REVIEW OF
SCIENTIFIC LITERATURE ON FATS & OILS
FOR 1934

R. C. NEWTON, Chairman

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The commercial situation of oils and fats is surveyed by the editors of Chemical and Metallurgical Engineering [Chem. & Met. Eng. 42, 57 (1935)] and by W. Brinkley (Cotton Oil Press 23, No. 7, 19). In the United States, due to curtailment, the 1934 production of cotton seed oil, various grain oils, and lard was reduced. The world coconut oil production also was of smaller volume as compared with the quantity turned out in 1933. This led to an important development in the oil market in connection with the rise in average price level. In January the "Chem. & Met's. weighted price index" for oils and fats was 51.38 (basis—100 for average during 1927). In December this number had risen to 83.32.

Total consumption of all oils and fats was greater, while production and stocks declined. The following data from Chem. & Met. serves as a good summary:

(All data given in millions lbs.)

	Jan. to Sept. 1934	Jan. to Sept. 1933
Vegetable oil consumption	3,112	2,978
Animal fats consumption	1,554	1,385
Fish oil consumption	115	115
Vegetable oil factory production	2,525	2,708
	Jan. 1, 1934	Sept. 30, 1934
Vegetable oil stocks	1,550	1,051
	Jan. 1, 1933	Sept. 30, 1933
Vegetable oil stocks	1,338	1,220

Data on individual oils or fats may be obtained from the first reference.

Soap production in 1934 was larger than during the year 1933. This was probably due to the low prices of fats and oils prevailing in the early part of the year.

Consumption of drying oils was greater than in the preceding year. Future supply of this type oil may be increased for reason that experiments with tung tree cultivation are now rapidly progressing in the United States, several parts of the British Empire, some South American countries, and Russia, in an attempt by these countries to become independent in regard to these raw materials. There is a continued search for new oil source as substitutes. Notable among the most recently developed sources is the oiticica nut oil. Gardner estimates that production of this oil could amount to one hundred million barrels a year without difficulty and that this oil may replace most of the China wood oil now used in the manufacture of varnish.

Import restrictions partially destroyed what for many years was an important market for American lard. Germany limited imports of lard to 40 per cent of the average imports during corresponding months of 1931-1933; further restrictions on exportation of lard to Germany were caused by unbalanced foreign exchange. England has also limited imports on pork products from this country.

Levies on foreign oils imported into the United States and the new state tax assessed in eight states on margarin containing oil or fat not of domestic production have been effective in increasing the use of cotton oil as well as beef fat and oil and decreasing the use of coconut oil in margarin. In January (1934) coconut oil constituted 71.6 per cent of the oil and fat constituents of margarin. By July it had fallen to 46.4 per cent. Cotton oil constituted 10.4 per cent of the oil and fat contents in January, and in July it was 30.5 per cent. Oleo oil used increased in the same period from 10.2 to 17.9 per cent of the total oil used.

Development of domestic oil resources in various countries, as is now the tendency, may in the future restrict trade in this product; and those countries having large supplies may have to find new uses for it. The discussion by A. W. Schmidt and K. Gaupp (Tropenpflanzer 37, 51-9) on the use of vegetable oils for Diesel engine fuel may be of significance in this respect; although these authors do not recommend it because of its lower efficiency, an over supply could be used for this purpose.

Commercial Treatment of Oils and Fats

Technical papers, patents, and discussions on rendering, extracting, and refining processes have continued to appear. To give a review of the trend along this line, short notes on many recent papers follow:

The drip method of refining lard (Nat'l Prov. 91, No. 17, 7-9, 22 and Meat 2, 10-11, 13), has been introduced in some meat packing plants; it is claimed that by this method rendering and refining are combined in one operation and it is possible to make a uniform, high-grade lard, having low fatty acid content, high smoke point, and good stability from any kind of pork fat. Similar good results are claimed in another paper [Nat'l Prov. 92, No. 4, 11-12, 35 (1935)] on a vacuum refining method in which the lard is protected from air during the whole process.

A continuous oil extraction process now in use in some plants is described by H. H. Bighouse (Chem. & Met. Eng. 41, 482-3). The extraction unit consists of a steel tank placed vertically, having a cone-shaped bottom section on the center axis, in which is built a steam-jacketed section which extends downward to the upper region of the cone. The solvent is passed downward through the steam-jacketed section while the minced oil-bearing mass is passed counter-currentwise. Operation cost, power, steam, and solvent loss are claimed to be lower by this process. The counter-current principle is used by K. Hildebrandt (U. S. Pat. 1,961,420) in a U-shaped apparatus. A. Nyrop (Brit. Pat. 418,107) extracts oil from a minced mass by heating and subjecting to high pressures and then suddenly submitting the mass to reduced pressure in order to burst the fat cells, after which rendered fat is separated from the solid residue. A patent issued to G. E. Ryan (U. S. Pat. 1,980,000) pertains to an improved mechanical structure of a cottonseed oil press. T. A. Todosieva [Schriften Zentral. Forschung. Lebensm. Chem. (U. S. S. R.) 4, 20-32 (1933)] finds C_2HCl_3 and $C_2H_4Cl_2$ very effective and as rapid as petroleum ether for extraction of fat from bone meal, fish meal, and the like.

G. Bredeman and H. Kummer (Fettchem. Umschau 41, 81-5) experimenting with soy beans to study the influence of storage on the yield and speed of extraction of oil and phosphatide obtained the following results: By use of benzene for extraction of air dried ground bean meal the amount of phosphatides in the oil decreases with increasing drying time and elevation of temperature. Storage in a moist, warm hothouse increased the yield of pure oil and the phosphatides yield increased slightly. Increasing moisture content of beans increased the yield, especially of the phosphatides. It is assumed that free oil within the cell dissolves the free phosphatides which are readily extracted, but an additional amount of oil and phosphatides is present in more or less of a combined form, which dissolves only on prolonged extraction.

A continuous method for refining oils now in use in this country is described by E. M. James (Oil & Soap 11, 137-9). This method depends on the following component parts: (1) A proportionometer for accurately proportioning two continuously flowing liquids one to the other, (2) a mechanical mixer, (3) a suitable heater for rapidly raising the temperature of the mixture of oil and lye, and (4) high speed centrifugal separators for continuously separating neutral oil and soap stocks. The authors state that this process will refine cottonseed oil with a reduction of loss of free oil in the foots of approximately 30 per cent below the loss suffered by conventional batch methods.

Refining oils with phosphoric acid seems to have some good points, as may be seen from the stimulation of interest in patenting processes, in which this acid is used. Notable among such patents are: (1) L. E. Appleton's (U. S. Pat. 1,973,790) pertaining to the use of phosphoric acid in such a manner as to remove the impurities and increase the free fatty acid content of linseed oil; (2) I. G. Farbenindustrie A.-G (Brit. Patent 405,398) makes use of phosphoric acid, salt, or other electrolytes, with subsequent deacidification for edible oils; (3) A. Freiburg (U. S. Pat. 1,964,875) adds a small quantity of cellulose after treatment with phosphoric acid; this is followed by filtering; and (4) E. W. Eckey (U. S. Pat. 1,982,907) claims the use of phosphoric acid refining as a method of stabilizing the odor and flavor and at the same time removing the impurities. Procter & Gamble Company, to which this last patent is assigned, have applied in the name of their assignees for patents on the use of phosphoric acid as an antioxidant (U. S. Pat. Office, Ser. No. 629,891, filed Aug. 22, 1932). Among the late acid refining inventions is the modification of the I. G. Farbenind. A.-G. patent (Ger. Pat. 569,797,) for refining oils and fats by treating them with boric acid at temperatures above 100° and distilling; this was extended by their new patent (Ger-Pat. 592,089) to incorporate the replacement of boric acid by its esters with polyhydric alcohols. An improvement in refining, according to Wm. Gensecke (U. S. Pat. 1,968,252), is concerned with the use of salt solutions containing acids, such as magnesium sulfate or sodium sulfate and sulfuric acid, with subsequent removal of acids by neutralization with alkali before separating the precipitated substances. Patents (U. S. Pat. 1,885,859 and 1,963,505 and Fr. Pat. 771,338) issued to L. Rosenstein and W. J. Hund, claim the use of liquid ammonia and alkylolamines for refining of fats, oils, and waxes.

In calculating refining losses from the amount of neutral oil left in soap stock, E. J. Better and J. Szimkin (Allgem. Oel. u. Fett-Ztg. 31, 193-6) could not confirm Wittka's findings [Allgem. Oel u. Fett-Ztg. 29, 9-13 (1932)] that prolonged heating of a soap stock with acid during refining should increase the free fatty acid up to 6.7 per cent and thereby cause factory losses. They did, find, however, some free acids in the unsaponified matter of soapstock by the Spitz and Honig method. They attribute these free acids to the hydrolytic action of the soap stock upon its neutral oil forming mono or diglycerides. When these free acids are subtracted from the total acids found by the usual titration of the acidified and boiled soap stock, the discrepancies between laboratory tests and actual factory losses largely disappear. In answer to the preceding, Wittka (Allgem. Oel. u. Fett-Ztg. 31, 359-60) stated that B. and S. did not obtain results previously published because variations in composition are often responsible for such variations in results; e.g., B. and S. in one example used an oil which was relatively free from impurities and in other examples the oils had been previously treated with strong caustic.

S. Goranflo (U. S. Pat. 1,951,241) patented a method for purification of fatty acids. Acids are heated to 240-270° and discharged in the upper plates of a bubble tower through which they fall counter-currently through super-heated steam. The fatty acid vapors are condensed at a temperature above the boiling point of water and under vacuum.

According to patent by Schering-Kahlbaum A.-G. (Ger. Pat. 592,972 Cl. 53h. 1.01) rancid oils and fats are restored by treatment with aldehydic and ketonic precipitants, such as NH_2OH, N_2H_4, hydrozin, semicarbozide, etc., and then filtered.

Oils can be decolorized and deodorized by heating. After studying various methods of deodorizing fish oils, G. Matsumoto and H. Matsuo (Repts. Imp. Ind. Research Inst. Osaka, Japan 15, No. 3, 29) recommend polymerization at high temperatures (200-300°) under reduced pressure. Y. Shinozaki and M. Sato (J. Soc. Chem. Ind., Japan 37, 372-B) contended that alcohol extracted oils can be decolorized by heating to 200° and filtering without any preliminary treatments such as alkali or acid washing. The coagulated matter obtained in such a manner contains phosphorus 2.18 per cent and nitrogen 1.03 per cent (phosphatides).

A number of methods for bleaching oils by use of adsorbents have been suggested. E. Gilbrich (Seifensieder Ztg. 61, 710), recommends bleaching and adsorptive earths for removing the greenish color in several fats and oils. The "Soc. des produits peroxydes" patented (French Pat. 762,166) the use of per-compounds at temperatures below 75° in treatment of oils to enhance subsequent bleaching by adsorbents. According to R. Neu (Fettchem. Umschau 41, 70-1) silica gel when precipitated with concentrated hydrochloric acid from commercial water glass removed little color and little nitrogen from soy bean oil at 100°, but with increasing dilution of hydrochloric acid the gels obtained are more active, the most effective being obtained with an 0.1 molar acid solution. R. Fussteig (Mat. grasses 26, 10042-7) discusses the merits of carlonit, a natural active earth recently discovered near Carlsbad. This earth is said to be much more economical than artificially activated earth; it absorbs but little oil and filters easily.

