• *Letter to the Editor*

A Note on the Preparation of Cholesteryl Esters of Long-Chain Fatty Acids

THE PHYSIOLOGICAL ROLE of cholesteryl esters of long-chain fatty acids has received considerable attention since Alfin-Slater and co-workers (1) suggested that they may be involved in essential fatty acid transport and metabolism. In our studies of the metabolism of cholesterol and its esters in relation to atherosclerosis, it became necessary to prepare the esters in moderately large quantities.

Various workers have prepared the cholesteryl esters of saturated fatty acids by reacting cholesterol with fatty acids, the acid anhydrides, or acid chlorides (2, 3). The preparation of the cholesteryl esters of unsaturated fatty acids has been mainly confined to the C_{18} series, *viz.*, oleic, linoleic, and linolenic. The esterification is effected usually by reacting cholesterol with the appropriate acid chloride (2,3,4). The reaction involving cholesterol and free fatty acids is not always feasible; it requires relatively high temperature, causing the production of some undesirable side-products that are difficult to remove. The methods using acid anhydrides or acid chlorides also suffer from many disadvantages, *viz.*, they are not readily available or are laborious and expensive to prepare.

It is the purpose of this note to report, for the first time, a simple and convenient procedure for the synthesis of cholesteryl palmitate and stearate by the well-known interesterification reaction. By reacting cholesteryl acetate and the methyl esters of the appropriate fatty acids in the presence of a suitable catalyst, such as sodium ethylate, chromatographically pure cholesteryl esters have been prepared in good yield.

A typical reaction was conducted in a 200-ml. round-bottom flask as follows: 0.05–0.1 g. of sodium ethylate was added to a mixture of 4.3 g. (0.01 mole) of cholesteryl acetate, obtained by acetylation of cholesterol purified by bromination-debromination procedure, and 3.0 g. (0.01 mole) of methyl palmitate (free from contaminants, as determined by gas-liquid chromatography). The flask was heated under vacuum (20–30 mm.) at 80–90°C. for 1 hr. under a slow stream of pure nitrogen. The reaction mixture was cooled and washed with petroleum ether (30–60°) and filtered to remove insoluble material. The filtrate was evaporated to dryness under vacuum, and the cholesteryl palmitate was crystallized twice from acetone. Yield 4.6 g., m.p. 77–78°C., $[\alpha]_D - 24.8°$ in chloroform (c 5.0).

Cholesteryl stearate (m.p. 81.5–82.5°C., $[\alpha]_D - 23.7°$ in chloroform [c 5.0]) also was obtained in good yield.

Paper chromatography of these esters by the method of Labarrere *et al.* (5) yielded single spots and showed that they were free from cholesteryl acetate or cholesterol.

The preparation and properties of the cholesteryl esters of the C_{18} unsaturated acids as well as arachidonic and other longer-chain fatty acids and their separation by thin-layer chromatography are in progress. Details will be published later.

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ABSTRACTS . . . . R. A. REINERS, Editor

ABSTRACTORS: S. S. Chang, Sini'tiro Kawamura, F. A. Kummerow,
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• Fats and Oils

COLOR REVERSION OF REFINED AND DEODORIZED SOYBEAN OIL. I. EFFECTS OF TEMPERATURE, AIR, AND LIGHT ON THE COLOR REVERSION OF REFINED SOYBEAN OIL, AND A METHOD OF MEASURING COLOR REVERSION. Ichiro Harada, Yutaka Saratani, and Masao Ishikawa (Hohnen Oil Co., Ltd., Shimizu, Shizuoka-ken). *Nippon Nôgei-kagaku Kaishi* **34**, 545–51 (1960). The darkening of refined vegetable oils (especially soybean oil) during keeping is called "color reversion." When deodorized soybean oil was kept at 20, 50, 75, or 100°, color reversion occurred earlier at higher temperatures, and then promptly the color faded; however, the maximum color (expressed in red value by the Lovibond colorimeter) was similar at 50–100°. The change of velocity of color reversion according to the temperature was very similar to the change of initial velocity of autoxidation of oil as expressed by peroxide value or oxygen uptake. The color of decolorized (but not deodorized) oil was stable at 50°, and faded at 75 and 100° (more rapidly at 100°). When the decolorized oil was heated at 180–270°, the color faded more rapidly at higher temperatures under reduced pressure, but it faded only slightly in the air. Experiments about the influence of the air showed that the velocity of color reversion of deodorized oil depended on partial pressure of oxygen. Solar irradiation of decolorized and deodorized soybean oils produced irreversible color fading. The color reversion in the dark was specific to soybean oil.

II. GENERAL ASPECTS OF COLOR REVERSION AND THE RELATION BETWEEN COLOR REVERSION AND TOCOPHEROL CONTENTS. *Ibid.* 551–8 (1960). Comparative experiments with some oils showed that cottonseed oil reverted in color, but sunflower oil, rapeseed oil, and safflower oil (very similar to soybean oil in fatty acid composition) were very stable with respect to color. Thus the substrate for color reversion was not in fatty acids but probably in unsaponifiable matter. Soybean oil was examined as to the refining stages: deacidified oil showed stable color, decolorized oil showed a little reversion, but only deodorized oil showed appreciable color reversion. Thus heat treatment during deodorization had some relation with color reversion. The substrate for color reversion was resistant to alkali, adsorbed slightly to acid clay, was heat-stable, and was distilled out in the deodorization procedure. Many additional experiments led to the assumption that the substrate for color reversion was tocopherol. Total tocopherol contents were soybean oil 0.085, cottonseed oil 0.088, sunflower oil 0.048, rapeseed oil 0.060, and safflower oil 0.052%.

III. Influences of iron and antioxidants on color reversion. *Ibid.* 558–62 (1960). The color reversion of soybean oil was accelerated, when heated in the presence of iron. Iron dissolved in soybean oil was present as a complex with the peroxides in the oil. It was assumed that the complexes were decomposed by heat treatment to liberate an active radical and iron, which accelerated the color reversion. The primary antioxidants (propyl gallate, butylated hydroxyanisole, nordihydroguaiaretic acid, and isoamyl gallate) had no preventive power for color reversion. This was explained by assuming that tocopherol itself (the natural antioxidant in soybean oil) was closely connected with color reversion and that color reversion and autoxidation belonged to the same reaction system. Secondary antioxidants, *i.e.* synergists (tartaric and oxalic acids, NH_4 citrate, and H_3PO_4) inhibited strongly the color reversion. The mechanism must be related to chelation of metals; synergists chelated free metals only and did not react with metal hydroperoxide complexes.

