• *Fats and Oils Report*

Margarine Ingredients Prices Versus Use

THESIS: *Fats and Oils Used in Margarine Are Responsive to Price Relationship Changes.*

There is nothing simple about fats and oils price patterns. Supply and demand factors at work in these markets are many. The interplay of market influences is complex. These influences seem designed to purposely defy analysis. Market analysts, on the verge of despair, are tempted to conclude that only the freight rate specialist has a more formidable task.

A brief review of supply and demand factors is the best place to begin:

GOVERNMENT SUPPORT PRICE PROGRAMS: The loan price established for soybeans, corn, cotton, etc., may have a definite influence on size of crop produced. Coupled with support price is acreage allowances. In order to get more production both price and acres may be increased, or one may be increased and the other decreased. Something usually happens to make such attempts at market manipulations unrealistic.

P.L. 480 and DONATION PROGRAMS: When the government is willing to provide payment for fats and oils at prices other than world cash market prices, a fictitious pricing structure results for both oil and meal. This distorts normal price patterns.

MEAL DEMAND: Demand for protein animal feed is seldom in balance with demand for oil produced by the crushing industry. Oils can be more readily stored than meal, so that crushers tend to produce for the meal market with oil taking a secondary place of importance. Some day in the not too distant future we may see a reversal in this factor.

LIVESTOCK PRICES: These influence meal demand. With animal prices going up, producers feed to heavier weights which yield more lard and tallow. And as meal prcies go up, crush goes up resulting in excess oil production. But if feed prices are too high, feeders swing to supplemental feeds and pastures if possible.

WEATHER: Always there is the weather to affect production. Weather affects meal demand and has the potential of strongly influencing supplies. It also affects oil yield of seeds crushed. Production area, too, affects oil yields as soybeans in the south tend to produce more oil than those in the north. This is an important consideration as the south continues to expand its bean acreage.

GOVERNMENT PRODUCTION ESTIMATES: Sometimes are close to figures actually realized and sometimes are not. Government forecasters do the best they can and I am firmly convinced that there is no political motivation in these estimates. Nevertheless, pricing ideas have to be revised with each production revision. More on this later.

COMPETITION FROM OTHER FATS AND OILS: A case in point is recent displacement of US lard in England by fish oil, or soybean oil by sunflower oil. We could also mention increased soybean production in Brazil on former coffee plantations.

PROTECTIVE TARIFFS: To protect a developing crushing industry in Western Europe there is an import duty on soybean oil but not on beans and meal. France has increased rapeseed production significantly, which further displaces demand for soybean oil. Japan has an import duty on soybeans but not most other oilseeds. This duty will be cut in half over the next 5 years as a result of recent GATT negotiations in Geneva.

COMPETITION FROM OTHER PROTEIN SOURCES: Urea, a by-product of ammonia, is being successfully used as an economical source of protein for ruminant animals. In 1966 it is estimated that the equivalent of 2 million tons of soybean meal were displaced by urea, with further substitution in prospect as more economies of urea production take place. Two million tons less meal means 924 million lb less oil produced. Increased fish meal use also means more fish oil available and less vegetable oil needed. Another substitution on the horizon is high-lysine corn now being developed. This can substantially reduce the protein demand from other sources, potentially cut bean crush and therefore oil production. This may create demand for a higher oil-content seed in the future.

CRUSHING PROFITS: Oilseed crushers, like other industries, strive to operate at a profit. There are times when they apparently operate at a loss with combined return for oil and meal less than the cost of raw material. In some cases they have secured raw material earlier at a lower cost, or put on "board crush" at better levels. Presumably some crush at a loss in order to support their integrated outlets for meal and/or oil. Some keep going to keep favored customers and hope for brighter days ahead. Eventually crush is curtailed in order to work off product inventory and allow demand to return prices to the profit column. Government support prices are important in this aspect. If the crusher or exporter of soybeans, for example, can't match the support price and still make a profit, then the farmer logically lets the government have them instead.

ECONOMIC CONDITIONS: Changes in disposable income affect demand for meat products, thus affecting amount of meal consumed and oil produced while at the same time affecting the availability of animal fats. Coupled with disposable income are employment level, tax adjustments and inflationary trend. Strikes at packing plants or crushing mils affect fats and oils production. Railroad or trucking strikes and freight rate changes affect distribution patterns and prices. Shipping strikes affect exports and imports. International tensions create a demand for commodity ownership. Disrupted diplomatic relations curtail international trade, while Suez and Panama Canal difficulties slow it down and make it more expensive. Gross national product growth and birth rate are also important considerations.

