. So far there has been no published report of an attempt to employ this method of preparation.

What is probably the best cocoa butter-like fat currently being marketed is said to be obtained by the fractionation of Borneo tallow, the glycerides of which resemble those of cocoa butter except that the Borneo tallow contains slightly higher proportions of trisaturated glycerides and glycerides containing stearic acid. A solvent like acetone probably is used in the fractionation procedure.

Cocoa Butter-Like Fats from Lauric Acid Oils. Large quantities of good confectionery fats have been prepared for many years from coconut oil, and this oil itself has been used extensively. Coconut oil has a melting point of 24 to 27°C. and a very short plastic range, passing abruptly from a brittle solid to a liquid. The plastic range is not quite as short as that of cocoa butter; the last 55% melts over about a 16° range. Coconut oil is hydrogenated to various melting points up to about 45°C. Complete hydrogenation changes about one-fourth of the triglyceride molecules of the oil to mixed triglycerides of stearic acid and lower saturated fatty acids.

The oil also is marketed in mixtures with domestic fats. Such a mixture has a greater resistance to rancidity than does a domestic fat of the same melting point and also possesses better eating properties. At the same time the mixture is more compatible with cocoa butter than is coconut oil and is not as susceptible to the development of a soapy flavor as is the latter.

Good confectionery fats also are being prepared from palm kernel oil, both by hydrogenating the oil and by fractionating the oil to produce a palm kernel stearine. The component fatty acids of palm kernel oil are similar to those of coconut oil except that the palm kernel oil contains about 18% of oleic acid, about twice as much as is found in coconut oil.

Performance of lauric acid oils in confectionery coating compositions of the pastel type, which contain no cocoa fat, is said to be good. A firm, glossy surface is obtained; and any polymorphic transformations during and after solidification do not seem to create problems. However, because these oils contain more than 50% of lauric and shorter-chain fatty acids, compatibility with cocoa butter is relatively poor. When a palm kernel stearine containing 20% liquid oil at room temperature is mixed with cocoa butter, which also contains about 20% liquid oil at room temperature, the resulting mixture will not contain 20% of liquid oil, which would be expected if compatibility were excellent; rather the mixture will contain up to 40% liquid oil (18). Increasing the content of liquid oil in chocolate coatings increases the tendency to bloom.

While the lauric acid oils possess good resistance to oxidative rancidity, they are susceptible to so-called "ketone" rancidity. This type of rancidity, caused by the action of microorganisms, is produced only when moisture and nitrogenous nutrients are present. The odor produced on account of the formation of ketones may not be unpleasant, but the microorganisms also hydrolyze the glycerides and produce small amounts of the shorter-chain fatty acids, which confer a disagreeable, soapy flavor upon the fat (19). It is claimed that ketone rancidity is not encountered by confectioners adhering to good plant practices.

Oils of Exceptional Resistance to Deterioration

The need of the food industry for oils liquid at room temperature and highly resistant to rancidity, hydrolysis, and other forms of deterioration has long been recognized. Oils tending to fill this need have been supplied. For years it has been the practice to roast peanuts and other nuts in coconut oil because it possesses marked resistance to oxidative rancidity and does not crystallize to a visible extent on the surface of the roasted nuts. In roasting operations a batch of coconut oil frequently is discarded when it becomes contaminated to a certain extent by a transfer of oil from the nuts being roasted. In the frying of potato chips, oils highly resistant to rancidity are desired. These and similar needs have been served by the selection and limited modification of natural oils. Needs requiring still more specialized oils exist.

By recent legislative action the use of mineral oil by the confectionery industry for lubricants, slab dressings, and polishing oils was prohibited. Use of an edible, digestible oil is now demanded. Even without legislative action the use of edible and digestible products is preferred. The raisin and dried fruit industry is in need of a stable oil which will improve the appearance of their products and minimize stickiness. Specialty oils of unusual oxidative stability are also required as vehicles for flavors, colors, vitamins, and similar products.