Hydrogenation of mixtures of free fatty acid and ester. Tetsutaro Hashimoto and Tomotaro Tsuchiya (Chem. Ind. Research Inst., Tokyo). *Yukagaku* **9**, 83–7 (1960). Equimolar mixtures of a free fatty acid and an ester were hydrogenated at 180° with Ni-kieselguhr catalyst. The progress of hydrogenation was examined by determining iodine no. and m.p. on the whole product, the acid part, and the ester part. In case of the mixture of erucic acid and methyl oleate, free fatty acids were considerably more rapidly hydrogenated than the esters. In the case of the mixture of linoleic acid and methyl oleate, the former was more rapidly hydrogenated; linoleic acid was selectively hydrogenated in comparison with oleic acid only in the initial period; this selectivity was lost as linoleic acid content decreased; then saturated acid content surpassed that of the saturated esters. In case of the mixture of linolenic acid and methyl oleate, the former was more rapidly hydrogenated. Hydrogenation of linolenic acid was presumed to be made selectively at the double bond of 15:16. In case of the mixture of linoleic acid and methyl linoleate, the acid was more rapidly hydrogenated, but the difference was smaller than that found in the mixture of monoenoic acid and its ester. In case of the mixture of linoleic acid and methyl linolenate the ester was more rapidly hydrogenated.

Isomerization of fats and oils. I. Isomerization of soybean oil with iron pentacarbonyl catalyst. Tetsutaro Hashimoto and Hisako Shiina (Chem. Ind. Research Inst., Tokyo). *Yukagaku* **9**, 79–83 (1960). The maximum amount of conjugated dienoic acids in the $Fe(CO)_5$-isomerized soybean oil was 30%. When the oil was heated with $Fe(CO)_5$, the oil was decomposed and its acid no. increased. This was enhanced at temperatures higher than 200°. Infrared absorption spectra of the reaction products showed the formation of *cis-trans* conjugated double bonds as well as *trans-trans* double bonds and nonconjugated *trans* double bonds. Isomerization of free fatty acids did not proceed so smoothly as that of neutral fat.

II. Structure of solid conjugated fatty acids produced during the isomerization of methyl linoleate with iron pentacarbonyl catalyst. *Ibid.* 376–9. Solid fatty acids composed mainly of *trans-trans* conjugated dienoic acid were separated from isomerized methyl linoleate by low-temperature crystallization. The oxidation products of the methyl esters of the solid acids in acetone by $KMnO_4$ included hexanoic, heptanoic, azelaic, sebacic, and oxalic acids. Thus the solid acids were assumed to contain 9,11- and 10,12-octadecadienoic acids.

Chemical analysis of commercial margarine and shortening produced in various countries. I. European products. Kimitoshi Nakazawa, Isao Niiya, and Motoko Yokoyama (Japan Margarine and Shortening Makers Assoc., Nihonbashi, Tokyo). *Yukagaku* **9**, 200–7 (1960). Analyses were made on 19 samples of margarine and 10 samples of shortening from England, Germany, Norway, and Belgium on fat, moisture, vitamin A, and some characteristics of separated fat and fatty acids. The products containing much lauric acid based fats showed ester odor after long preservation. Norwegian products contained lactose. Estimated linoleic acid content was 10–20%, probably due to peanut, cottonseed, whale, and fish oils. English shortenings were probably made from peanut, palm, and whale oils. Hydrogenated peanut, palm, lauric-series, whale, and herring oils apppeared as single products on the market.

II. American products. *Ibid.* 383–92. Similar analyses were made on 18 samples of margarine, 7 samples of shortening, 2 samples of lard, and 3 samples of butter from the United States. Most of margarine was made from soybean and cottonseed oils. Few samples produced ester odor after preservation. Margarines contained fat 78.0–80.6, moisture 14.8–17.4, NaCl 0.9–3.4%, and vitamin A 8,800–17,300 i.u. The fat from margarine consisted of linoleic 18.2, oleic 58.2, and saturated 23.6% on average. Shortening contained much more (30–50%) solid acids than margarine.

Structure and synthesis of milk fat. II. Fatty acid distribution in the triglycerides of milk and other animal fats. F. D. McCarthy, S. Patton, and Laura Evans (Dept. of Dairy Sci., Penn. Agr. Exper. Station, Univ. Park). *J. Dairy Sci.* **9**, 1196–1201 (1960). Triglyceride structure of a number of fats was studied by use of the specificity of pancreatic lipase for cleaving the fatty acids esterified on the 1 and 3 positions of the glycerol. These fats included the back, visceral, blood, and milk triglycerides of an individual cow; milk fat before and after seven days of inanition; visceral and back fat of a pig, and the depot fat from a steer. In all these samples the per cent of C_{10}, C_{12}, and C_{14} saturated acids and the C_{14} and C_{16} monounsaturated acids, when present, were found to exist in higher concentrations in the monoglycerides resulting from the action of pancreatic lipase than in the intact fat. On the other hand, the C_{18} saturated and C_{18} di- and triunsaturated acids were found in lower concentrations in the monoglyceride derived from all fats. In pig and milk fat C_{16} fatty acid was seen to be concentrated in the 2 position, while in ruminant body fats and blood triglycerides C_{18} monounsaturated acid was evident at higher levels in the monoglyceride. In normal milk only a slight concentration effect of C_{16} acid in the 2 position was noted, indicating almost uniform distribution. However, after seven days of inanition this acid showed a high concentration in the 2-position. A comparison, based on structure and composition of blood triglycerides and milk fat in the same animal, suggests that if blood triglycerides contribute to milk fat there either must be a rearrangement of fatty acids on the glycerol or a supplementary synthesis of triglycerides which changes the pattern of fatty acid positioning.

The fatty acids and glycerides of cow's milk fat. E. Jack (Univ. of Calif., Davis, Calif.). *J. Agr. Food Chem.* **8**, 377–380 (1960). Milk fats contain a variety of individual fatty acids ranging in carbon chain length from 4 to 26 and of various degrees of unsaturation from monoenes to pentaenes. The unsaturated acids exist in many positional and geometrical isomeric forms. The composition of milk fats is influenced by diet and by the plane of nutrition of the animal. The general distribution patterns of fats have been studied, but no sound conclusions can be drawn about milk fats. Investigative tools are now becoming available whereby both the general distribution pattern and specific distribution and location in glycerides of individual fatty acids can be determined.