Highly acid oils treated in presence of catalysts with glycerol in stoichiometric quantity gave a product having a residual acidity of 2 to 5 per cent as oleic acid, according to experiments by E. Vassallo (Olii minerali olii grassi colori 14, 9-10). In an experiment with 95 per cent oleic acid acidity, treated with 96 per cent ethyl alcohol in presence of Fe_2Cl_6, 63 per cent was esterified.

Y. Toyama, T. Tsuchiya, and T. Ishikawa [J. Soc. Chem. Ind. (Japan) 37, 192-3B] experimented with olive oil, its fatty acids, and eight equimol. mixtures of alcohols and reported that alcoholysis of fats is not a selective reaction.

R. Oda and S. Wada [J. Soc. Chem. Ind. (Japan) 37, 295-6B and Science Papers' Inst. Phys. Chem. Research (Tokyo) 24, No. 510, 171-3)] ammonalyzed many oils by the action of anhydrous liquid ammonia on the oils under pressure; obtaining good yields of acid amide. They state that this reaction is similar to hydrolysis of fat with water.

C. E. Adams, G. L. Parkhurst, and V. Voorhees (OIL AND SOAP 11, 43-5) describe their patented process for removal of stearin from fatty oils. Hydrocarbon mixtures, such as liquified butane-propane gas mixtures, are used to dilute the oil; and, by keeping it at a low temperature stearin settles out.

To obtain a good substitute for the tallow used in sizing textiles, M. S. Patel and B. S. Kanvinde (Bombay Presidency Dept. Indus. Bull. 8, 8 pp.) suggest the use of 80 per cent peanut oil, 15 per cent coconut oil, and 5 per cent castor oil, refining and hydrogenating to a melting point of 50°. Such a product has characteristics similar to animal tallow. Another interesting substitution is the addition of the esterified aliphatic acids of sperm oil to neatsfoot oil, patented by Deutsche Hydrierwerke A.-G (German Pat. 567,618). In order to use castor oil as an admixture to mineral oil, this oil must be first made soluble in the latter; to accomplish this K. Klein (Ger. Pat. 593,634) heats the castor oil in an autoclave under pressure.

A method of hydrolyzing fat was patented by J. R. Moore and E. K. Wallace (U. S. Pat. 1,967,319). The fat is dissolved in a water miscible solvent such as acetone or other ketones or a solution of ketones, alcohols, and ethers, water, and an acid catalyst. The mixture is heated to hydrolyzing temperatures, the solvent distilled, and the water and glycerol are decanted from the solution.

Recent synthetic methods for the manufacture of fats and oils have been reviewed in a paper by H. H. Franck (Chemie & Industrie Special No. 889-93, April). This paper also deals with the developments in connection with the production of higher aliphatic alcohols. Another review of interest is the one by R. Strauss (Fettchem. Umschau 41, 45-51) on the progress in production of artificial fatty acids, 1930-1933.

C. E. Nabuco de Araujo, Jr. [Chimica e. industria (Brazil) 1, 281-2 (1933) and Chimica e. industria (Brazil) 2, 4-6] gives results of experiments on production of fatty acids from petroleum hydrocarbons. In his first paper experiments are described on the electrolysis of paraffin in a sulfuric acid emulsion with the presence of catalyst. The yellow and greenish fatty acids produced in this manner turn rancid in 40 hours. According to the second paper, better results are obtainable and in about one-half the time by boiling the emulsions in presence of ceric sulfate with a reflux condenser instead of electrolysis. The catalyst is reduced and must be reoxidized. The acids thus produced are soluble in benzine and petroleum ether; this shows absence of (OH)-radicals. The sodium soaps made from these acids are hard, odorless, yellowish in color, and exhibit all the characteristics of normal soaps.

F. C. Bowman and A. Mass [Ind. & Eng. Chem. (News Ed.) 12, 337-8] report results obtained by C. L. Mitchell and E. L. Wetmore on experiments conducted to determine the feasibility of using metals in construction of a butter churn. Aluminum alloy containing 2 per cent magnesium or 2 per cent silicon proved least susceptible to tarnish, did not affect the flavor of the butter, and the tendency of the butter to adhere to the metal was less than with other metals.

The description of a modern hydrogenation plant by K. Schneider Fettchem. Umschau 41, 204-12) and the paper by K. H. Bauer (Z. Untersuch. Lebensm. 68, 38-41) briefly discussing hydrogenated food fats and the structure of the fatty acids occurring therein are of importance to those wanting a general conception of the fat hardening process.

In regard to the theory of hydrogenation, F. Bloemen (Fettchem. Umschau 41, 95-8 and Ibid. 151-4) postulate that, on the supposition that catalytic hydrogenation is a reversible reaction with positive heat evolution, hardening occurs in a stepwise saturation of the double bonds with equilibrium relation and the catalyst transforms the heterogeneous system H-oil-catalyst into a homogeneous reaction phase. He developed some mathematical equations which lead to the following conclusions: (1) Selective saturation increases with increased temperature. (2) Selectivity decreases with increased pressure. (3) The reaction speed rises to a maximum, then falls: the maximum for oleic acid is 170°, for linolenic acid 250°. Iso-oleic acid increases with rising temperature and decreases with increasing pressure. The law of equilibrium as formulated in the first part of this paper applies only to the hypothetical case in which all fat molecules are subject to catalytic influence of uniform intensity. He asserts that such a condition is never met practically, due to the limited sphere of influence of each catalyst particle and to the fact that intensity of catalytic action is greater at or near the surface of the catalyst particle. Both of these considerations explain why previously drawn conclusions as to the effect of temperature and pressure on the course of the hydrogenation are of qualitative rather than of quantitative nature, and also offer a theoretical explanation of the known importance of controlling the amount of catalyst as a means of influencing the degree of selectivity of hydrogenation. In a paper (Fettchem. Umschau. 41, 154-5) to supplement the last two papers, Bloemen points out that the formulated theoretical considerations are in good agreement with the experimental results of H. J. Waterman and co-workers [Recueil Trav. chim. Pays-Bas 51, 653 (1932) and Ibid. 52, 9 (1933)].

The results obtained by S. Ueno [J. Soc. Chem. Ind. (Japan) 37, 457-8B] are noteworthy because they are not in agreement with current theories or results of other authors. He states that formation of iso-oleic acid is somewhat depressed when sardine oil is hydrogenated with a nickel-Kieselguhr catalyst at high temperatures (250-300°) under atmospheric pressure. The amount of catalyst had practically no relation to the formation of iso-oleic acid. At high temperature (275°), the results were rather irregular, and it was concluded that the hyrogenation included side reactions like polymerization, decomposition, etc.

In regard to olive oil, J. M. Pertierra (Anales Soc. espan. fis. quim. 32, 738-41) finds that in order to avoid secondary reactions and destruction of molecules it is advisable to hydrogenate at high pressure (80-120 atmospheres) and 160° temperature. In this manner the solid products obtained contain 70 per cent of the original fatty acids as solid fatty acids. He also states that the absorption of hydrogen with olive oil begins at 80° with 80 atmospheres pressure.

The economical importance and feasibility of using ammonia as a source of hydrogen in hydrogenation have been set forth by C. Tyler (Oil and Soap 11, 231, 241). The equipment described will produce catalytically pure hydrogen under pressure; this source of hydrogen is recommended for small requirements or for decentralizing large operations. A dissociator for such a source of hydrogen is advertised by one concern with the description that, with ammonia delivered at 15½ cents per pound, and 22 lbs. required to produce 1,000 cubic feet of gas, cost of electricity 1 cent per kilowatt for the required 15 kilowatts and 15 cents charge for depreciation, the cost of 1,000 cubic feet of gas is $3.71.

Nickel formate catalyst has been favorably recommended for fat hardening. I. Lyubarski [Masloboino Zhirovoe Delo No. 5, 17-19 (1933)] asserts that with such a catalyst the hydrogenation in presence of impurities as carbon monoxide, hydrogen sulfide, carbon oxysulfide, phosphine, carbon dioxide, and methane was markedly accelerated, which, with ordinary nickel catalyst, would cause a negative effect. L. G. Jenness (Oil and Soap 11, 131), demonstrated with several plant tests that .05 to .075 nickel as the nickel foraminate will permit hydrogenation comparable with the use of 0.2 to 1.0 per cent nickel in the form of other catalysts, with less formation of free fatty acid and color. Another catalyst that is finding some use is discussed by Bog, Volokitin and Egunov [Masloboino Zhirovoe Delo No. 4, 16-17 (1933)]. This catalyst is prepared by the treatment of a nickel-aluminum alloy with sodium hydroxide. Such catalysts do not require the usual hydrogen reduction and the authors state that they are not sensitive to the usual poisons (H_2S, etc.). W. A. Lazier (U. S. Pat. 1,964,000) has patented a method of preparing catalysts by reduction of compounds containing nickel, chromate, and a nitrogen radical $NiO_2(NH_4)_2(CrO_4)_2$ is one example.

As carriers for catalyst, L. R. Williams and C. A. Jacobson (Ind. & Eng. Chem. 26, 800-2) recommend the use of carbon black. Sadikov (Russian Pat. 31,535) patented the use of glass wool, pearls or chips. R. Brindley (Fr. Pat. 758,751) treats nickel oxide with ethyl orthosilicate that has been coagulated by the addition of ammonia; this mass is then divided into granules, dried, and reduced.

Edible Fats and Oils in Relation to Cookery

Advances in the shortening field deal generally with those made in deodorizing, clarifying, testing, creaming, and packaging. Some of these subjects are treated in other parts of this review. The trend in packing of small amounts seems to swing somewhat toward the use of greaseproof paper cartons; while improvements in steel barrels encourage an increased use of these in place of the wooden barrels as containers for large amounts.

The Bailey shortometer has established itself as the best apparatus and method for evaluating the shortening power of a fat. The new automatic form of this instrument (Cereal Chem. 11, 160-3), has made its use less cumbersome. Dr. Jennie Fisher Cawood [Ind. & Eng. Chem. 25, 1171-3 (1933), and Ibid. 26, 968-9] investigated the possibility of calculating the amount of fat necessary in various formulas by means of the shortometer. When amounts of fats used in the formulas were in the inverse order of their shortening value, the breaking strengths came out approximately the same and when the shortening is to be used in other formulas, the amount necessary can be calculated from the shortening test.

During a comparative study of the shortening value of fats I. T. Noble, H. McLaughlin, and E. G. Halliday (Cereal Chem. 11, 343-6) observed that manipulative factors cause some variation in the breaking strength (Bailey shortometer) obtained with a fat. Creaming of fat and sugar to a maximum volume was capable of producing a crisper wafer; incomplete mixing of dough gave similar effects and rolling without flour gave wafers with little more than half the strength as is obtained with use of flour to prevent sticking.