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Now, let's examine price factors. Just what does determine the price of fats and oils used in margarine? One hears talk of "normal" price differences between each. But why are they so frequently abnormal? Why, for example, does soybean oil go up 2 cents a pound from the previous year when the supply is significantly larger?

A simple "supply and demand" answer is not good enough. History won't support this simplicity. The obvious answer then is that competing oils or fats are higher due to supply and demand factors. Now we're getting closer, but this is only part of the answer. There are other dynamic influences.

GOVERNMENT ACTION or lack of action is the principal one among other influences. First in this category is *production estimates.* Several weeks or even months before the crop is planted or sows bred, we get an estimate of production. These are usually useful in formulating pricing ideas for remaining old crop supply and expected new crop availability. Subsequent pricing action can cause farmers to change their production ideas, so succeeding production estimates have to be adjusted. Weather and other factors also necessitate adjustments. Second is *consumption estimates.* These are also subject to change. Meanwhile, government agencies must continue to operate established programs based on current estimates. This brings us to *government purchase programs* of meat, poultry, lard, salad oils, margarine, butter, eggs or cotton, which is number three. *Public Law 480,* foreign and domestic donation programs are number four. These last two can be adjusted as changes are made in production and demand estimates, but sometimes fully compensating adjustments are not possible because of entrenched dependence on these programs on the one hand, or budgetary limitations on the other. Number five is *price support and acreage control programs.* Beyond a certain point in the crop year there can be no change in these to compensate for subsequent production and demand adjustments. Thus, with a combination of these governmental influences we are likely to see fictitious price levels established for one or more of the fats and oils for which the market cannot make adequate adjustment in usual supply and demand

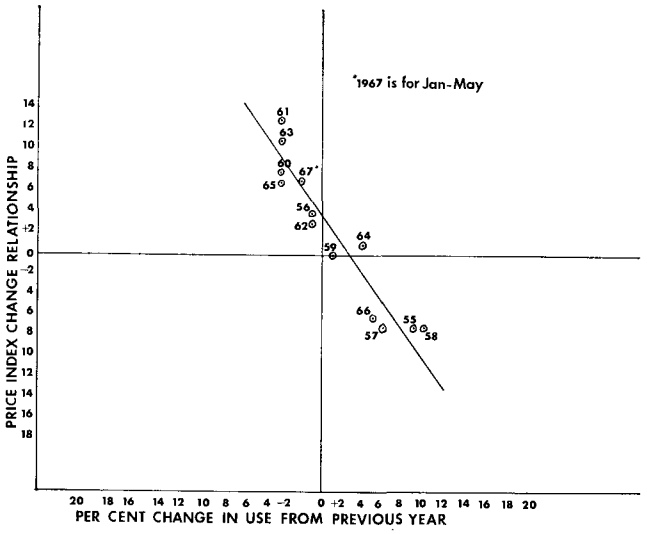

FIG. 1. Soybean oil use in margarine as percent total fats and oils used vs. price index relationship to other oils (calendar year).

terms. In other words the government has the ability to estimate demand, then sets support price and production allowances to satisfy expected demand, then tries to absorb the difference through manipulation of various purchase programs.

FARMER MARKETING ACTION is another economic consideration. There may be plenty of soybeans produced for the prospective (and realized) oil and meal demand, but farmers may hold tight at harvest time or they may sell freely. They may conduct a large withholding action in hogs creating a temporary shortage of lard but a larger total supply later as the animals put on more weight.

PROMOTIONAL INNOVATIONS can also cause an adjustment in economic factors. A recent and current illustration is corn oil margarine which results in displacement of other fats and oils, but usually on a different set of price considerations. On the other hand innovations can create additional demand for margarine.

PLANT TECHNIQUES may change, or refinement methods may be improved for one of the component fats or oils. This would result in a reshuffling of component percentages.