Unique fatty acids from Limnanthes douglasii seed oil: the C_{20}- and C_{22}- monoenes. C. R. Smith, Jr., M. O. Bagby, T.K. Miwa, R. L. Lohmar, and I. A. Wolff (Northern Reg. Res. Lab., Peoria, Ill.). *J. Organic Chem.* **10**, 1770–1774 (1960). The principal fatty acids of *Limnanthes douglassi* seed oil are shown to include two previously unknown components: *cis*-5-eicosenoic (65%) and *cis*-5-docosenoic acid (7%). The oil also contains *cis*-13-docosenoic (erucic) acid (13%) and 10% of an unknown C_{22}-acid.

Plasticisers and polymers derived from fats. W. C. Ault (Eastern Utilisation Research and Development Div., Agr. Research Ser., U.S.D.A., Philadelphia, Pa.) *J. Oil & Colour Chemists' Assoc.* **43**, 631–9 (1960). The manufacture of epoxidised fatty derivatives for use as plasticisers has increased since the discovery of their stabilising effect of p.v.c. compositions. Soybean oil has usually been chosen for epoxidation because it is cheap and plentiful, but the product cannot be used as a primary plasticiser because its compatibility is limited. Research in this area has led to primary solvent type plasticisers of the epoxy type, such as the alkyl epoxystearates and epoxidised acetoglycerides. A novel class of fatty derivatives having potential value as plasticisers are those with a phosphorus to carbon bond. The 9,10-trialkyl phosphonostearates are noteworthy, having a low migration loss and generally imparting good low temperature characteristics to p.v.c. The preparation of vinyl stearate and of its homo- and copolymers has been studied and commercial production has resulted. Other types of fatty materials investigated include the long chain alkyl acrylates and vinyl epoxystearate. New types of polymers have been prepared by the condensation of epoxidised oils with phthalic anhydride in the presence of certain organic bases.

THE UTILISATION OF CUSTARD APPLE SEED AND OIL. N. B. Naidu (Regional Res. Lab., Hyderabad, India). *Indian Oil and Soap J.* 10, 350–352 (1960). Custard apple seed (Hindi, *Sherifa*; Telugu, *Sitaphal pandu*) contains a toxic material which gives the crude oil insecticidal properties comparable with D.D.T. The oil can be detoxified by alkali-refining, leaving an oil similar in properties to groundnut oil. Refined custard apple seed oil can be used as an alkyd plasticiser, or in soap manufacture.

FILM BALANCE PROBES THIN FILM MIXTURES. *Chem. Eng. News* 40, 40–41 (1960). Binary mixtures of polyvinyl acetate and fatty acids give monomolecular films that are stronger than the films from either compound alone. Properties of the mixed films and methods of evaluating are discussed.

COMPOSITION OF MOLECULAR DISTILLATES OF CORN OIL: ISOLATION AND IDENTIFICATION OF STEROL ESTERS. A. Kuksis and J. M. R. Beveridge (Dept. of Biochemistry, Queens University, Kingston, Ontario). *J. Lipid Research* 1, 311–320 (1960). Molecular distillates of corn oil consisting of the three most volatile 1.7% cuts and the next most volatile 4.9% cut obtained from 150 kg. of refined oil have been subjected to simple solvent and chromatographic fractionation. These fractions represented about 10% of the original oil and some 50% of its unsaponifiable material. About 75% of the unsaponifiable material was sterol, of which 75% was free, the rest combined mostly as long chain fatty acid esters. The remainder of the analysed unsaponifiable material consisted of hydrocarbons (3.3%), tocopherols (15%), material more polar than free sterols (5.0%), and various other uncharacterized fractions of differing polarity (2.7%). The sterol fraction was made up largely of linoleates, oleates, and palmitates of *beta*- and *gamma*-sitosterols and the triterpenoid *alpha* sitosterols. Indications were obtained for the presence of tocopherol esters in corn oil. Mono- and diglyceride esters of the major corn oil fatty acids of corn oil were found (0.05 and 0.52%, respectively).

CULINARY MIX. C. C. Elsesser and S. W. Bogyo (General Foods Corp.). *U. S. 2,954,297.* A culinary mix suitable for reconstitution into a batter for baked goods contains a flour, a leavening agent, and a dried emulsion consisting of an edible partial ester of a glycol and a higher fatty acid and a fat encapsulated by a matrix of edible hydrophilic solids such as a proteinaceous material or a mixture of proteinaceous and carbohydrate materials.

MARGARINE AND METHOD FOR PRODUCING SAME. D. Melnick and F. H. Luckmann (Corn Products Co.). *U. S. 2,955,039.* A liquid unhydrogenated vegetable oil is blended with a hardened selectively hydrogenated vegetable oil in a ratio of 30:70 to 70:30 parts. The liquid oil has a linoleic acid content of about 25 to 80%; the hardened oil has a melting point of from 98° to 112°F. and contains not more than 5% linoleic acid. The hardened oil should be hydrogenated in such a manner that the increase in saturated fatty acid content is not more than about 16%.

COMPOSITIONS COMPRISING REACTION PRODUCT OF A POLYALKYLENE ETHER GLYCOL, A FATTY ACID TRIGLYCERIDE, AND AN ARYLENE DIISOCYANATE AND FOAM PREPARED THEREFROM. R. P. Kane (E. I. du Pont de Nemours and Co.). *U. S. 2,955,091.* A water-foamable polyisocyanate-polyurethane composition is obtained by reacting at a temperature between 25° and 100° (a) a polyalkylene ether glycol having a molecular weight of 500 to 1900, with at least 60% of the glycol being 1,2-propylene ether units; (b) a fatty acid triglyceride having a hydroxyl number not less than 100; and (c) an arylene diisocyanate. The molar ratio of the glycol to triglyceride should be from 1:0.5 to 1:1.5, and the number of free isocyanate groups to the total number of hydroxyl groups from 1.3:1 to 1.6:1. The reaction is carried out until substantially all of the hydroxyl groups have been reacted with isocyanate groups, followed by the addition of a sufficient amount of an arylene diisocyanate to give 8 to 14% by weight of free isocyanate groups.

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• Fatty Acid Derivatives

THE SEPARATION OF THE LONG CHAIN FATTY ALDEHYDES BY GAS-LIQUID CHROMATOGRAPHY. G. M. Gray (Lister Inst. of Preventive Med., London). *J. Chromatography* 4(1), 52–59 (1960). The long chain fatty aldehydes can be separated as their aldehyde dimethyl acetals by gas-liquid chromatography. Separations on Apiezon L grease and Reoplex 400 stationary phases are described. The relative retention volumes of some pure aldehyde dimethyl acetals are given and compared with the relative retention volumes of the corresponding fatty acid methyl esters. A tentative identification on the basis of their relative retention volumes on both stationary phases, is made of a number of unusual aldehydes found in mixtures isolated from natural sources.