The consistency of shortening is important in trade. Most shortening users test consistency by the "finger indentation and feel method" and supplement this by the "mouth softening method" which, although familiar to oil chemists as trade methods are not controlled procedures. The controlled penetration test described by C. O. Gravenhorst (Oil and Soap 11, 86-7) would be of value for the purpose. The test is carried out by measuring the penetration of a metal ball into the fat; this method as shown in the above table indicates much greater variation in fats than can be ascertained by melting point and iodine number.

Oil	I No.	M. P.	Hardness
Peanut oil (hardened)	60.2	35.0° C.	17½ at 20°
Peanut oil (hardened)	61.5	35.1°	65 at 20°
Peanut oil (hardened)	69.0	31.9°	6 at 10°
Peanut oil (hardened)	69.1	27.2°	9½ at 10°
Whale oil (hardened)	...	37.0°	60 at 20°
Seal oil (hardened)	...	37.0°	39 at 20°
Whale oil (hardened)	...	41.3°	38 at 20°
Seal oil (hardened)	...	41.4°	19 at 20°

The Swift & Co. patent (Can. Pat. 333,067) issued in 1933 and other patents issued to Procter & Gamble Co. (Fr. Patents 757,807, 757,808, 758,057 and 758,058) indicate that enhanced results are obtained by adding mono and diglycerides to a shortening. Such treatment improves the creaming qualities of the shortening and thereby one obtains baked products of better texture and volume. Also in this connection, the Procter & Gamble Co. have patented a method (Can. Pat. 340,803, 340,804, 340,805, and Brit. Pat. 412,766) to make the mono and diglycerides.

The possibility of reaction taking place between butter and chemical leavener was investigated by W. Stoldt (Pharm. Zentralbl. 75, 297-8). Analysis of the fat extracted from brown cakes prepared with potassium carbonate as a leavener shows no change has taken place (e.g. saponification number, R-M. number, Polenske number, iodine number and refractive index) during the baking process.

Deterioration of Fats and Oils

The regular appearance of modification of existing methods for detecting deterioration of fats and oils is convincing evidence that there is a great desire for an improved method. In this respect I. Korpaczy [Kiserletugyi Kozlemenyek 36, 211-15 (1933) also Z. Untersuch. Lebensm. 67, 75-9] has extended the Stamm method [Bull. Soc. Pharm. (Esthonia) 5, 181 (1925), also Analyst 51, 416-7 (1925)] so that the color developed is compared with the color of standard Bordeaux-S solutions. By this method a fat showing a color number greater than 5 (Standard containing 5 mg. Bordeaux-S and 0.5 mg. tartrazin per 100 cc. H_2O) should be considered deteriorated and unfit for consumption.

K. Täufel and P. Sadler (Z. Untersuch. Lebensm, 67, 268-73) in a paper on autoxidative spoilage of fats, discuss the significance and limits of the Kreis reaction on the basis of some new investigations. They described three methods of carrying out the Kreis reaction: their advantage as compared with previous methods consists particularly in the fact that the color reaction is conducted apart from the substance being investigated, and hence free from such influences as may otherwise destroy it. J. M.

Aas (Fettchem. Umschau 41, 113-5) plotted the color intensity (Lovibond) of the Kreis test against time; results show that the intensity of color follows Beer's Law.

C. H. Lea (Ind. & Eng. Chem. Anal, Ed. 6, 241-6) investigated the bisulfite method for determination of aldehydes in fats. His modification of this method will determine the presence of 0.1 per cent aldehyde in cottonseed oil with an accuracy of the order of 0.001 per cent. It is suggested that since statements in literature attribute the rancid odor to presence of aldehydes, a quantitative chemical test corresponding closely with the organoleptic method would best be achieved by estimating the substance or substances (heptaldehyde and nonaldehyde) actually responsible for the rancid odor and flavor.

A method for comparison of the susceptibilities of oils and fats to oxidize is described by C. H. Lea (J. Soc. Chem. Ind. 53, 388-91T). The sample is dispersed on filter papers, suspended in glass jars at 100° and the peroxide value determined at intervals.

New data on the antioxidant properties of various compounds were reported. G. R. Greenbank and G. E. Holm (Ind. & Eng. Chem. 26, 243-5) report that of the phenols, only the ortho and para types are active as antioxidants for fats and oils. Some unsaturated polybasic aliphatic acids, notably maleic, are also antioxidants for fats and oils. The results with carotene agree with those of Franke [Z. physiol. Chem. 212, 234 (1932)] that lipochromes accelerate oxidation of glycerides. Quercetin, on the other hand, was found to possess antioxidative properties. H. S. Olcott's (J. Am. Chem. Soc. 56, 2492-3) paper deals with the same subject. He finds hydroxyhydroquinone and apionol excellent antioxidants. The 1, 3 and 1, 8 naphthalene diols are effective while the 1, 4 derivative is inactive. Esterfication and alkylation of one or more of the hydroxyl groups destroys or greatly reduces antioxygenic activity. Side chains on the benzene nucleus reduce the activity of hydroquinone. Maleic, tartaric and citric acids are inactive. This last statement is not in agreement with the report by Greenbank and Holm; this is probably due to the difference in the methods used for evaluating antioxidants.

A. L. Caldwell and F. E. Bibbins (J. Am. Pharm. Assoc. 23, 7-14), studied the oxidation of codliver oil in the presence of antioxidants and concluded: There is no means of predicting the value of an antioxidant in oils and fats merely from chemical structure. The "trial and error" method must be used to determine: (1) possible value of an antioxidant and (2) the amount necessary to give maximum activity. Their tests, with many compounds, show naphthols, quinone, and hydroxy-compounds are the three most dependable types; however, some compounds of these groups form deposits in the oils on standing.

A good inducement for the better protection of codliver oils from deterioration is the report of A. D. Holmes, F. Tripp, and D. F. Menard (Oil and Soap 11, 102-4). The analyses of many oils obtained from the open market show a fatty acid content ranging from 0.38 to 20.88 percent. Many of the medicinal oils show poor stability.

E. Freyer's (Oil and Soap 11, 162) data on relation of moisture content of cotton seed during storage to the free fatty acid of the oil later produced from them, furnish inducement to protect cotton seeds from excessive humidity during storage. Seeds stored 90 days containing, respectively, 9.5 and 14.5 per cent moisture showed an average free fatty acid content in their oil of 0.6 and 47. Other studies by M. K. Thornton, Jr. (Oil and Soap 11, 209, 216) confirm these results and caution storers of seeds to dry seeds to less than 10 per cent moisture before storing.

The fat soluble vitamins in tomatoes, carrots, and wheat germ oil are associated with inhibitors. According to E. M. Bradway and H. A. Matill (J. Am. Chem. Soc. 56, 2405-8) it appears that the inhibitors in these three materials and lettuce are probably all different substances; lycopene, vitamin A and E are not active, and there are other inhibitors in plant tissues aside from those found in the unsaponified portions of the lipids and the glucosides. E. W. Kochenderfer and H. G. Smith. [Proc. Iowa Acad. Sci. 39, 169-70 (1932)] working with soy-bean lecithin, find it has slight antioxidant properties for lard, but after purification by precipitation with acetone, the antioxygenic properties are either reduced or increased, depending on the kind of lecithin preparation used.

The effect of salt has received consideration in respect to oxidation of fats in two papers. L. B. Kilgore (Oil and Soap 11, 72-3) experiments demonstrate that the addition of salt to mayonnaise containing cottonseed oil resulted in the formation of fewer peroxides in the oil. C. H. Lea (J. Soc. Chem. Ind. 53, 192-4T) reports the salt occurring in curing pickle for bacon has a pronounced accelerating effect on the oxidation of pork fat.

Evidence presented by R. B. Bohm and R. S. Olson (Oil and Soap 11, 210) shows that some antioxidants which are effective in prolonging the life of shortening largely disappear when judged as their protective value in baked products. To determine stability of a shortening in baked products (i.e., crackers, biscuits, etc.), it is necessary to use the shortening in the baked product and test the stability of the product.

H. L. Roschen and R. C. Newton (Oil and Soap 11, 226-8, 236) report that peroxides and volatile material formed in rancid lard are inactive as catalysts of oxidation.

K. Manschke [Z. Fleisch u. Milchhygiene 44, 94-5 (1933)] reports that such practice as either adding diacetyl or treatment to favor formation of diacetyl in butter for improvement of flavor, increases the susceptibility of the butter to oxidize.

M. Nakamura [J. Soc. Chem. Ind. Japan 37, 86-9B] reports that with the presence of p-nitroaniline oxidation of a fatty oil is increased in the first stages of oxidation; this activity increases with iodine value of the fat and in the course of oxidation the phenomenon of inversion takes place when the iodine number becomes lower. In this last stage of oxidation the compound acts as an antioxidant. This inversion was observed only in oils having an iodine number less than 120.

The irradiation effects on olive oil were reported to be peculiar by M. Horio and Y. Kasakawa [J. Soc. Chem. Ind. (Japan) 37, 415-6B] in that the rate of formation of peroxide gradually decreases to a minimum as the time of irradiation is prolonged.

W. S. Kisselow and W. E. Chazet [J. Chem. Ind. (Russia) 10, No. 3, 31-43] report small amounts of antioxidants hasten and large amounts retard the drying of linseed oil varnish films.

It is commonly known that light affects the spoilage rate of fats. Data on the effects of various wave lengths of light had been presented by G. R. Greenbank and G. E. Holm [Ind. & Eng. Chem. 25, 167-8 (1933)], C. H. Lea [J. Soc. Chem. Ind. 52, 146-9T (1933)] and M. R. Coe and J. A. LeClere [Cereal Chem. 9, 519 (1932)]. The latter authors (OIL AND SOAP 11, 189-90; Siebel Tech. Rev. 9, No. 2, 51-2, and Ind. & Eng. Chem. 26, 245-8) have continued their work and reported that oils protected with opaque or green wrappers showed no organoleptic rancidity after seven months, although they may have strong positive reactions in the Kreis, von Fellenberg and peroxide tests. W. L. Davis, (J. Soc. Chem. Ind. 53, 117-120T and Ibid. 148-51T) asserts that it is the depth of color and not the actual color which is important for protection of fats against spoilage.

Working with oleic acid, oleic acid esters, and linoleic acid K. Täufel and A. Seuss (Fettchem. Umschau 41, 107-13 and Ibid. 131-7) observed the following: (1) Oxygen absorption and peroxides increase steadily while epihydrinaldehyde (Kreis test) in various samples fluctuates as oxidation progresses. (2) The tendency to oxidation decreases on passing from oleic acid to ethyl oleate to glycol oleate to oleic acid glyceride. (3) The tendency of linoleic acid to oxidize is disproportionately large as compared to oleic acid when the degree of unsaturation is considered, showing that the two double bonds in linoleic acid have some influence on one another. (4) The effect of light on oils is similar to the effect produced by pro-oxidant metal salts. (5) Peroxide and Kreis tests are of qualitative value in detecting rancidity, but give no quantitative significance. Results like those under numbers 2, 3, and 4 of the preceding observations were reported at the same time or probably a little earlier by Th. Ruenele (Seifensieder Ztg. 61, 125). A paper by B. F. Chow and S. E. Kamerling (J. Biol. Chem. 104, 69-79) demonstrated that linoleic acid and linseed oil suspended in a phosphate buffer absorbed oxygen much more rapidly than oleic acid under the same conditions.