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To the market economist it is of primary importance to assess all these factors in order to determine current and

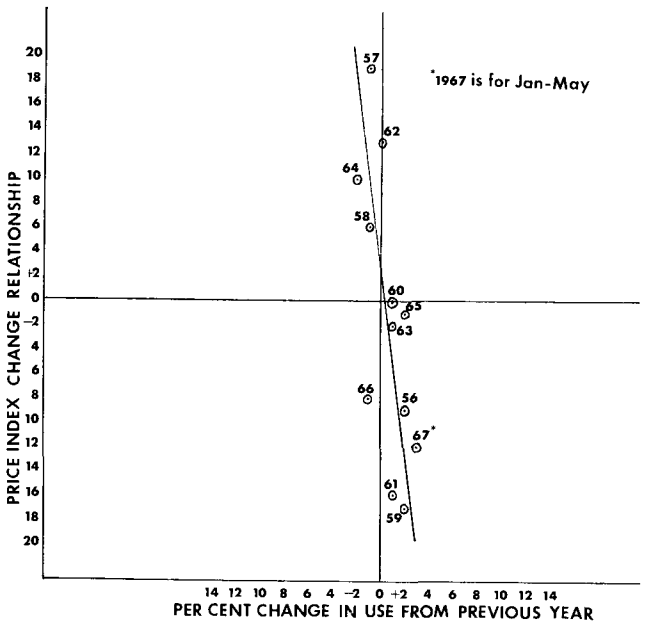

FIG. 2. Lard use in margarine as percent total fats and oils used vs. price index relationship to other oils (calendar year).

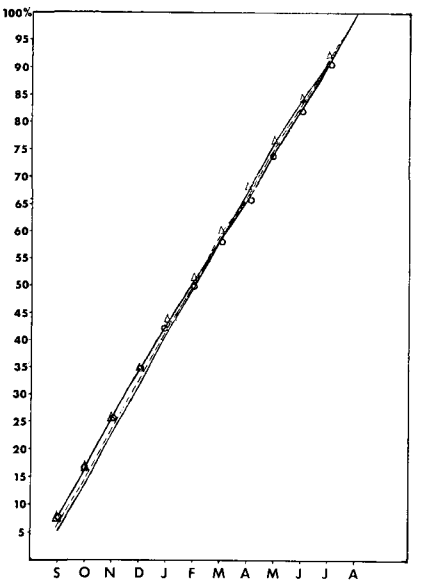

FIG. 3. Monthly cumulative soybean crush expressed as percentage of the total, 1961–62 through 1965–66.

future price relationships. Unless he is constantly aware of them all, his analysis will be inadequate. It's so easy to quote a "rule-of-thumb" that often is relied upon long after the rule has been repealed by one or more of the dynamic forces just enumerated. One prominent industry representative recently said that soybean oil should hold 2 cents above lard. Such simplified reasoning has little relation to fact. In recent years we have seen monthly averages of SBO 4 cents over lard and 4 cents under lard.

Price is the prime determinant in establishing the relative amount of various fats and oils used in margarine manufacture. There has to be a relation between price and use. This relation should follow a pattern with reasonable consistency; a pattern which can be demonstrated and which can be used in making future projections even though there are distortions of normal patterns by outside influences.

The search for such a pattern is tedious. There are many frustrations such as those enumerated above; numerous complications which cause distortions of a simple supply and demand schedule. It wasn't quite so bad prior to 1960 when the basic consideration was between soybean oil and cottonseed oil. These two regularly represented about 95% of fats and oils used in margarine. But since that time, their use represents only about 80%. We now have lard for price reasons, and corn oil for promotional specialty reasons.

Most reliable of all the possible approaches to this problem appears to be charting the percentage change in rela-

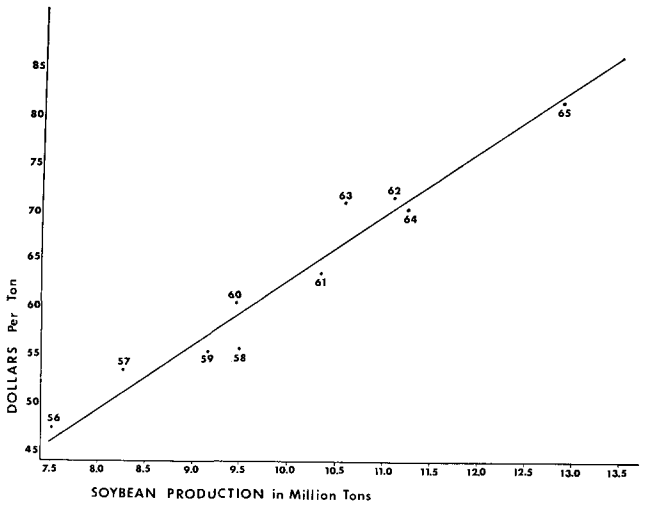

FIG. 4. Soybean meal: annual production vs. annual average price. 44% bulk unrestricted Decatur (year Oct.–Sept.).