HIGHER FATTY ACID ESTERS OF DEXTRAN. L. J. Novak and J. T. Tyree. *U. S. 2,954,372.* The desired product is a dextran ester of a saturated fatty acid containing 14 to 18 carbon atoms, having an average of about 3 fatty acid radicals per anhydroglycose unit of the dextran. The dextran ester is insoluble in water and forms a thin, adherent protective film when applied to the skin.

LONG-CHAIN FATTY ACID ESTERS OF VITAMIN B_6. F. A. Kummerow and T. Sakuragi. *U. S. 2,955,115.* The fatty acid group of the ester is derived from a carboxylic acid having from 8 to 20 carbon atoms.

POLYMERIZATION OF UNSATURATED FATTY ACIDS. L. D. Myers, C. G. Goebel, and F. O. Barrett (Emery Industries, Inc.). *U. S. 2,955,121.* Unsaturated fatty acids are heated in the presence of minor proportions of surface-active crystalline clay mineral and water. Incorporated in the reaction mixture is a catalytic amount of an alkali material capable of reacting with the fatty acids to form soap.

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• Biology and Nutrition

THE CHEMICAL COMPOSITION AND NUTRITIVE VALUE OF COCOANUT AND ITS PRODUCTS. K. Krishnamurthy, R. Rajagopalan, M. Swaminathan, and V. Subrahamanyan (Central Food Tech. Res. Inst., Mysore, India). *Indian Oil and Soap J.* 11, 375–384 (1960). The amino acid composition of cocoanut proteins and the nature of the carbohydrates in cocoanuts are shown. The potential of cocoanut protein as a supplement for human diets is discussed, and the composition of whole cocoanuts, kernels, water, oil, and cake are given. The authors cite 63 references.

IMMUNOCHEMICAL STUDIES OF ORGAN AND TUMOR LIPIDS. VIII. COMPARISON OF HUMAN TUMOR AND OX SPLEEN CYTOSIDES. M. M. Rapport, Liselotte Graf, and N. F. Alonzo (Dept. of Biochem., Albert Einstein Coll. of Medicine, Yeshiva University, New York 61, N.Y.). *J. Lipid Research* 1, 301–304 (1960). Preparations of cytolipin H, a human tissue hapten containing fatty acid, sphingosine, glucose, and galactose in equimolar proportions have been compared with similar preparations isolated from ox spleen. The iodine number and the specific rotation of preparations derived from human tumor are significantly larger than those from ox spleen. Results of other chemical analysis based on the carbohydrate and sphingosine portions of the molecule as well as the immunochemical reactions are indistinguishable for both.

QUANTITATIVE GLASS PAPER CHROMATOGRAPHY: A MICRODETERMINATION OF PLASMA CHOLESTEROL. J. R. Swartwout, J. W. Dieckert, O. N. Miller, and J. G. Hamilton (Nutrition and Metabolism Res. Lab., Dept. of Med., Tulane Univ. School of Medicine, New Orleans, La.). *J. Lipid Research* 1, 281–285 (1960). A rapid sensitive method for the determination of sterols is described. Microgram samples are spotted of impregnated glass fiber paper, chromatographed for seven minutes, dried, sprayed with sulfuric acid, and charred by heating. The amount of char formed is measured by densitometry. Values obtained for cholesterol in the serum are in agreement with those obtained by the Sobel-Mayer method. The method has been adapted to the determination of cholesterol in ten microliters of plasma and to the determination of standard solutions of other steroids.

THE INOSITOL PHOSPHOLIPIDS. J. N. Hawthorne (Dept. of Medical Biochemistry and Pharmacology, The Medical School, Birmingham 15, England). *J. Lipid Research* 1, 255–281 (1960). The author has presented a very thorough review of the chemistry of phospholipids containing inositol. The topics covered are: nomenclature, the chemistry of inositol, the chemistry of the inositol phosphates, chemical synthesis of phosphatidylinositol and related compounds, isolation of phosphoinositides from tissues, analysis of phospholipid mixtures, estimation of lipid bound inositol, phosphoinositides of animal tissues, vegetable phosphoinositides, and the phosphoinositides of microorganisms. The biosynthesis of the phospholipids, the enzymes which hydrolyze them, their turnover rates and other aspects of the metabolism and function of inositolphosphatides are also treated. 234 references.

Studies on the biosynthesis of cholesterol. XII. Synthesis of allyl pyrophosphates from mevalonate and their conversion into squalene with liver enzymes. DeW. S. Goodman and G. Popjak (Exper. Radiopathology Unit, Hammersmith Hospital, London, W 12, England). *J. Lipid Research* 1, 286–300 (1960). The biosynthesis of allylpyrophosphates (the phosphates of dimethylallyl alcohol, geraniol and of farnesol) from DL-mevalonate-C^{14}-2 and from (−)-5-phosphomevalonate-2-C^{14} with soluble liver enzymes in the presence of ATP and Mg^{++} is described. The allylpyrophosphates were partially purified and their properties studied. They are unstable below pH 5 and cleave into inorganic pyrophosphate and allylic alcohols. The alcohols were identified by gas liquid radiochromatography after hydrolysis of the pyrophosphates by various phosphatases.

Effect of infusions of phosphatides upon the atherosclerotic aorta in situ and as an ocular aortic implant. S. O. Byers and M. Friedman (Harold Brunn Inst., Mount Zion Hospital and Medical Center, San Francisco, Calif.). *J. Lipid Research* 1, 343–348 (1960). Rabbits fed cholesterol and oil supplemented diets were carefully paired for equality of plasma cholesterol concentration during the feeding period and a subsequent thirty days of normal diet. The normal diet was continued and one of each pair of rabbits was then subjected to intravenous infusion of mixed phosphatides of animal or soybean origin twice weekly for an average of 11 infusions. At the end of this time the aortas of the infused rabbits showed markedly less atherosclerosis than their paired controls.

The question of biohydrogenation of fatty acids. J. F. Mead and J. C. Nevenzel (Dept. of Biophysics and Nuclear Medicine, School of Medicine, Los Angeles 24, Calif). *J. Lipid Research* 1, 305–310 (1960). Rats were fed methyl palmitoleate-1-C^{14} and the palmitic acid was isolated from their organs and depot fat. Degradation studies revealed that very little activity found its way into the palmitic acid by hydrogenation of the palmitoleate. The major route of carbon from the unsaturated to the saturated acids is through acetate.