Powick's chain reactions in explaining the mechanism of rancidity of fats [J. Agr. Res. 26, 323-62 (1923)] start with oleic acid and finish with epihydric aldehyde; R. Neu [Allgem. Oel u. Fett-Ztg. 30, 583-8 (1935)] suggests instead the following chain: olein is oxidized to linolenic acid ester, this by selective oxidation of the two outer double bonds becomes a saturated diperoxide; by splitting off hydrogenperoxide it becomes the corresponding dimonoxide ester, by water adsorption an unsaturated tetrahydroxy acid ester; by splitting again, heptyl and maleic aldehyde result and also half aldehyde of pimelic acid ester; by losing carbon monoxide maleic aldehyde forms acrolein and this by oxidation forms epihydric aldehyde. Similar reactions are suggested for linolin and linolenin.

Ketone formation takes place upon heating fat acids, at first increasing, then decreasing with long continued heating as described by K. Täufel, H. Thaler, and M. Martinez (Margarine Ind. 26, 37-9 (1933)]. This decrease in amount of ketone is probably due to decomposition similar to that undergone by methyl nonyl ketone in aqueous or paraffin solution. The ketone reaction disappears completely with very long heating. Caprylic and lauric acids undergo ketone formation much more readily than palmitic, stearic, and oleic. Since these results are not in agreement with previous data, they were checked by H. Schmalfuss, H. Werner, and A. Gehrke [Margarine Ind. 26, 87-9 (1933)]. Contrary to Täufel *et al.*'s findings lauric acid which is ketonic at 110° becomes more, rather than less so, on further heating. The claim that methyl nonyl ketone was destroyed at 110° was not substantiated.

H. N. Brockesby and O. F. Denstedt (Can. Biol. Fisheries 8, 323-43) report that polymerization takes place rapidly in pilchard oil at temperatures above 250°. Up to 300° the saponification equivalent of acids from polymerized oil remains the same. Depolymerization of the oil is not brought about by hydrogenation at 180°. Saturated acids may be removed from polymerized oils by simultaneous heat polymerization and steam distillation.

K. W. Bauer and M. Krall's (Fettchem. Umschau 41, 194-6) heated oleic acid to temperatures of 200° and 250° in an atmosphere of nitrogen and found the solid acids increased from 7 per cent to 12.8 and 19.8 per cent, respectively. Heating in presence of nickel increased these figures slightly while heating with copper gave only 9.33 per cent. Nickel seems to favor the formation of the acid leaving the double bond in the 8-9 position.

M. Th. Francois and S. Droit [Bull. soc. chim. 53, 1564-72 (1933)] heated Barbadoes nut oil to about 340° in carbon dioxide at 60-70 mm. pressure and assumed that the following took place: The free fatty acids in the oil are first dehydrated; the water there formed and the acidity produced caused a decomposition of the glycerides; but the liberated glycerol is immediately dehydrated to acrolein, water, and aliphatic acids. The saturated acids distill practically unchanged, while the ethylenic acids can decompose according to various mechanisms. They may split at the double bond with formation of acids and hydrocarbons of low molecular weight; they may be dehydrated with transient production of anhydrides, a small portion of which is entrained in the distillate, but the major portion is converted into more or less saturated and polymerized hydrocarbon by loss of carbon dioxide and carbon monoxide.

Composition and Characteristics of Fats and Oils

The significance of determining composition of various oils and fats is well expressed by R. N. Wenzl [Ind. & Eng. Chem. (Anal. Ed. 6) 1-7]:

"Where control of composition is an important factor in the success of commercial processes, as in growth of crystals in molten fatty acid mixture, reliance must be placed largely on empirical formulas for the blending of fats of different grades and different sources. . . . In industrial research, analyses of fatty acid mixtures are frequently of service only in so far as they can be interpreted in terms of composition. Such interpretations based solely on resultant properties such as iodine value, titer, etc.—are at best uncertain and often quite misleading. There is need, therefore, for methods that determine, specifically, the percentage of individual fatty acid present."

This author has made some further developments of the Twitchell mixed-melting-point method for determining individual saturated acids and presented valuable data for this purpose.

R. Dubrisay [Chimie & Industrie No. 1045-7, June (1933)] suggests the application of the Gibbs principle, that composition of the surface film of a solution has not the same composition as the mass of the liquid, for separating two or more soaps of fatty acid by bubbling air through the solution and separating the foam. He gives several examples of fractionation of fatty acids by this method.

H. N. Griffiths and T. P. Hilditch (J. Soc. Chem. Ind. 53, 75-81T) have worked out a method whereby oleic acid, in admixture with linoleic and linolenic acids can be determined by analysis of the mixed fatty acids after treatment with oxides of nitrogen (HNO_3 and Hg) until the oleic-elaidic acid equilibrium has been reached. From the yielded iodine value of solid acids, the quantity of elaidic acid is obtained, and therefrom the maximum percentage of oleic acid in the original mixed acid, assuming that with mercury-nitric acid as an isomerizing agent the yield of elaidic acid is equivalent to 66% of the oleic acid present. The results from this method show good agreement with the Kaufmann thiocyanogen value method, but values for linolenic acid calculated from the yield of "insoluble hexabromide" reached only half those given by the new method. This elaidinisation method as described is more tedious than the Kaufmann process; its use was mainly to support the validity of the latter method. In another paper T. P. Hilditch (Biochem. J. 28, 779-85) discusses and criticizes the interpretations suggested by various writers on some fatty acid analyses. Data are presented on percent of various fatty acids in palm oil and pig back fat before and after hydrogenation, and it is assumed that the accuracy in such simple fats is about one unit percent. The complications met with in fractionating the methyl esters of butter-acids and the variations obtained from various butters are dealt with by a discussion of the work of many authors and himself from the standpoint of obtaining good quantitative data and computing the general composition of butter fatty acids.

M. S. Libbert's [Ark. Agr. Expt. Sta. Bull. No. 280, p. 40 (1932)] analysis of butter according to the method of Hilditch and Jones shows that a type sample of American butter contains the following acids: butyric 3.2, caproic 1.8, caprylic 0.8, capric 1.4, lauric 3.8, myristic 8.3, palmitic 24.4, stearic 13.9, oleic 38.4 and linoleic 4.0. A. W. Bosworth and J. B. Brown [J. Biol. Chem. 103, 115-34 (1933)] isolated and identified decenoic ($C_{10}H_{18}O_2$) and tetradecenoic acids ($C_{14}H_{26}O_2$) from butter. They could not verify the occurrence of linoleic acid but found evidence that butter contained some C_{20}, C_{22} or C_{24} acids with two double bonds.

The component glycerides of oils whose unsaturated acids belong to the C_{18} series can be established from the saponification numbers of fractions obtained by fractional crystallization of the oil after hydrogenation. By this procedure T. P. Hilditch and E. C. Jones (J. Soc. Chem. Ind. 53, 13-21T) find in cottonseed oil 60% of the glycerides contain one palmitic radical and two unsaturated C_{18} groups with perhaps 15% dipalmito-olein or dipalmitolinolein; only the remaining 24% consist of unsaturated glycerides. Soy-bean and linseed oils contain 20 to 25% mixed saturated-unsaturated acid glycerides, mainly palmito-diunsaturated glycerides. In olive and tea-seed oil the wholly unsaturated glycerides are less than 7% of the whole, and since linoleic acid forms 10% of the mixed unsaturated acids, it is probable that about 20% of the oil will consist of mixed oleolinoleins, so that the content of triolein in either oil cannot greatly exceed 50%.

J. Bougault and G. Schuster [Compt. rend. 192, 953-4 (1931) and Ibid. 1240-1 (1931)] reported that by partial saponification of azelaopalmitostearin they obtained ∝ palmito ∝ stearin, melting point 34°. On repeating this work T. P. Hilditch [J. Soc. Chem. Ind. 52, 101-5T (1933)] stated that selective removal of azelaic acid does not take place but there is a conversion of part of the combined stearic acid into ethyl stearate (m.p. 34) and that Bougault and Schuster ∝ mono-palmito ∝ monostearin presumably was ethyl stearate. On repeating the experiments Bougault and Schuster upheld their report in proving, by melting point and molecular weight determinations, that ∝ palmito and ∝ stearin is formed.

Work on the separation and identification of long chain fatty acids in fats has been reported mostly by Japan's investigators. K. Kino (J. Soc. Chem. Ind. Japan 37, 442-4B) reported the presence and presented data on the drying properties of the following acids from sardine oil: $C_{22}H_{44}O_2$, $C_{22}H_{42}O_2$, $C_{22}H_{40}O_2$, and a mixture assumed to be $C_{22}H_{38}O_2$, $C_{22}H_{36}O_2$, and $C_{22}H_{34}O_2$. S. Ueno and M. Iwai (J. Soc. Chem. Ind. Japan 37, 52-3B) (Ibid. 251-5) report the presence of large amounts of C_{20} and C_{22} acids in menuke oil and "Hiragashura" liver oil. In the latter oil they identified a new highly unsaturated acid ($C_{24}H_{38}O_2$) which they named scoliodonic acid. Working with sardine oil M. Takano (J. Soc. Chem. Ind. Japan 37, 549-51B) identified the presence of the following acids: zoomeric, oleic, gadoleic, cetoleic, and eicocenoic. Y. Toyama and T. Tsuchiya (J. Soc. Chem. Ind. Japan 37, 14-20) also identified gadoleic acid in cod liver oil. The same acid was identified in other fish oils by the latter authors and with T. Ishikawa (J. Soc. Chem. Ind. Japan 37, 534-6B) it was found present in whale oil. Highly unsaturated C_{24} fatty acids were also found in the various oils tested by Y. Toyama and Tsuchiya (J. Soc. Chem. Ind. Japan 37, 530-4B).

Data on composition and characteristics of oils and fats and percentage of oil in some materials are presented in appended charts. The abundance of these data shows that trade restrictions of many countries have caused a stimulated interest in searching for new sources of oil to substitute for the imported oils.

An attempt was made by H. N. Griffiths and T. P. Hilditch (Analyst 59, 312-8) to utilize the oleic elaidic acid equilibrium formed in the elaidin test to estimate the triolein in natural fats; although this object was not achieved (owing to small yields of trielaidin from triolein), it was found that the trielaidin could be separated from the triolein by crystallization from an acetone solution; and consequently a quantitative character could be given to the elaidin test. They recorded the proportion and characteristics of the crystallized "elaidins" obtained from 10 well-known oils under standardized conditions and suggest such data may be useful in detection of adulteration of olive oil.