The most obvious solution to the problems appears to be the employment of glycerides of short-chain, saturated fatty acids. As the following tabulation shows, the melting points of the simple triglycerides of the saturated fatty acids with an even number of carbon atoms decrease as the chain length decreases and eventually reach values which are quite low:

Glyceride	Melting point, °C.
Tristearin	72.5
Tripalmitin	65.5
Trimyristin	57.0
Trilaurin	46.5
Tricaprin	31.5
Tricaprylin	8.3
Tricaproin	−25.0
Tributyrin	<−75.0
Triacetin	−78.0

Unfortunately, as the chain length becomes quite short, the vapor pressure reaches a point where it detracts from the utility of the simple triglycerides. The boiling point of triacetin is 259°C., and that of tributyrin is 315°C. To most individuals triacetin and tributyrin possess an intensely disagreeable flavor. The shorter-chain fatty acids themselves possess a marked flavor and odor, and any free fatty acids of this type formed by slight hydrolysis of their glycerides will be noticeable. The flavor problem insofar as triglycerides are concerned can be overcome by making mixed triglycerides, like diacetostearin and dibutyrostearin, which are bland in flavor and odor. However this raises the melting point. The thermodynamically stable form of 1,2-diacetostearin melts at 48.6°C. and that of 1,2-dibutyro-3-stearin at 20.7°C. The problem of making a saturated, low-melting triglyceride can be solved most nearly by making a mixture of mixed triglycerides containing saturated fatty acids of both long-chain and short-chain lengths. Such mixtures take advantage of the physical-chemical principles governing melting-point depressions. Just how much can be achieved by utilizing this approach remains to be determined.

To obtain the greatest resistance of unsaturated oils to oxidation and the development of off-flavors and odors, antioxidants must be present. This applies also to trisaturated glycerides. Apparently the stearic acid group is only about 10 times as resistant to oxidation as is the oleic acid group. Presumably there is an optimum concentration of antioxidants in trisaturated glycerides just as there is an optimum concentration in unsaturated triglycerides, but the addition of antioxidants in amounts below the optimum should provide sufficient protection. A few hundredths of 1% of propyl gallate raises the stability of a trisaturated glyceride to well over 1,000 hrs. as measured by the active oxygen method.

As an example of the nature of the products which can be made, an experimental oil consisting mostly of equal proportions of 1,2-dibutyropalmitin and 1,2-dibutyrostearin might be described. The oil was prepared by treating with butyric anhydride, the molecularly distilled monoglycerides of commercial stearic acid. Its properties were found to be as follows:

Property	Value
Viscosity, centistokes	
68°F.	41.5
77°F.	33.5
104°F.	18.8
176°F.	6.4
Smoke point, °F.	311.0
Flash point, °F.	459.0
Fire point, °F.	525.0
Cloud point, °F.	60.0
Pour point, °F.	50.0
Melting point, °F.	61.0

The experimental oil was extremely resistant to the development of rancidity. Stability tests showed that the oil did not become rancid after 1,500 hrs. when a small amount of antioxidant was present. In fact, at 1,500 hours the oil was colorless and as bland in flavor and odor as at the start of the test. By way of comparison, under these test conditions, lard becomes rancid in 3 to 4 hrs., cottonseed oil, 16 to 20 hrs., and good vegetable oil shortening, about 300 hrs.

Specialty oils made from coconut oil and hence containing a high proportion of glycerides of the saturated C_6 through C_{12} fatty acids are being marketed by at least one large manufacturer for use as slab dressings, polishing oils, and vehicles for flavors and vitamins. A technical bulletin for one of the products lists the following specifications:

Form	Pale yellow liquid
Color (Lovibond)	30 Yellow, 2.5 max. red
Free fatty acids (as oleic)	0.05 Max.
Iodine value	10 Max.
Specific gravity at 120°F	0.9170
Refractive index at 60°C	1.4352
Setting point	0.0°C.
Moisture	0.1% Max.
Kreis test	Negative
AOM stability	150 hrs. plus