Uptake and metabolism of triglycerides by the rat liver. Y. Stein and B. Shapiro (Dept. of Biochem., Hebrew University-Hadassah Medical School, Jerusalem, Israel). *J. Lipid Research* 1, 326–331 (1960). Triglycerides were prepared with C^{14} in the glycerol moiety and tritium in the fatty acid parts as well as with overall tritium labeling. Tracer amounts of these triglycerides were incorporated into blood plasma lipoproteins and the solutions were injected intravenously into rats. Large amounts of the radioactive material were recovered in the liver 15 minutes after the injection and the triglycerides were located primarily in the liver mitochondria and microsomes, with little in the fat droplets. Five minutes after the injection of doubly labeled triglycerides the triglycerides recovered in the liver had practically the same H^3 to C^{14} ratio as the injected material indicating that intravenous lipolysis is not necessary for the uptake of neutral fat by the liver. After longer periods the H^3 to C^{14} ratio in the triglycerides increased rapidly, indicating intrahepatic lipolysis with the loss of free glycerol and the re-esterification of free fatty acids with endogenous unlabeled glycerol precursors. Part of the tritiated fatty acids was also recovered in the phospholipid fraction, while very little of the C^{14} glycerol was used in the synthesis of phospholipids.

The effect of changes in nutritional state on the lipolytic activity of rat adipose tissue. D. S. Robinson (Sir William Dunn School of Pathology, Oxford University, Oxford, England). *J. Lipid Research* 1, 332–338 (1960). When intact epididymal fat bodies from rats given excess carbohydrate, are incubated *in vitro* in the presence of albumin and chyle, free fatty acids (FFA) appear in the incubation medium. These FFA are produced following hydrolysis of the chyle triglyceride by clearing factor lipase present in the fat tissue. When fat tissue obtained from fasted rats is incubated under the same conditions, the amount of FFA appearing in the incubation medium is much less, and it is derived from the tissue rather than from the chyle triglyceride. The function of the clearing factor lipase is discussed in relation to these findings and some of the limitations of the study defined.

The influence of epinephrine and fasting on adipose tissue content and release of free fatty acids in obese-hyperglycemic and lean mice. N. B. Marshall and F. K. Engel (Dept. of Nutrition, The Upjohn Co., Kalamazoo, Mich.). *J. Lipid Research* 1, 339 (1960). Epididymal fat pad adipose tissue obtained from obese hyperglycemic mice exhibited an impairment in its ability to mobilize free fatty acids (FFA) when incubated with epinephrine and in response to a sixteen-hour fast. FFA production by adipose tissue of fed obese mice was significantly greater than that observed in adipose tissue obtained from lean litter mates. It is suggested that the impaired mobilization of FFA may be implicated in the etiology of this type of obesity.

Rapid ultramicro estimation of serum total cholesterol. R. L. Searcy, Lois M. Bergquist, and R. C. Jung (Dept. of Pathology, Los Angeles County Osteopathic Hospital, Los Angeles 33, Calif.). *J. Lipid Research* 1, 349–351 (1960). An ultramicro cholesterol technique based upon a new color reaction and requiring only 10 microliters of serum is proposed. The need for extraction with lipid solvent is eliminated by drying serum on filter paper segments directly and eluting directly in the ferrous sulfate color reagent. This method has been successfully applied to sera obtained from 200 blood donors.

Peroxidation of lipids in tissue homogenates as related to vitamin E. J. G. Bieri and A. A. Anderson (Natl. Inst. of Arthritis & Metabolic Diseases, Public Health Service, Bethesda, Md.). *Arch. Biochem. Biophys.* 90. 105–110 (1960). When dietary vitamin E was adequate, only brain formed peroxides during a one-hour incubation period. When depleted, all tissues rapidly formed lipid peroxides. The time required for the different organs to acquire antioxidant protection, from dietary tocopherol, varied from one day for liver to more than a month for kidney and testes. Rats and chicks were studied.

Phosphatidic acids as intermediates in fatty acid absorption. J. M. Johnston and J. H. Bearden (Univ. of Texas, Southwestern Med. Sch., Dallas). *Arch. Biochem. Biophys.* 90, 57–62 (1960). Following the incubation of intestinal segments from the hamster in either palmitic acid-C^{14} of $NaH_2P^{32}O_4$, the phospholipid fraction containing the major activity was phosphatidic acids. The incorporation of P^{32} into the phosphatidic acids in the intestinal wall was increased two- to threefold when fatty acids were included in the incubation mixture. The results suggest that phosphatidic acid is an intermediate in the absorption of fatty acids from the intestine.

Specifications for the spreadability of butter. R. Riel (Dairy Tech. Res. Inst., Ottawa, Canada). *J. Dairy Sci.* 9, 1224–1230 (1960). Specifications for the spreadability of butter have been established in objective terms. A wide range of resistance to spreading has been obtained by tempering the butter samples at different temperatures. Spreadability measurements made with a modification of the Huebner-Thomsen apparatus are recorded. These data have been compared with the subjective assessments of a panel of 15 persons. The objective spreading resistances corresponding to the subjective desirable spreadability ranged between 260 and 530 g. The range for acceptable spreadability was 160 to 890 g. In the single brand of margarine tested, the desirable spreadability ranged between 260 and 540 g. and the acceptable spreadability ranged between 160 and 1,100 g.

A new insight into pathogenesis of carbon tetrachloride fat infiltration. R. Recknagel, B. Lombardi, and M. Schotz (Res. Div., Cleveland Clinic Found., Cleveland, O.). *Proc. Soc. Exptl. Biol. Med.* 4, 608–610 (1960). Intravenous administration of Triton to rats causes a marked elevation of plasma triglycerides. If the rats have been poisoned with carbon tetrachloride 2 hours previously, accumulation of triglycerides in the plasma following Triton administration is markedly reduced. The existence of an hepatic triglyceride secretory mechanism is inferred from the work of others, and it is postulated that carbon tetrachloride poisons this triglyceride secretory mechanism. Triglycerides, which would normally be secreted into plasma, are retained in the liver.