A new method of determining unsaturation was proposed by M. Goswani and K. L. Basu (Analyst, 59, 533-4). The oil is saponified, neutralized to bromothymol blue and the amount of hypochlorous acid that the sodium salts will absorb is determined. The HClO values of peanut oil = 18.1, buffalo ghee = 7.3, coconut oil = 1.9, olive oil = 18.2, mustard oil = 22.3, sesame oil = 22.7, linseed oil = 38.2, and fish oil ("clupea ilisha") = 18.2.

W. J. Wiley and A. H. Gill (Ind. & Eng. Chem. Anal. Ed. 6, 298) recommend that in order to make the thiocyanogen number more nearly as accurate as the iodine number, since it is usually connected with the latter, determinations should be made on a 0.4 gram sample and with the use of 50 c.c. of thiocyanogen solution.

After comparing the various methods for determining iodine number, A. D. Barbour (OIL AND SOAP 11, 7-9) found that the Wijs and Margosches method gives the highest I values; the Rosenmund-Kuhnhenn method, the lowest; and the Margosches, the most variable.

The results by Hanus method approach most nearly the average value of all methods. The results agree with the findings of S. Yushkevich [Masloboino Zhirovoe Delo No. 2, 9 (1930)] that the Kaufmann method is outstanding, from the viewpoint of ease of preparation and pleasantness of use. The average results by the Kaufmann method were intermediate between the Wijs and Hanus method. The official laboratories of Brazil have accepted the Winkler method for unity in official procedure; this method and Hübl, Hanus, Wijs and Waller methods are discussed in a paper by C. H. Liberalli [Rev. soc. brasil. quim 4, 250-63 (1933)]. The use of a chloramine (dichloroamine —T) is advocated by L. Hunter and F. F. Hyde [Analyst 58, 523-7 (1933)] for preparation of Wijs solution.

In relation to free fatty acids, the method now in use for expressing it as oleic, except for copras, is significantly accurate according to the paper by L. Margaillan and E. Allemand (Chemie & Industrie Special number). A Moen [Tids. Norske Landbruk 40, 153-7 (1933)] recommends determining the free fatty acid value of the oil extracted from herring meal as an indication of the quality of the meal.

Various methods for determining acetyl number were compared by K. Täufel, H. Thaler, and M. de Mingo (Fettchem. Umschau 41, 156-8). Completely acetylated substances tested were diacetate of dihydroxystearic acid, acetate of cholesterol and octadecyl acetate. The acetate contents of these compounds were determined by the (1) Benedict-Ulzer method, (2) by the filtration method, in which the material is saponified with a measured excess of a solution of alkali in alcohol; the solution is acidified with an equivalent amount of acid, and fatty acids are removed by filtration and the free fatty acid in the filtrate corresponding to the bound AcOH in the sample is titrated, (3) by the Freudenberg method in which the bound AcOH is converted into AcOEt and removed by distillation. The Freudenberg method gave excellent results with all three substances, while the other two methods were less satisfactory in certain cases. The Freudenberg method appears capable of application to fatty materials, except those such as butter or palm kernel oil, which contains fatty acids lower than caprylic acid. M. Th. Francois (Ans. fals, 27, 334-9) discussed the various definitions and methods of determining acetyl number of fats and oils, and makes a plea for adoption of single method and definition. He proposes as the most suitable Andre's definition (No. of mg. of AcOH which can be fixed with 1 g. of lipid) and Delaby and Breugnote method 1-3 g. fat in 10 cc. of a mixt. of 1:2 Ac_2O and pyridine, heat for 30 min. to 1 hr. After cooling titrate with 0.5 N NaOH and phenolphthalein). A micro-method for determination of the acetyl and of the hydroxyl number of fatty acids was described by O. Fürth, H. Kaunitz and M. Stein (Biochem. Z. 268, 189-201).

Other micro-methods are those described by H. Vasbinder [Pharmac. Weeksbl. 71, 1193-7 (1934)] for determination of Reichert-Miessl, Wollny, Polenske and Kirschner numbers.

H. Mohler and H. Helberg (Mitt. Lebensm. Hyg. 25, 1-7) review the methods of determining diacetyl in butter and describe their modification of the Vizern and Guillot's procedure.

Procedure for detection of hardened fats in shortening, butter and other fats from iodine number of the portion of fatty acids, the lead salts of which are insoluble in ethyl alcohol, acetone, or benzene, are described by J. Grossfeld and J. Peters (Z. Untersuch. Lebensm. 68, 345-58) and K. H. Bauer (Chem. Ztg. 58, 541-2). For the same purpose J. Peltzer (Z. Untersch. Lebensm. 67, 629-34) recommends utilizing the saponified values of the fractions vacuum distilled from the ethyl esters of the fatty acids. The difference between saponification values of the first and last ester fraction from hardened oils is greater than in case of lard, beef fats, etc. S. Peters [Milchwirtschaft. Forsch. 15, 507 (1933)] states that when fats are added to an aqueous ethyl alcohol acetic acid or aqueous ethyl alcohol ether mixtures, two different phases are obtained; the relation between the temperature at which the respective phases become clear may be used to separate fats in three groups: (a) tallow, lard, hydrogenated, and vegetable oils; (b) butter fat; (c) coconut and palm kernel oil. A. Peters (Z. Untersuch. Lebensm. 68, 521-30) detects adulteration of lard with tallow or hydrogenated oils by the difference in specific gravity of the solid glycerides, separated in an ether alcohol mixture. When fat is added to such a mixture having a specific gravity .80783, two phases are formed. The lard glycerides will be at the boundary of the phases; if adulterated with hard fats, there will be some glycerides at the bottom of the lower phase. Coconut oil or palm kernel oil may be detected in lard by the relation in temperature at which a solution of the mixed fats in acetic acid-xylol mixture forms a single phase.

G. Schuster [Compt. rend. 197, 760-2 (1933)] recommends determination of azelaic acid number for detection of adulteration of coco butter. He defines the azelaic acid number as the number of milligrams of postassium hydroxide required to neutralize the acidity of one gram of mixed insoluble acid glycerides obtained by potassium permanganate oxidation of fat.

E. J. Better and J. Szimkin [Fettchem. Umschau 41, 72-3 (1934)] find the Baudouin test for the presence of sesame oil is reliable only when the acid layer retains the red color for some time, and retains it also when a few drops of water are added immediately upon the appearance of the red color. The above authors (Fettchem. Umschau 41, 225) also report that presence of 5% or more of fish oil (train oil) may be detected by adding 10 drops of Hanus solution to a solution of the oil in chloroform acetic acid mixture containing a small amount of bromine. The appearance of a green color indicates train oil is present.

Because of difficulties occurring with the Baudouin reaction on rancid fats, L. Pavoline (Olii Minerali, Olii e Grassi, Colori e Vernici 14, 41) proposes a new reaction for sesame oil. A green color develops on addition of sulfuric acid; the color is bluish-green if furfurol solution is added before the sulfuric acid.

The analytical results of H. D. Royce and M. C. Kibler (Oil and Soap 11, 116-9) indicate the crude cottonseed produced in this country contains an average of 0.05% gossypol and is sometimes as high as 0.21% in hot pressed oil. This impurity is of no significance in regard to the refined edible oil because the usual refining processes remove the gossypol.

OIL OR FAT CONTENT OF VARIOUS MATERIALS REPORTED DURING 1934

Material	Oil or Fat Content
Weed seeds of Russia (1)	
"Galeopsis tetrahit"	41.8
"Galeopsis latanium"	40.7
"Galeopsis versicolon"	40.4

"Stachys palustris" 38.0
"Brassica campestris" 34.8
"Camelina glabrata" 31.7

Oil bearing seeds of Philippines (2)

"Aleurites moluccana" 63.53
"Aleurites trisperma" 83.97
"Anacardium occidentale" . 43.39
"Arachis hypogaea" 42.03
"Caesalpina crista" 20.56
"Calophyllum inophyllum" .60.72
"Canarium ovatium" 72.01
"Ceiba pentandra" 34.48
"Chisocheton cumingianus".67.46
"Chisocheton pentandrus"..13.27
"Chrysobalanus icaco" 21.27
"Cinnamomum merccadoi"..43.45
"Cocos nucifera" 31.61
"Croton tigilium" 37.17
"Delonix regia" 9.68
"Dysoxylum decandrum" .. 1.45
"Entada phaseoloides" 2.07
"Gliricidia sepium" 26.12
"Gossypium hirsulum" 34.09
"Heritiera litteralis" 5.34
"Hevea brasiliensis" 40.51
"Hydnocarpus alcalae" 44.27
"Hypnocarpus hutchinsonii".55.39
"Intsia bijuga" 11.16
"Jatropha curcas" 46.40
"Leucaena glauca" 13.18
"Mallotus philippensis" ...11.25
"Moringa oleifera" 32.60
"Nephelium mutabile" 58.18
"Orania palindan" 1.14
"Pachyrrhizus erosus" 25.81
"Pahudia rhomboidea" 8.10
"Pangium edule" 38.50
"Parashorea malaanonan" .. 2.91
"Parkia javanica" 18.89
"Pithecolobium dulce" 17.69
"Pongamia pinnata" 28.63
"Psophocarpus tetragonolobus" 13.11
"Ricinus communis" 53.67
"Samanea saman" 11.16
"Sesamum orientale" 43.25
"Sesbania grandiflora" 7.09
"Sterculia foetida" 50.26
"Swietenia mahogeni" 60.19
"Tamarindus indica" 5.54

Sapukaja nut (3)...........63.6
Oiticica nut (4)............62.0
Babassu kernel (5).....67 to 69
Iguape nut (Brazilian) (6)..61

Seed oils of Leguminosae (7 & 8)

"Pongomia glabra" vent...27.25
"Acacia confusa" Merrill .. 6.2
"Leucaema glauca" Linn... 7.74
"Albizzia lebbeck" Linn.... 5.47
"Baukinia purpurea" L....15.24
"Erythrina indica" Lam...11.9
"Psidium guajava" L......13.37
"Anona squamosa" L......14.75
"Tamarindus indica" L.... 3.9
"Euphoria longana" Lam.. 1.75
"Manihot glaziovii" Muell.12.13
"Sapindus mukorossi" Gaertn. 28.0
"Scolopia crenata" Clos....15.0
"Heptapleurum octophyllum" Forbes 10.0
"Tabernaemontana coronaria" Willd. 11.0
"Cerbera odollam" Gaertn..64.0