If oils of a more unconventional nature are to be prepared for special resistance to hydrolysis, coneration might be given to esters of various monohydric alcohols. Here the proper selection of the alcohol might be important. As the molecular weight increases the resistance to chemical hydrolysis increases. Also secondary alcohols are several times as resistant to hydrolysis as are normal alcohols of the same molecular weight. These considerations apply if glycols are used. Esters of neopentyl glycol are claimed to possess exceptional resistance. Possibly *alpha* dimethyl fatty acids would impart similar resistance to their esters. The glycerides of *alpha* dimethyl stearic acid are not hydrolyzed by the digestive enzymes in the body. The question of edibility must, of course be answered before using any of these products in foods.

Potentially Useful Fats and Oils

Many derivatives of fat-forming acids described in the literature are potential specialty fats for use on and with foods. Several of these derivatives which are not now being used or are being used only to a limited extent will be described.

Dibasic Acid-Containing Fats. The coupling of two or more glycerides of fat-forming acids by esterification with short-chain dibasic acids should, on the basis of general considerations, produce edible compounds with certain characteristics not attainable with ordinary fats. At least some of these compounds should be edible because fumaric and succinic acids occur in the Krebs cycle. Coupling diglycerides results in a molecule considerably larger than a molecule of triglyceride prepared from the same fatty acids. Consequently an increase in viscosity would be expected.

When 1,3-diolein and 1,3-distearin were esterified with fumaric, succinic, and adipic acids, the anticipated increases in viscosity were obtained (20). For example, the compound obtained by esterifying 1,3-diolein with fumaric acid, bis[1-(oleoyloxymethyl)-2-(oleoyloxy)ethyl]fumarate, had a viscosity of 86.50 centistokes at 38.8°C. while 1,3-diolein had a viscosity of 48.50 at the same temperature.

Other unexpected properties were found. On melting and cooling the 1,3-distearin compounds, glossy white solids were formed which were much harder than tristearin. On cooling solutions of the same compounds, long fiber-like crystals resembling asbestos formed. The 1,3-diolein compounds, on the other hand, crystallized extremely slowly or not at all. The compound made with fumaric acid could not be crystallized under any conditions: it merely became more viscous as the temperature was lowered.

Polymeric fats were prepared by the interaction of fatty acids, short-chain dibasic acids, and glycerol (21). The highest number-average molecular weight obtained was about 1,700. By varying the proportions of the reactants, the viscosity could be varied over a relatively wide range. Viscosities over 2,000 centistokes at 50°C. were attained. The melting points of the polyester products which contained stearic acid as the only fatty acid and in which the dibasic acid was fumaric, succinic, or adipic had melting points ranging from 35.7 to 67°C. Some of the oleic acid compounds did not appear to crystallize on cooling. On crystallization of the melt, the polyesters containing stearic acid formed a fine-grained crystal structure and possessed a hardness at 30°C. which ranged from that of beeswax to that of completely hydrogenated cottonseed oil. The products prepared had properties that indicated potential use of them as coating materials by the food industry.

Products from Polyols Other than Glycerol. Esters of long-chain fatty acids and cellulose, starch, amylose, dextrin, sucrose, and glucose have been the subject of numerous investigations conducted over many years. The properties described suggest many potential uses; yet few, if any, of the esters are being marketed. The principal deterrant seems to be the lack of a simple and economical method of preparation. The polyols either do not react or deteriorate extensively when treated under the usual esterification conditions. The favorite laboratory method of preparation consists of esterifying the polyol with an acid chloride in the presence of pyridine or some other organic base.

Malm *et al.* (22) prepared the cellulose triester of most of the saturated fatty acids from C_2 through

C_{16} and determined a number of their properties. In this series cellulose tricaprylate was found to possess the lowest melting point, 86°C.; and cellulose triacetate the highest, 306°C. The melting point of cellulose tripalmitate was found to be 105°C. The tensile strength of the triesters decreased rapidly from about 7.2 kg./mm.^{2} for the acetate to about 1.0 kg./mm.^{2} for the caprylate. As the chain length of the acyl group increased from C_8 to C_{16}, the tensile strength decreased gradually to about 0.5 kg./mm.^{2} The data are, of course, valid only for the particular sample of cellulose which was employed. For other degrees of polymerization these values would change. The data are in the range however where the possible use of these products as dip-type coatings for foods is indicated.