The value of corn versus fat and wheat bran in a practical broiler ration compared to their predicted energy values. L. Potter, L. Matterson, and E. Singsen (Dept. of Poultry Sci., Storrs Agri. Exper. Station, Univ. of Connecticut, Storrs, Conn.). *Poultry Sci.* 5, 1178–1182 (1959). An eight-week experiment was conducted to compare the weights and feed efficiencies of White Plymouth Rock male chicks fed practical-type diets containing graded levels of fat, 0, 3.5, and 7.0 percent, and diets of different density formed by the absence or presence of 10 percent wheat bran. From a linear response, holding wheat bran constant, the addition of 1 percent fat at the expense of corn resulted in an increase of .00515 in feed efficiency (gain per unit feed consumed) and 7.71 grams in weight at eight weeks of age. The addition of 1 percent corn at the expense of wheat bran resulted in an increase of .00237 in feed efficiency and 5.58 grams in weight. The feed efficiency of the broilers could be better predicted with the use of metabolizable energy values of Hill and Renner (1957) than with the use of productive energy values of Fraps (1946). For each 20 to 22 additional metabolizable calories added per pound of diet, feed efficiency was increased 1 percent.

NUTRITIONAL AND CHEMICAL CHANGES OCCURRING IN HEATED FATS. E. Perkins (Food Res. Dept., Armour and Co., Chicago, Ill.). *Food Tech.* **14**, 508–514 (1960). Data derived from laboratory heated oils cannot be projected to predict whether an unsaturated oil will be damaged sufficiently during processing and commercial frying operations to be harmful. The data obtained is sufficient, however, to justify the suspicion that the use of such oils containing polymeric materials may not be desirable from a nutritional point of view. It is obvious that practical research must yet be done in order to answer at least three main questions: A) Are polymers formed in unsaturated oils during deodorization, processing, and use? B) Are polymeric materials absorbed on food products and if so to what extent? C) What are the physiological and nutritional effects of these materials?

EFFECT OF DIETARY LIPIDS ON GROWTH OF TRANSPLANTABLE NEOPLASMS IN MICE. Carolyn Lingeman, E. Smith, and P. Beamer (Dept. of Pathology, Indiana Univ. School of Med., Indianapolis). *Proc. Soc. Exptl. Biol. Med.* **4**, 716–719 (1960). The incidence of susceptibility of inbred mice to 2 transplantable neoplasms, L1210 leukemia and adenocarcinoma 755, was not influenced by variation in the dietary fats. Diets deficient in fat likewise had neither inhibiting nor stimulating activity in the pathogenesis of the 2 neoplasms.

COMPARISONS OF ULTRACENTRIFUGE AND POLYANION PRECIPITATION METHODS FOR SERUM β-LIPOPROTEINS. W. Florsheim and Constance Gonzales (Long Beach Vet. Hosp. and Univ. of Calif. Med. School, Los Angeles). *Proc. Soc. Exptl. Biol. Med.* **4**, 618–620 (1960). Ultracentrifuge analysis confirms that polyanion-complex precipitation method for human serum β-lipoproteins is adequate and does not denature the lipoproteins when either rice starch sulfate or mepesulfate are used as precipitating agent. The method is applicable to isolation of β-lipoproteins from several but not all species of animals.

QUANTITATIVE ANALYSIS OF THE DEVELOPMENT OF EXPERIMENTAL ATHEROSCLEROSIS IN THE DOG. L. E. Duncan, Jr. and Katherin Buck (Sec. on Clin. Endocrinology, Gen. Med. and Exper. Therapeutics, Natl. Heart Inst., Bethesda, Md.). *Circulation Res.* **8**, 1023–1027 (1960). Atherosclerosis was produced in dogs by feeding them thiouracil and cholesterol. The increments in cholesterol concentration at sites along the length of the aortas of these dogs were determined by subtracting from the value for each site the corresponding value obtained from normal dogs. After about 1 month on the experimental regimen, the cholesterol increments along the length of the aorta formed a gradient. The increment was greatest in the proximal aorta and progressively less down the length of the aorta. After about 5 months on the regimen, the gradient no longer existed. Instead the cholesterol increment in the abdominal aorta exceeded that in the thoracic aorta. Albumin is known to enter the aortic wall with a gradient of rates that is similar to the gradient of cholesterol increments early in the course of experimental atherosclerosis.

FATTY ACID DISTRIBUTION IN LIPIDES FROM EGGS PRODUCED BY HENS FED COTTONSEED OIL AND COTTONSEED FATTY ACID FRACTIONS. R. J. Evans, Selma Bandemer, and J. A. Davidson (Depts. of Agr. Chem. and Poultry Sci., Mich. State Univ., East Lansing). *Poultry Sci.* **5**, 1199–1203 (1960). Mixed cottonseed oil fatty acids were separated into seven fractions by crystalization from acetone in the cold. Each of these fractions and crude cottonseed oil were fed to groups of laying hens, and the eggs were stored at 0° for almost one year. Egg oil from each group of hens was transmethylated and the fatty acid composition determined by gas-liquid chromatography. The fatty acid compositions of each cottonseed oil fatty acid fraction and of the basal ration lipides were also determined. Egg lipides contained a higher concentration of stearic acid than did dietary lipids. Supplementing the diet with small amounts of fatty acids to change the levels of the fatty acids in the rations of the hens did not increase the levels of these fatty acids in the egg oil very much.

INSECTICIDE RESIDUES IN MILK; EFFECTS OF FEEDING LOW LEVELS OF HEPTACHLOR EPOXIDE TO DAIRY COWS ON RESIDUES AND OFF-FLAVORS IN MILK. C. A. Bache, G. G. Gyrisco, S. N. Fertig, E. W. Huddleston, D. J. Lisk, F. H. Fox, G. W. Trimberger, and R. F. Holland (N.Y. State College of Ag., Cornell Univ., Ithaca, N.Y.). *J. Agr. Food Chem.* **8**, 408–409 (1960). Heptachlor epoxide was fed to dairy cows at 0.5 and 1.0 p.p.m. of roughage intake. Analysis of the butter fat indicated residues reached a level of 0.38 and 1.94 p.p.m. for the two levels, respectively. These feeding rates simulate the residue of heptachlor epoxide shown to be present on alfalfa after practical application of heptachlor.

EPOXIDATION AND CYCLIZATION OF SQUALENE. B. L. Van Duuren and F. L. Schmitt (Inst. of Ind. Med., N.Y. Univ. Med. Center). *J. Organic Chem.* **10**, 1761–1765 (1960). The epoxidation of squalene, isosqualene, and tetracyclosqualene was examined. It is shown that epoxidation of squalene with peracetic acid proceeds stepwise. Di-, tetra-, and hexaepoxysqualenes and diepoxytetracyclosqualene were isolated and studied. Some of the lead tetraacetate cleavage products of the diols derived from these epoxides were identified.