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CHARACTERISTICS REPORTED FOR VARIOUS OILS DURING 1934

Oil or fat source	Density	Refr. Index	Acid No.	Sap. No.	R-M No.	I No.	Ac. No.	Unsap.
Rue seed fat ("Ruta gravealens")[1]	$0.9295\frac{20}{4}$	1.4723^{40}	0.7	194	0.6	189.0 (Hanus)	14.0	0.9%
Oiticica nut[2]	0.9704^{15}		6.5	189.5	0.56	182		0.5
Babassu kernel[3]	0.924^{15}	$1.450\frac{40}{D}$		249		16.6		
Persea indica fruit[4]	0.952^{15}	1.4514^{D}	35.08			97.82		
Peanuts (Argentine)[5]	0.9187 to 0.9171^{20}	1.4717^{20}				101 to 103		
Bear grease, Sample I[6]		$1.4695\frac{20}{D}$	3.65	195.6		90.1		0.08
Bear grease, Sample II		$1.4665\frac{20}{D}$	1.40	195.6		63.2		0.10
Rubber seed[7]	0.9306^{15}	1.4755^{20}		136.1		131.8		0.78
Kaoliang Embryo[9]	0.9114	1.46±.01	3.11 to 21.21	180±11	0.18 to 0.81	119±5		2.57 to 3.43
Kaoliang Testa[9]		1.457	96.47	185.8	0.46	110.8	18.8	8.04
Iguape nut[10]	0.9298	1.470^{40}	1.3 to 4.8	197±7		139 to 166 (Hubl)		0.4
Pumpkin seed[11]	0.9159	1.4737^{20}	12.49	174.2	1.5	116.8 (Hanus)	2.76	1.58
Magnolia seed[12]	0.970^{15}	1.4951^{20}	5.21	219.2	5.21	102.4		
Green turtle[13]	0.921^{15}			213.2		61.5	1.9	0.45
Passion fruit seed[14]	0.9207^{25}	1.4737^{25}		190.4	0.11	140.4	8.1	0.62
Pataua palm[15]	0.9118^{25}	1.4662^{25}	3.01	190.4	0.33	75.4	10.4	0.48
Barbadoes nut[16]	$0.918\frac{15}{15}$ ±.002	$1.4725^{100°}$	5.0(av.)	176 to 190		93 to 98 (Hanus)	4 to 9.6	
"Karasumi" (mallet ovary)[17]	$0.8818\frac{20}{4}$	$1.4695\frac{20}{D}$	16.0	120.1		130.6		40.64
Sapulkaja nut[18]	0.920			198		75.9		

CHARACTERISTICS REPORTED FOR VARIOUS OILS DURING 1934—(Continued)

Oil or fat source	Density	Refr. Index	Acid No.	Sap. No.	R-M No.	I No.	Ac. No.	Unsap.
Millet ("Pancum miliaceum")[19]	$0.9383\frac{15}{4}$	$1.4577\frac{70}{D}$	12.8	191.5	1.76	129 (Wijs)	16.9	3.3
Linn seed ("Cassis occidentals")[20]		$1.4770\frac{15}{D}$	10.2	178.7	0.5	113.9 (Wijs)		7.4
Quince seed ("Cydonia vulgaris")[21]	$0.9220\frac{15}{4}$	$1.4738\frac{20}{D}$	15.3	194.2		121.9 (Wijs)	14.7	0.36
Worms[22]:								
"Tubifex tubifex"		$1.4845\frac{20}{D}$	78.8	204.7		85.9		10.48
"Lumbrieus terrestris"		$1.4986\frac{40}{D}$	32.3	114.8		70.8		36.68
"Lumbrieus rubellus"		$1.4893\frac{40}{D}$	41.6	149.3		76.4		21.30
"Hirudo medicinalis" (Leach)		$1.4855\frac{20}{D}$	19.0	156.5		127.6		18.21
Crustaceous animals[22]:								
"Daphnia magna"		$1.4762\frac{20}{D}$	86.3	173.8		111.2		13.55
"Leptodora kindtii"		$1.4892\frac{20}{D}$	86.9	185.5		124.4		16.67
"Carinogammoroes Roes"		$1.4871\frac{20}{D}$	75.8	203.7		83.5		11.49
"Potamobius fhiviatilis"		$1.4863\frac{20}{D}$	16.8	217.7		97.8		12.25
"Cambarus affinis"		$1.4849\frac{20}{D}$	21.0	204.3		98.3		14.03
"Eriocheir sin"		$1.4774\frac{20}{D}$	9.3	212.0		106.3		5.92
"Crangon crangon"		$1.4981\frac{20}{D}$	34.9	179.9		106.4		13.64
"Leander adspersus"		$1.4917\frac{20}{D}$	31.6	177.5		108.1		15.15
Insects[22]:								
"Libellula quadrimac"		$1.4750\frac{20}{D}$	51.4	203.4		97.2		10.43
"Ephemera vulg."		$1.4802\frac{20}{D}$	60.9	211.1		108.0		5.99
"Culex pipiens"		$1.4724\frac{20}{D}$	35.2	190.2		79.0		8.28
"Corethra plumic"		$1.4829\frac{20}{D}$	32.3	213.0		95.5		5.12
"Chironomus gregar"		$1.4759\frac{20}{D}$	18.8	217.7		82.0		3.50
"Dytiscus marginalis"		$1.4761\frac{20}{D}$	30.1	209.5		83.1		4.75
"Coccinella septempunctata"		$1.4668\frac{20}{D}$	45.9	215.4		83.6		5.00
"Formica rufa"		$1.4778\frac{20}{D}$	69.4	195.4		71.1		9.62
"Notonecta glauca"		$1.4740\frac{20}{D}$	65.8	244.3		85.5		9.32
Mollusk[22]:								
"Lumaea stagnalis"		$1.4912\frac{20}{D}$	64.4	152.3		80.5		29.79
"Planorbis corneus"		$1.4933\frac{20}{D}$	63.1	171.4		77.1		24.09
"Planorbis plan"		$1.4831\frac{20}{D}$	39.7	172.9		80.5		17.39
"Paludina vivipara"		$1.4979\frac{20}{D}$	58.2	156.5		64.9		35.15
"Unio sp."		$1.4954\frac{20}{D}$	28.8	183.0		91.6		20.77

CHARACTERISTICS REPORTED FOR VARIOUS OILS DURING 1934—(Continued)

Oil or fat source	Density	Refr. Index	Acid No.	Sap. No.	R-M No.	I No.	Ac. No.	Unsap.
"Anodonta sp."		$1.4959\frac{20}{D}$	33.0	152.0		93.4		24.12
"Dreissensia polym"		$1.4917\frac{20}{D}$	49.5	191.0		94.0		14.02
"Sphaerium sp."		$1.4750\frac{20}{D}$	59.0	143.8		77.5		24.22
Seed oils of Leguminose[23]:								
"Pongamia glabra" vent.	$0.9217\frac{30}{4}$	$1.4730\frac{30}{D}$	29.33	193.26		80.69		0.33
"Albizzia lebbeck" Linn.	$0.9313\frac{30}{4}$	$1.4707\frac{30}{D}$	2.73	190.17		104.57		3.8
"Erythrina indica" Lam.	$0.8964\frac{40}{4}$	$1.4602\frac{40}{D}$	2.95	184.50		71.94		0.49
"Psidium guajava" L.	$0.9174\frac{30}{4}$	$1.4720\frac{30}{D}$	3.40	192.11		140.73		0.49
"Anona squamosa" L.	$0.9127\frac{30}{4}$	$1.4660\frac{30}{D}$	5.28	188.76		80.92		0.35
"Tamarindus indica" L.	$0.9273\frac{20}{4}$	$1.4750\frac{20}{D}$	8.44	206.36		110.67		1.70
"Euphoria longana" Lam.	$0.9221\frac{20}{4}$	$1.4700\frac{20}{D}$	34.28	200.56		64.19		2.86
"Manihot glaziovii" Muel.	$0.9187\frac{30}{4}$	$1.4728\frac{30}{D}$	10.16	200.09		140.91		0.22
"Sapindus mukorosse" Gaertn.	$0.9328\frac{30}{4}$	$1.4690\frac{30}{D}$	17.11	220.72		62.45		0.43
"Scolopia crenata" Clos.	$0.9212\frac{30}{4}$	$1.4722\frac{30}{D}$	17.02	195.67		121.58		1.7
"Heptapleurum octophyllum" Forbes	$0.9493\frac{30}{4}$	$1.4754\frac{30}{D}$	20.07	228.19		99.68		0.57
"Tabernaemontana Coronaria" Willd	$0.9383\frac{30}{4}$	$1.4750\frac{30}{D}$	7.86	197.97		80.64		5.07
"Cerbera odollam" Gaertn.	$0.9070\frac{30}{4}$	$1.4632\frac{30}{D}$	0.74	199.15		66.28		0.13
Seed oils of Theaceae[24]:								
"Thea tenuiflora" Hay	$0.9129\frac{20}{4}$	$1.4675\frac{20}{D}$	1.92	195.3		85.04		0.8
"Thea liflora" Hayata	$0.9512\frac{20}{4}$	$1.4670\frac{20}{D}$	1.26	187.01		83.37		0.46
"Thea Chinensis" L.	$0.9174\frac{20}{4}$	$1.4680\frac{20}{D}$	1.76	188.8		88.0		

CHARACTERISTICS REPORTED FOR VARIOUS OILS DURING 1934

Oil or fat source	Titer	Viscosity	M. P.	Hehner No.	Hexabromide No.	Thiocyanogen No.
Oiticica nut[2]	52°	22 (50° Engler)	.....	.....	.....	.....
Babassu kernel[3]	....	10 (50° Engler)	26°	.....	.....	.....
Persea indica fruit[4]	....	....	.....	95.14	.....	.....
Bear grease sample I[6]	24.5	....	17	94.76	.....	.....
Bear grease sample II[6]	36 05	....	26.5	94.41	.....	.....
Rubber seed[7]	....	....	.....	.....	14.15	.....
Linseed (of India)[8]	....	....	.....	.....	.....	119.1
Rye (of India)[8]	.....	....	.....	.....	.....	87.34
Sesame (of India)[8]	....	....	.....	.....	.....	75.2
Rape (of India)[8]	.....	....	.....	.....	.....	80.14
Peanut (of India)[8]	.....	....	.....	.....	.....	73.68
Almond (of India)[8]	.....	....	.....	.....	.....	83.25
Castor (of India)[8]	.....	....	.....	.....	.....	88.19
Mohuwa (of India)[8]	.....	....	.....	.....	.....	47.93
Tallow (of India)[8]	.....	....	.....	.....	.....	34.98
Ghee (of India)[8]	.....	....	.....	.....	.....	27.54
Coconut (of India)[8]	.....	....	.....	.....	.....	10.92
Kaoliang Embryo[9]	.....	....	--17 to —21	.....	.....	.....
Kaoliang Testa[9]	.....	....	60 to 62	90.01	.....	.....
Iguape nut[10]	12.7	....	.....	.....	.....	.....
Magnolia seed[12]	.....	....	.....	88.4	.....	.....
Green turtle[13]	27.1	....	.....	94.54	.....	.....
Passion fruit seed[14]	.....	....	.....	.....	.....	81.2
Pataua palm[15]	.....	....	.....	.....	.....	72.8
Millet ("Pancum miliaceum")[19]	.....	....	.....	.....	.....	80.0
Linn seed ("Cassis occidentals")[20]	.....	....	.....	.....	.....	78.2
Quince seed ("Cydonia vulgaris")[21]	.....	....	.....	.....	.....	82.7