tive use of fats and oils in margarine versus relative change in price index. In order to establish an equal base for price, a combined price index was developed. This is simply the 1957–59 average price of soybean oil, cottonseed oil, corn oil and lard with that average price representing 100. (This average is 11.59 cents, or the multiplier factor of 0.862813). Thus in Fig. 1 we see plotted on the horizontal axis the change from the previous year in soybean oil used as a percentage of the total, while on the vertical axis is the amount of change in soybean oil price related to the other components. For example, in calendar year 1955 soybean oil use was up 9% from the previous year at the expense of cottonseed oil. The price for both oils dropped from the previous year. On the price index soybean oil dropped 7 points more than cottonseed oil, thereby giving us a measure of increased use of soybean oil in margarine. In 1956 prices for both oils went up, but on the price index soybean oil went up 4 points more than cottonseed oil so the use of soybean oil was off 1%.

In 1950 soybean oil represented 41% of the fats and oils used in margarine, with cottonseed oil 55% and lard 1%. Soybean oil reached maximum use of 85% in 1959, but has since fallen off to a current rate of 73%. Cottonseed oil has dropped to a current rat of only 5%. Corn oil has climbed from negligible in 1958 to a current rate of 10%, while lard is up to 9%. Therefore in Fig. 1 we can plot use thus far in 1967 this way. Soybean oil use as percentage of the total is running 2% below last year. Prices for all fats and oils are down from last year, but soybean oil is off 6 index points less than cottonseed oil and 9 points less than lard.

Now let's look at lard in the same way (Fig. 2). This is much more inelastic. A much greater change in price relationship is required to realize a small change in lard use as a percentage of the total. For example, in 1956 lard use was up 2%. All prices were up, but lard was up 9 index points less. Thus far this year lard use is running 3% greater than last year. Lard price has been off 1 index point less than soybean oil but off 3 points more than cottonseed oil.

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Now, what about the soybean oil situation? This soybean marketing year (September through August) has provided us with many examples of the problems mentioned earlier:

1. Government raised soybean support price to $2.50 national average.
2. Acreage was increased significantly.
3. Hot weather took its toll resulting in crop estimate reduction.
4. Improved weather later revived plants resulting in better than expected crop.
5. Farmers held tightly, preferring to speculate with cash beans, knowing there was a good support price.
6. Market has had to stay high to attract beans out of loan.
7. Government has had to make significant reductions in estimates for crush and export.
8. Public Law 480 programming of oil has been less than expected.
9. Larger than expected quantities of sunflower oil and fish oil have been offered on world market.
10. Mid-East tensions have eliminated some countries from PL 480 eligibility.
11. Increased animal slaughter and weights have placed more lard and tallow on the market.
12. Farmers withhold hogs from market and then liquidated sow herds.
13. Economic growth slowed in US and Europe.
14. Suez Canal traffic was disrupted.

As early as last February, with the year only half gone, we came up with projections of soybean crush and exports that shocked some in the trade but which are proving to be quite accurate. We said the crush would be 540 to 550 million bushels and exports 255 to 260 million leaving carryover of 106 to 111 million bushels. The government took until June, with four successive revisions, to come to the same conclusion. They started with crush of 585 million

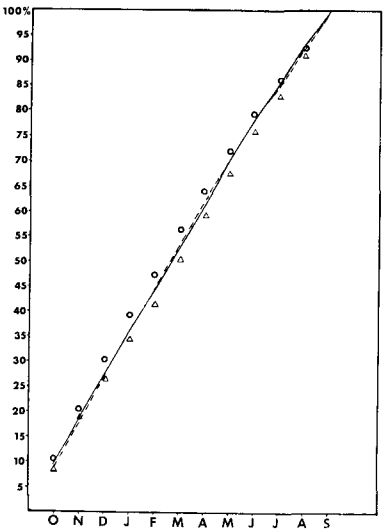

FIG. 5. Monthly cumulative lard production. Expressed as percentage of total 1961–62 through 1965–66.

bushels and exports of 275 million, leaving carryover of 46 million bushels. The manner in which we developed this analysis was described in the April edition of the JAOCS.