BIOASSAY OF CAROTENOIDS, VITAMIN A ACTIVITY OF BETA-APO-8′-CAROTENAL. W. Marusich, E. de Ritter, J. Vreeland, and R. Kurkar (Food and Ag. Products Labs., Hoffmann-La Roche Inc., Nutley 10, N.J.). *J. Agr. Food Chem.* **8**, 390–393 (1960). β-apo-8′-carotenal in oil solution was assayed for vitamin A activity in a series of U.S.P. vitamin A curative rat-growth assays. Combining data from two assays yielded an average potency of 1,200,000 U.S.P. units of vitamin A per gram of all-trans β-apo-8′-carotenal with a range of 1,070,000–1,330,000 units at $P = 0.05$ or $72 \pm 8\%$ of the activity of all-trans β-carotene on a weight basis. Dry stabilized beadlets of β-apo-8′-carotenal were also assayed in three separate tests. Within the limits of the assay procedure no significant difference was seen in vitamin A potency. The possibility is discussed that β-apo-8′-carotenal is an intermediate product in the biological conversion of β-carotene to vitamin A.

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• Drying Oils and Paints

RECENT ADVANCES IN THE CHEMISTRY AND TECHNOLOGY OF FATTY ACID CONDENSATION PRODUCTS. M. R. Mills and W. T. C. Hammond (Milling Group Development Lab., The British Oil and Cake Mills, Ltd., Albion Wharf, Erith, Kent). *J. Oil & Colour Chemists' Assoc.* **43**, 565–75 (1960). In 1957, the first details were published of a new reaction in which unsaponifiable condensation products were obtained by heating fatty acids under certain conditions in the presence of boric acid. When unsaturated acids derived from drying or semi-drying oils were used, film-forming products were obtained that dried more rapidly than the corresponding triglycerides or pentaerythritol esters. The main products are pyrones, formed by the condensation of four fatty acid molecules with the decomposition of their carboxyl groups. The mechanism of the reaction involves the formation of a boron complex that decomposes in the presence of water to form *beta*-diketones, and gives rise to pyrones on heating. The use of the products in varnish technology is investigated.

STYRENE OIL COPOLYMERS IN SURFACE COATINGS. M. C. Menon and J. S. Aggarwal (Regional Res. Lab., Hyderabad, India). *Paintindia* **3**, 19–22 (1960). A study of the reaction of styrene with drying oils, especially castor oil, is reported. A modified mass method, in which the addition of styrene and catalyst was made at high temperatures (180–200°C.), made a clear product with sufficient body. At least 3% benzoyl peroxide catalyst was necessary for proper copolymerization of styrene and oil. By this method, styrenated oil containing 50% styrene was prepared in 3 hours, as compared with 24 hours by other methods. The effects of catalyst, catalyst concentration, oil:styrene ratio, and solvent are tabulated.

METHOD OF PREPARING ALKYD RESIN FROM ISOPHTHALIC ACID. S. Young, Jr. (Standard Oil Co.). *U. S. 2,954,354.* A polyhydric alcohol (ethylene glycol, glycerol, trimethylol ethane, pentaerythritol, sorbitol, mannitol, etc.) is reacted with a vegetable oil or marine oil at a temperature between 180° and 230°. This alcoholysis reaction product is then further reacted with a benzenecarboxylic acid such as isophthalic acid while continuously removing water produced in the reaction and returning condensed reactants to the reaction zone by way of a reflux condenser, until the acid number and viscosity desired for the alkyd have been obtained. To prevent plugging of the reflux condenser by the formation of a solid phase consisting of isophthalic acid, the reaction is conducted in the presence of methanol.

FATTY ACID COMPOUNDS FOR USE AS DRYING OILS. H. S. Bloch (Universal Oil Products Co.). *U. S. 2,954,387.* The drying properties of glyceride oils are improved by heating the oil to a temperature of about 100 to 300° in the presence of an alkaline metal addition complex in which the alkaline metal is complexed with a hydrocarbon such as an acetylenic hydrocarbon or anthracene.

PAINT DRIERS. I. Kirshenbaum, J. H. Bartlett, and O. C. Slotterbeck (Esso Res. & Eng. Co.). *U. S. 2,955,949.* The described composition consists of a drying oil and a cobalt, manganese, or lead salt of a C_8 to C_{20} branched chain carboxylic acid.

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• Detergents

SIMPLIFIED DETERMINATION OF POLYETHYLENEGLYCOL IN NONIONIC SURFACE ACTIVE AGENTS. Masuzo Nagayama and Hiroshi Isa (Lion Fat & Oil Co., Ltd., Tokyo). *Yukagaku* 9, 77–9 (1960). The samples used were ethylene oxide addition compounds of lauryl alcohol, oleyl alcohol, and nonylphenol. This simplified method was based on minimum detectable amount on paper chromatogram obtained with water-saturated butanol as the solvent and the modified Dragendorff reagent as the spray reagent. When the number of moles of ethylene oxide combined were known, the by-produced polyethyleneglycol could be approximately determined by paper chromatography. The result agreed well with that from countercurrent distribution with the solvent system *n*-hexane, chloroform, ethanol, and water (35:15:40:10 by volume).

DETERMINATION OF SURFACE ACTIVE AGENTS IN VINYL EMULSIONS. IV. DETERMINATION OF ETHYLENE OXIDE-TYPE NONIONIC SURFACE ACTIVE AGENTS IN VINYL EMULSION. Shigeyoshi Miura (Tôa Gôsei Chem. Co., Ltd., Minato-ku, Nagoya). *Yukagaku* 9, 73–6 (1960). Determination of nonionic agents contained in vinyl emulsions produced from several monomers by use of nonionic agents as the emulsifier was studied. The monomers used in the experiment included styrene, vinyl chloride, vinylidene chloride, methyl methacrylate, butyl acrylate, methyl acrylate, and vinyl acetate. The nonionic agents used were polyoxyethylene nonyl phenyl ether (with 5, 10, 15, 20, 30, and 4 moles of ethylene oxide), polyoxyethylene lauryl ether (6, 2, and 47 moles of ethylene oxide), and polyethyleneglycol stearyl ester (mol. wt. of polyethyleneglycol 4000). Regardless of the kind of monomers, the nonionic agents with higher value of hydrophile- lyophile balance produced more stable emulsions with higher speed. The method of Schönfeldt [*J. Am. Oil Chemists' Soc.* 32, 77 (1955)] was applied with appropriate modifications.