CHARACTERISTICS REPORTED FOR VARIOUS OILS DURING 1934

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COMPONENT FATTY ACID CONSTITUENTS OF THE OILS REPORTED—1934

Fat Source	% Oil Content	Saturated acids			Unsaturated acids			Other acids reported
		Myristic	Palmitic	Stearic	Oleic	Linoleic	Linolenic	
"Pinus pumila" nuts[1]	23.77		5.09		17.52	71.84	5.55	
"Pinus pumila" kernel[1]	51.2							
"Manicaria saccifera" kernel[2]	57.7	18.9	8.2	2.4	9.7	1.4	....	Lauric 47.5; capric 6.6; caprylic 5.3
"Astrocaryum Tucuma" kernel[2]	39.8	21.6	6.4	1.7	13.2	2.5	....	Lauric 48.9; capric 4.4; caprylic 1.3
"Maximiliana Caribaca" kernel[2]	4.8	21	9	?	18		....	Lauric 47; capric 5
Coconut oil[2]	.....	18.1	9.5	2.4	8.2	1.5	....	Lauric 44.9; capric 7.6; caprylic 7.8
Soy bean (from various parts of Russia)[3]	.....		11.22 to 20.55		18.3 to 32.6	41.9 to 56.2	0.46 to 12.5	
"Ganua motleyana" seed[4]	.....	....	10.17	18.56	68.77	2.49	....	
*"Gassia occidental" seed[5]	.....		19.7		30.7	31.4	6.3	
*"Pamicum miliaceum"[6]	.....		10.7		23.9	46.9	7.2	
*Quince seed[7]	19.2		8.6		39.2	....	3.9	
*Tunny liver[8]	.....	5	19	7	30	trace	...	Arachidonic 20; clupanodenic 22
*"Persea indica"[9]	.....	....	21.05	9.45	43.97	13.25	...	
*"Anguilla vulgaris" (eel fat)[10]	.....		20.3			66.18		
*Passion fruit[11]	18.17	....	6.78	19.86	19.0	59.9	5.4	Arachidic 0.34
Malayan vegetable fats[12]:								
Pericarp kernel fats ("Sterculia foetida")	...	....	10.7	40.3	43.6	3.3	...	Arachidic 2.1
"Sterculia foetida" (fruit coat)	.....	....	33.9	2.7	59.3	4.1	...	
"Palaquium oblongifolium" seed	.....	0.2	5.9	54.0	39.9	...	...	
Rambutan seed tallow	.....	....	2.0	13.8	45.3	...	...	Arachidic 34.7; C_{20} monethylenic 4.2
Pulsam seed	.....	....	3.0	31.0	43.7	...	...	Arachidic 22.3; C_{20} monethylenic trace
Tonka bean	.....	....	6.1	5.7	59.6	15.4	...	C_{20}—C_{24} 13.2

*Analysis reported on basis of total oil.

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Physical Test on Fats

S. A. Ashmore (Analyst 59, 515-7) designed an apparatus for determining the temperature of crystallization of cacao butter. The Tyndall effect is utilized to determine the temperature at which solid particles appear; that is, a scattering of light occurs at this point, and the tube containing the fat appears luminous against a dark background. He utilized this apparatus for determination of the amount of Boreno tallow in cacao butter. J. Lund (Fettchem. Umschau 41, 86-90) modified the official Finkener method for determining solidification of fats by recommending that the flask containing the fat be removed from the box and shaken. When the temperature sinks no more than 0.2° per two minutes, it is then replaced and the highest temperature recorded is the solidification point.

L. W. Greene (Oil and Soap, 11, 31-2) reviews the investigations in which the microscope has been used to identify fats and products derived from them. He recommends more research along this line in order to develop technic of this nature in analysis.

Viscosity of fresh oil is inversely proportional to the iodine number; since this relation holds for each type of oil, H. Shrader (J. Soc. Chem. Ind. 53, 770) recommends that accurate viscosity determinations can be used to detect adulteration or spoilage.

The R. Dubrisay and P. Pecard capillary index [Compt. rend. 178, 205-8 (1924)] shows a marked and characteristic difference for crude and refined olive oil—average 66.9 and 31.4 resp.—and between these and the indices of usual substitutes of olive oil—maize oil 17, soy-bean 13, sesame 58, peanut 28—thus according to H. Marcelet (Compt. rend. 198, 2073-4) affording a means of detecting adulteration.

An extensive study of the rise of oils on vertical strips of paper or spreading on horizontal sheets led H. Marcelet [Chimie & industrie Special No., 916-31 (April, 1934)] to the following conclusions: (1) For marine animal oils the rise or spread of these oils varies inversely as their molecular weights irrespective of their chemical constitution or viscosity; atmospheric oxidation of the oil has a marked effect on the phenomenon in certain oils. (2) For vegetable oils the rise or spread varies inversely as their molecular weights, and chemical constitution apparently has no effect. (3) Same holds for mineral oils; but contrary to the case of marine animal oils, the viscosity varies practically as the average molecular weight.

To meet the need of a quantitative method for determination of stability of an emulsion, A. A. Pchelin and E. Z. Novik-Bain [Repts. Central Research Inst. (Moscow) issue 4, 111-25] proposed a procedure in which stability is reported in percentage figures.

Methods of measuring color have been reviewed by J. E. Doherty and J. F. Ahearn (Oil and Soap 11, 46-52) and C. Stiepel (Allgem. Oel-u. Fett-Ztg. 31, 443-5). The former authors find that color standards made from inorganic salt solutions of the following salts are most stable: $FeCl_3$-HCl, UO_2Cl_2, $CoCl_2$, $CoSO_4$, $CuCl_2$, $CuSO_4$, Na_2CrO_4, $NiCl_2$, and $NiSO_4$. The only disadvantages of these are variations of color with temperature and the formation of precipitates on standing. Methods of overcoming the latter are given. The last named writer devised a colorimeter and suggests that in order to have a unified method, the color of an oil could be reported in the amount of inorganic colored compounds present in a given amount of solution that matches the oil.

Other physical tests, i.e., shortening power, differential solubility, etc., are discussed in those parts of this review to which they are related.

Physiological Studies With Fats

I. Smedley-Maclean and M. S. B. Pearce (Biochem. J. 28, 486-94) oxidized palmitic acid by means of hydrogen peroxide in the presence of cupric salts in order to study some substances which are possibly formed in the intermediate stages of oxidation of fats "in vitro." Evidence was found of hydroxylation in several points of the palmitic chain and as the palmitic carbon chain was gradually broken down, there appeared hydroxy acids containing ten carbon atoms. There were also some indications of chains containing respectively thirteen and seven carbon atoms. Ketonic acids were only in very small quantities; therefore, they are not the main products of oxidation. The presence of lactones indicated that the gamma or delta hydroxy acids formed were split off during the course of reaction. Analysis showed that unsaturated hydroxy - acids formed the main bulk of the intermediate substances. Low iodine number of these indicates the presence of some unsaturation in the one-two position. Volatile acids of low molecular weight were also formed to a considerable extent.

Various publications in recent years have shown the body requires unsaturated fatty acids. H. M. Evans, S. Lepkovsky and E. A. Murphy (J. Biol. Chem. 107, 431-40; Ibid. 441-4; and Ibid. 445-9) report new experiments on this problem. The deficiency caused by feeding only saturated fats or no fats cannot be compensated by feeding large amounts of the fat soluble vitamins A, D and E, vitamin F (the essential unsaturated fatty acid) being absent. In male rats lack of unsaturated fats in the diet causes sterility and a degeneration of the testes. Regeneration of testes as regard to weight and function was strikingly produced by administration of the unsaturated acids. Other papers by the same authors (J. Biol. Chem. 107, 429-37; Ibid. 438-42 and Ibid. 443-7) deal with the sparing action of fats on vitamins B and G. Fats were found to exert their optimal sparing action upon vitamin B when both the protein and vitamin G were high. The ability of fats to spare vitamin B was arranged as following in the order of their effectiveness: coconut oil, lard, Crisco (hydrogenated cottonseed oil), butter fat, synthetic lard, hydrogenated coconut oil, corn oil, olive oil, hydrogenated sesame oil, sesame oil. Variations occur in the growth with and without fat when vitamin G is low or absent; on this account no statement is made as to whether fat exerts a beneficial effect on diets in which vitamin G is low or absent when requirements for other dietary factors are satisfied.

Another symptom of the lack of unsaturated fatty acids in the diet of rats is an abnormally high respiratory quotient described by L. G. Wesson [Am. J. Physiology 81, 513 (1927) and J. Biol. Chem. 73, 507 (1927)]. This was reinvestigated by L. G. Wesson and G. O. Burr [J. Biol. Chem. 91, 525 (1931)]; indications were found that linolenic acid was curative for the abnormalities described by H. M. Evans and G. O. Burr, and G. O. Burr and M. M. Burr, but not curative for the metabolic abnormality described by Wesson. L. G. Wesson and F. C. Murrell's (Proc. Soc. Exptl. Biol. & Med. 31, 1118-21) work with lard hydrogenated to destroy the linolenic acid present, indicated the factor in question is not linolenic acid.

The effect of saturated fatty acid content in the diet on the composition of the body fat of rats is reported by H. D. Barbour (J. Biol. Chem. 106, 281-8). The saturated acid content of body fats of rats may be lowered by feeding fats of low saturated acid content but cannot be raised beyond a level of 25 to 27% by feeding fats of higher saturated acid content. The arachidic acid of peanut oil is almost quantitatively excreted by the rat. Miss Ethel M. Cruickshank (Biochem. J. 28, 965-77) made similar but more intensive studies on hens. The degree of saturation in egg fat and body fat was affected by ingestion of unsaturated fatty acid but increasing the amount of saturated acid had little effect on the mixed fatty acid composition of the egg fat.

When tested on rats, S. K. Kon and R. G. Booth (Biochem. J. 28, 121-30) found lard possessed an antirachitic activity of the same order as that of butter. The author in this paper and in another paper (Biochem. J. 28, 111-20) suggested that there are at least two factors antirachitic for rats present in butter; one of the factors is not recoverable in the nonsaponifiable residue and the usual vitamin D which is resistant to saponification.

Papers on influence of solvents on the activity of the fat soluble vitamins are important. Miss H. S. Mitchell [Proc. Soc. Exp. Biol. & Med. 31, 231-3 (1933)] states that ten to twelve times as much spinach were required to furnish a unit of vitamin A when accompanied with ½ cc. mineral oil, and about eight times as much when fed separately at least six hours apart. Reduction of vitamin A activity of butter by mineral oil feeding has been previously reported by R. A. Dutcher and co-workers [Proc. Soc. Exp. Biol. & Med. 24, 953, (1927)]; in a recent paper (J. Nutr. 8, 269-82) this author found that the effect does not occur in the case of the vitamin A from cod-liver oil. The hypothesis is advanced that the hydrocarbons of unassimilated mineral oil possess greater solvent effect on carotene than is possessed by the lipids of the intestinal juices, thereby preventing absorption of carotene. Conversely, it is suggested the lipids and sterols of the digestive juices possess a preferential solvent effect on the sterol vitamin A, thereby promoting utilization by removing this vitamin from mineral oil.