Wolff *et al.* (23) prepared and characterized various esters of corn starch, amylose, and amylopectin in an effort to discover new industrial uses for these corn products. Almost all of the esters possessed a broad melting range. The amylose esters were found to form pliable and transparent films of rather low tensile strength.

The dextran, sucrose, and glucose esters comprise a series of compounds ranging from waxy solids to viscous liquids. Of these compounds the partial esters of sucrose are the most likely to find commercial use in the food industry. They are good emulsifiers (24), and manufacturers of various food products have expressed an interest in using them.

Acetoglycerides. The acetoglycerides, as the term will be used, are glycerides containing one long-chain fatty acid group and one or two acetic acid groups per molecule. 1,2-Diaceto-3-stearin and 1-aceto-3-stearin are typical representatives of this class of glycerides. They can be prepared easily either by acetylating monoglycerides with acetic anhydride or by interesterifying a mixture of fat, glycerol, and triacetin. Molecular distillation of the reaction product yields mixtures exceptionally rich in acetoglycerides.

The acetoglycerides are unique among fatty derivatives in that they will crystallize to plastic, nongreasy solids (25) (Figure 5). The plastic crystals are actually in the thermodynamically unstable *alpha*-3 form (26), but for all practical purposes this form is stable. Products containing two or more glycerides, and even single compounds containing small amounts of other glycerides as impurities, remain in the plastic state for years when stored at ambient temperature.

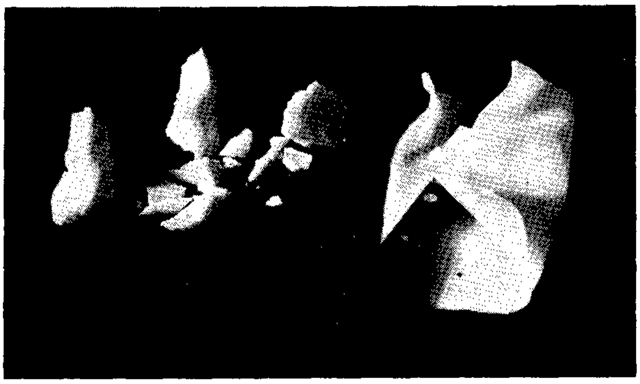

FIG. 5. Lumps of tristearin, right, and sheet of acetostearin folded over a spatula, left.

When examined under the microscope, the crystals of the acetoglycerides are long and ribbon-like and interwoven in a felt-like structure. Some products are translucent. Films of most of the products can be stretched several-fold without breaking. Melting points can be varied from about −24 to 48°C. by changing the proportions of the reactants and the nature of the fat used in the preparation.

Numerous food uses have been suggested for both the acetoglycerides which are solid at room temperature and for those which are liquid. The solid acetoglycerides when applied as thin, almost invisible films to processed meats, baked goods, cheese, and similar products serve as a moisture barrier and as a barrier to keep in flavor and odor. The use of acetoglycerides in mixtures for coating nut meats to make them more resistant to rancidity and increase their shelf life has been suggested (27), and the use of such coated nut meats in rations for the armed forces is provided for in a set of proposed specifications. The liquid acetoglycerides have been suggested for use as plasticizers of edible fat mixtures where a plasticizer liquid at low temperatures and relatively resistant to oxidation is required.

Many animal-feeding experiments have been carried out to establish the suitability of acetoglycerides as foods. The acetoglycerides behave as ordinary fats of a similar degree of unsaturation. Through the efforts of a manufacturer of these new fats, the Food and Drug Administration has just approved their use in nonstandardized foods at levels up to 5%.

At least 80 articles and patents concerned with the acetoglycerides have appeared, mostly since 1952. At least three firms, one in the United States and two in Europe, are making the acetoglycerides.

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