V. SEPARATE DETERMINATION OF ANIONIC AND ETHYLENE OXIDE-TYPE NONIONIC SURFACE ACTIVE AGENTS IN VINYL EMULSIONS. *Ibid.* 120–4. Stable emulsions could be formed by simultaneous use of nonionic agents with lower value of hydrophile-lyophile balance and anionic agents. Separate determination could be carried out by adding a large amount of ethanol to the emulsion to extract both types of agents. When ethanol could not be used, residual catalyst should be first decomposed, and then separate determinations could be made; nonionic agents by the ferrocyanide method, and anionic agents by use of cation-exchange resin.

A SURVEY OF JAPANESE LITERATURE ON FATS AND OILS FOR 1959. Saburo Komori (Osaka Univ.). *Yukagaku* 9, 428–40 (1960), 186 references.

RHEOLOGY OF SOAPS. Hitoshi Sekiguchi and Yasushi Kimura (Lion Fat & Oil Co., Ltd., Edogawa-ku, Tokyo). *Yukagaku* 9, 399–406 (1960). A review with 103 references.

STRUCTURE AND DETERGENCY OF SURFACE ACTIVE AGENTS. Seizaburo Hayashi (Nihon Yushi Co., Tokyo). *Yukagaku* 9, 457–60 (1960). A review with 10 references, principally of the author.

NEW SURFACTANTS LISTED. J. W. McCutcheon (475 Fifth Ave., New York 17, N.Y.). *Soap Chem. Spec.* 36(10), 53–62 (1960). This is the first of four installments of the latest revision of the list of surface active agents. The list includes only new or previously unlisted detergents and emulsifiers finding use in chemical specialties. The full list of both previously listed surfactants as well as types of surfactants employed in foods and in the manufacture of paints, printing inks, paper, etc., may be obtained in booklet form from the compiler.

LABORATORY METHODS FOR EVALUATION OF DRYCLEANING DETERGENTS. L. E. Weeks and J. T. Lewis (Monsanto Chem. Co., St. Louis, Mo.). *Soap Chem. Spec.* 36(10), 50, 105–107 (1960). Procedures are given for the determination of clarity and stability, solvent solubility, flash point, redeposition prevention, soiled wool detergency, water-soluble soil removal, and solvent relative humidity.

EPILATING COMPOSITION AND DEVICE. Ella B. Brummer. *U. S. 2,954,324.* A composition to be applied to the skin for mechanical removal of hair consists of a homogeneous reaction product of about 7 to 10 parts by weight of a weak acid such as citric, tartaric or tannic; 450 parts of sucrose; 37 to 45 parts of beeswax; and about 3 parts of sorbitan monopalmitate. The material is stable on storage, adheres to the hair but not to the skin, and has no irritating effect on the skin. The sorbitan monopalmitate stabilizes the composition against hardening during storage.

DETERGENT COMPOSITION. W. L. St. John and W. J. Griebstein (Procter & Gamble Co.). *U. S. 2,954,347.* A laundering composition which possesses heavy-duty cleansing power with depressed sudsing action consists of an anionic water-soluble alkali metal salt of an organic sulfuric reaction product having in its molecular structure an alkyl radical having 8 to 18 carbon atoms, at least an equal amount by weight of alkali metal polyphosphate, and a suds depressant. This depressant is a mixture of at least three compounds having acyl radicals of different carbon atom content such as saturated fatty acids of 16 to 31 carbon atoms or water soluble alkali metals soaps of such acids. The mixture should contain more than 50% of compounds having at least 16 carbon atoms and at least 5% having at least 20 carbons.

DETERGENT COMPOSITIONS. E. A. Schwoeppe (Procter & Gamble Co.). *U. S. 2,954,348.* The composition is similar to that described in *U. S. 2,954,347.* The suds depressant mixture contains in addition to the saturated fatty acids a nonionic polyoxyalkylene compound.

CLEANING COMPOSITION. D. H. Terry (Bon Ami Co.). *U. S. 2,955,047.* The oil-in-water emulsion consists of (a) 0.1 to 5% by weight of a dimethylpolysiloxane oil having a viscosity of from 200 to 350 centistokes at 25°; (b) 0.5 to 50% of a water-miscible organic solvent for the dimethylpolysiloxane oil; (c) 0.01 to 1% of a water-soluble synthetic surfactant (nonionic or anionic); (d) water.

SULFONATE DETERGENT COMPOSITIONS WITH IMPROVED FOAM CHARACTERISTICS. H. Y. Lew (California Res. Corp.). *U. S. 2,956,025.* The desired composition consists of 10 to 40% (by weight) of active organic detergent material and 60 to 90% of water-soluble inorganic salt detergent builders. The organic detergent material contains 5 to 50% normal primary C_{10} to C_{18} monoalkylbenzene sulfonate, 35 to 90% branched-chain C_9 to C_{18} monoalkylbenzene sulfonate detergent, and 2 to 15% of a normal alcohol chosen from the group consisting of C_{14} to C_{16} saturated primary monohydric alcohols and C_{14} to C_{22} 1,2-glycols.

SULFONATE DETERGENT COMPOSITION. H. Y. Lew (California Res. Corp.). *U. S. 2,956,026.* The organic detergent material consists of (a) 40 to 50% branched-chain C_9 to C_{18} monoalkyl benzene sulfonate detergent; (b) 5 to 10% of a normal alcohol selected from the group consisting of C_{14} to C_{16} primary saturated monohydric alcohols and C_{14} to C_{22} alkane, 1,2-glycols; and (c) 10 to 50% of a sulfonate characterized by a straight chain C_{10} to C_{24} alkyl radical attached to the sulfonic acid group by the terminal carbon, such as a normal alkane sulfonate or the α-carboxy, β-sulfo, β-hydroxy, or β-nitro substituted derivatives thereof.

CERTAIN SURFACTANTS AND METHOD OF MAKING SAME. M. De Groote and Jen Pu Cheng (Petrolite Corp.). *U. S. 2,956,067.* An oxirane ring-containing compound obtained by epoxidation of a higher fatty acid (8 to 22 carbons), a lower alkanol ester of a fatty acid, an amide of a fatty acid, or a naturally occurring glyceride of higher fatty acids is reacted with a polyol at a temperature of 65 to 170° for 1 to 5 hours. The resulting product is then reacted with an acylation susceptible polyamine at a temperature of 110 to 310° for 1.5 to 5 hours.