The vitamin A activity of carotene dissolved in peanut oil has five to six times the potency of solutions in hardened cottonseed oil and ethyl laurate though made of the same strength is reported by F. J. Dyer, K. M. Key and K. H. Coward (Biochem. J. 28, 875). F. C. McDonald [J. Biol. Chem. 103, 455-60 (1933)] finds peanut oil, ethyl butyrate, ethyl laurate, and ethyl palmitate poor and unsatisfactory solvents for carotene because decomposition takes place very rapidly even when stored under vacuum. Carotene in cod-liver oil or corn oil kept well for a much longer period of time. R. G. Turner (J. Biol. Chem. 105, 443-54) reports 0.2% solution of carotene in olive oil or ethyl laurate even in the presence of stabilizers — i.e., hydroquinone and quinhydrone—loses part of its activity in the course of twelve to seventeen months.

Gossypol, the impurity found in crude cottonseed oil, is a significant problem in cottonseed feeds because it is toxic and causes discoloration in yolks of eggs from hens fed cottonseed products. These effects may be inhibited as per P. J. Schaible, L. A. Moore and J. M. Moore (Science 133, 372) by feeding 2% ferrous sulfate in the poultry ration or as per W. D. Gallup and Reder (Proc. Oklahoma Acad. Sci. 14, 74-5) by feeding increased amounts of calcium salts or 2% sodium bicarbonate in the ration.

Soap and Other Detergents

Results showing the enhanced effect produced with the use of soap to form oil emulsions for treating roads are reported by H. F. Winterkorn (Am. Perfumer 29, 457-60).

Of economical importance is the method of utilizing the lyes from manufacture of soap by D. Kaufmann [Maslob. Jir. Delo 9, No. 8, 25 (1933)]. This deals with recovery of fatty material by precipitating with calcium hydroxide, collecting this and transforming into sodium soap by treating with a saturated solution of sodium carbonate.

In calculating soap charges, interest has been directed to basing such figures on fatty acid constituents rather than titer or chemical test. H. P. Martin (Ind. Chem. 10, 271) has made several calculations for oils and fats in order to have a basis of matching fat for substitution in soap formulas; as an example, he states that ten parts of palm oil are equivalent to nine parts of beef tallow and one part of peanut oil and, therefore, can replace as much of the latter mixture in any standard soap charge.

A. Thieme (Seifensieder Ztg. 61, 179-80, 199-200) describes a method for making liquid soap.

The use of rosin in soaps, including properties it imparts to soap was discussed by A. Campbell (Ind. & Eng. Chem. 26, 718-9). In a paper presented at the meeting of "American Oil Chemists' Society" H. J. Warmuth recommends the use of wood rosins in soap manufacture.

A. R. Cade and H. O. Halvorson (Soap 10, No. 9, 25-6, 49) and M. Bayliss and H. O. Halvorson [J. Bact. 29, 9-10 (1935)] introduced a new procedure for testing germicides and applied it to soaps. It was found that introduction of a double bond enhances the germicidal property of a saturated soap, but the addition of further double bonds does not alter it. Hydroxyl groups and triple bonds have only slight effects. The sodium compounds tested, listed in the descending order of their effectiveness are chaulmoograte, ricinoleate, oleate, linoleate, clupanodonate, alpha - elaeostearate lauryl sulfate, oleyl sulfate, ricinelaidate, beta elaeostearate, ricinstearolate, undecylenate, sativate, stearate, palmitate, myristate, laurate, etc. B. Bachrach (Soap 10, No. 11, 21-3) recommends naphthenic acid soaps as a specialty soap and disinfectant.

It may be of particular interest to the soap industry that out of 461 claims for skin diseases resulting from occupational exposure, on the New York occupational disease calendar during 1933, soap accounted for 101. This dermatitis may be due to contact of acid, alkali or oil capable of causing it; however, the report goes on to state that constant immersion of hands in water will cause irritation of skin in some people and when in addition to the skin being constantly wet, the skin comes in contact with alkali such as that present in chip soaps and soap powders, many workers are affected.

Atmospheric carbon dioxide produces free fatty acids in soap, and will cause spoilage by formation of brown spots due to oxidation of these free fatty acids; in addition the sodium carbonate formed will cause the soap to become more alkaline in reaction. To verify this C. Bergell (Seifensieder Ztg. 61, 15-8, 33-4) passed carbon dioxide through a soap solution and found 7% of the fatty acids were liberated. L. Lascaray (Seifensieder Ztg. 61, 156) added to this evidence and suggested that during the drying process the decomposition of solid soap by carbon dioxide can be explained by the ready solubility of fatty acids in concentrated solutions, because the small amount of fatty acids liberated on the soap surface is strongly absorbed and held by the colloidal body of the soap, thus permitting a further decomposition of the soap. In this relation the report of G. Knigge (Seifensieder Ztg. 61, 571) on analysis of sodium stearate kept since 1899 is of importance. This soap had a rancid odor and positive Kreis test and contained 10.15 free fatty acid, some sodium carbonate, and sodium bicarbonate. When the free fatty acid was removed, the residue was odorless. The author found no case of rancidity existed except where free fat or free fatty acid was present.

The properties of soaps formed during the cleaning process are described by A. Raynor (J. Soc. Chem. Ind. 53, 365 and Ibid. 589-93). By this process fatty acids are introduced in fabrics by means of benzene. These are then washed in water containing an excess of soda ash. Saponification takes place during the washing and the soap formed in this manner, called "nascent soap," is equivalent in cleaning action to six times the fatty acids applied as soap flakes.

A review of recently issued patents pertaining to soap is presented by A. van der Werth (Allgem. Oel-u. Fett-Ztg. 32, 11-14). Following are some of the patents reported: Thaler (Austria Pat. 137,581) saponifies fats in two stages, about one-third is saponified with 40 to 50 degree lye and the final saponification is carried out with 18 degree lye. Leffer (Ger. Pat. 598,569 and 598,627) obtained two patents pertaining to preparation of soft soaps. One consists of saponifying with a lye in which the ratio of potassium and sodium is 9 to 1 respectively, the other patent pertains to saponifying under pressures at temperatures above 110°. Clayton, Kerrick and Stadt (U. S. Pat. 1,968,526) patented a continuous saponification apparatus and process. Two I. G. Farbenindustrie patents (Ger. Pat. 597,079 and 598,780) deal with the bleaching of soap with hypochlorites. W. H. Alton patented (U. S. Pat. 1,943,-253 and 1,968,628) the use of pyrophyllite, talc, mica and starch as an admixture for toilet soap.

The methods for sampling and analysis of commercial soaps and soap products officially adopted by the "American Oil Chemists Society" are reported by M. L. Sheely (Oil and Soap 11, 90-5). J. Davidsohn (Seifensieder Ztg. 61, 512) describes a method of determining salt in soap. C. Bergell (Seifensieder Ztg. 61, 89-90) proposed a method for determining free alkali in soap.

A series of new detergents and emulsifiers were patented by K. Keller (U. S. Pat. 1,948,924; Ibid. 1,971,415; Ibid. 1,947,650, and Ibid. 1,959,478). These are the sodium soaps or the sulfonated products, of chlorinated aliphatic hydrocarbons or fatty acids, with or without treatment with ammonia after chlorination. Information published by Y. Tanaka, R. Kobayashi and T. Takayama [J. Soc. Chem. Ind. (Japan) 37, 197-B and Ibid. 197-8] applies to some of the above detergents. In the first paper data on the reaction velocity between alkali and chlorinated fatty acids of various chlorine content are presented. In their second paper they demonstrated that aqueous solutions of chlorinated fatty acid soaps have a lower surface tension than solutions of ordinary soaps.

Because of the general nature of most of the papers on wetting agents of the sulfonated types, only a reference to them is given here. A. S. Richardson (Oil and Soap 11, 10-1) discusses alkyl sulfates; E. Neyman and S. Pilot's (Ind. & Eng. Chem. 26, 395-6) article is on sulfonic acids from petroleum; W. Kling (Chem. Ztg. 58, 557-9), C. A. Tyler (Soap 10, No. 3, 25-6, 65 and Ibid. No. 4, 21-3) and R. A. Duncan (Ind. & Eng. Chem. 26, 24-6) review the development and commercial possibilities of sulfated alcohols; H. A. Sweet (Soap 10, No. 5, 55-7,65) and E. L. Lederer (Angew. Chem. 47, 119-25) describe and give uses for those sulfated compounds bearing the name "Igepons" in commerce; L. W. Davis [Am. Dyestuff Reporter 22, 634-6 (1933)] wrote on theories of sulfonated oils; and J. Sokolinski (Am. Dyestuff Reporter 23, 265-8) discussed manufacture and uses of various sulfonates. The black malodorous so-called raw sulfate soap, obtained as a by-product in manufacture of sulfate cellulose can be refined by treatment with hydrogen peroxide and worked up into a soap product for numerous uses according to a patent issued to E. Pyhälä (Zellstoff u. Papier 14, 273-6).

Analytical methods for sulfonated oils are reported by: "American Oil Chemists Society" committee (Oil & Soap 11, 229-30, 238), C. Riess (Fettchem. Umschau 41, 199-200), R. Hart [Ind. & Eng. Chem. (Analytical Ed.) 6, 220-3], "International Society of Leather Trades Chemists" committee [Collegium 763, 674 (1933)] and U. S. Bureau of Standards [Commercial Standards CS 43-32 (1933)].

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MEMPHIS CONVENTION NOTES

Southern Hospitality Supreme:—That was the keynote of this great meeting. No more perfect hosts could be imagined than Mr. and Mrs. Worthen Agee, Mr. and Mrs. Ed. Barrow, Mr. and Mrs. Owen Daniel, and all of the other cordial and hospitable members of the Memphis Convention Committee. And what a setting for a convention is that Peabody Hotel—not forgetting the "Oil Mill."

It was great to see the Chicago ladies accompanying their husbands, including Mesdames Irwin, Vollertsen, Robinson, Dormitzer, Harris and Mrs. Blake, who was right at home back in Memphis.

No convention would be complete without the Hamners (especially Mrs. Dallas Fashion Plate).

The ladies report a wonderful luncheon at the finest country club in the South, and oh! those mint juleps! Lovely drives through Memphis' beautiful residential districts and other entertainment made the stay most enjoyable for the ladies.

Phil Ronzone, the demon Philadelphia poet, is reported to have had a wonderful time "under the Anheuser Bush."

Paul Stern and Evan Sigworth are said to have revived the old Fundamental Research Society — and how!

Everyone missed David Bruce McIsaac, but a telegram from him was cheered at the banquet. Be back next year, Mac.

The banquet with fine entertainment features and a dance afterwards was a splendid piece of entertainment, and was greatly enjoyed by all. Did Mayfield enjoy it? Actually he was half the show. No banquet would be complete without Tom Law, the perennial toastmaster, who was in rarest form. Ed. Barrow's meeting of the Golf Committee was "one for the book." Now everyone wants to be golf chairman next year.

Who is that ladies' man? Gee, he's terrific! How about Harry's Harem.

It was good to meet several new members, including Edward Hodgson of Athens, Ga., and Maumus Claverie of New Orleans.

A charming addition to the ladies at this meeting was our retiring president's wife, Mrs. Wayland Hutchins of Savannah, also Mrs. Brownfield of Dallas.