We reasoned that history repeats itself in the crushing industry, pointing out that while total annual crush varies from year to year the monthly cumulative total as a percentage of the annual total is strikingly similar in the past five years (Fig. 3). In charting this pattern it became impossible to show a distinct line for each year without using an extremely large chart scale. Bean exports perform the same way except in years of longshoremen strikes.

Price implications for this kind of adjustment are highly significant. USDA crush of 585 indicates a tremendous demand for meal, with meal prices correspondingly high (more on this in a moment). Exports of 275 indicate a similar situation overseas. And carryover of 46 on September 1 means just a little more than needed to carry the industry into late September when new crop is available. On the other hand lower crush and exports mean lower price levels, and carryover of 100 or more means some will have to end up in CCC hands and reseal loan. It remains the function of price, therefore, to attract enough beans out of the loan before July 31 to meet demand, but not too many. The grain trade can't afford to carry excess stocks into a new crop year except at a discount under new crop prices.

Soybeans are crushed for meal. Oil is a by-product. The value of meal derived from a bushel of beans is greater than the value of oil. This has been true for 13 of the past 15 years and it continues to be true today. It would be even more true except the government indirectly supports

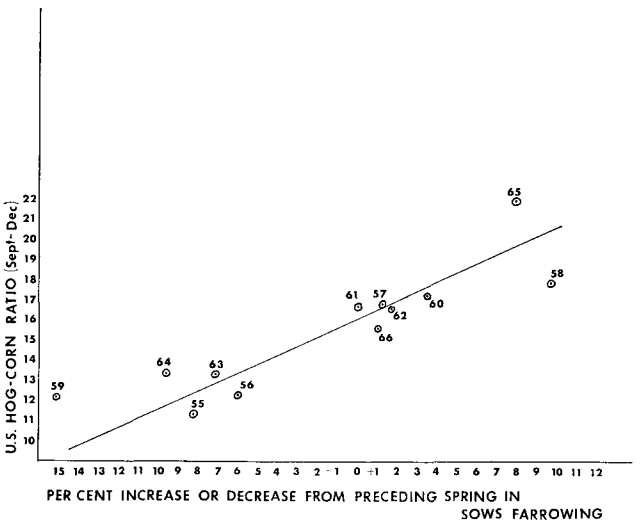

FIG. 6. Relationship of hog-corn ratio to spring farrowings.

oil prices above world levels so as to keep meal from going too high. This situation also provides an indirect support for other fats and oil prices.

Under these circumstances it is possible to show a correlation between soybean meal production and price (Fig. 4). The June edition of JAOCS carried this analysis. As price goes up so does production. And of course production is geared to demand because meal can be stored for only a short time. But when more meal is produced we also get more oil, and oil can be stored. For this reason it is important that users of oil should be keenly aware of what's going on in the meal market.

In April and May soybean meal prices were sagging badly and many people were expecting them to go considerably lower, while soybean oil prices were high and expected to go higher. We reasoned that, based on Charts C and D, meal would go higher and oil would go down. This, as you know, is what happened.

But what of the future? Can these two charts be useful for projections into crop year 1967–68? We think the answer is yes. The same basic supply, demand, and economic factors still apply. The question is, how much meal will be needed? We can expect fewer animals on feed. Farrowing intentions for this fall's pig crop are off 3%. Cattle on feed will be down. Broiler hatchery supply flocks are down. The cottonseed crop is not expected to be any larger than last year. We can expect more fish meal. More urea is likely at prices less than this year due to improved production techniques. This seems to add up to less soybean meal demand and consequently lower prices, based on Chart 4. But with fewer animals and improved economic conditions by the end of 1967 we should have higher animal prices and higher feeding rates. So the prospect is for meal production and prices to average about the same as this season, which should result in little change in soybean oil prices.

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Now, what of the lard situation? For production in the current season (October through September) we can use two billion pounds. This is derived from Fig. 5 which was constructed like Fig. 3 for soybean crush. The range of cumulative percentage through May of annual total is 68% to 72%, a slightly wider range than for soybean crush. The current situation leads us to believe that through May 70% of this year's total lard had been produced.

The June 1 Pig Crop Report indicates there were 9% more market hogs on farms than a year ago in the 180 lb plus category. In the 120 to 179 lb range there were only 1% more. In the 60 to 119 lb range there were 4% more, while below 60 lb there were 5% less. June hog marketings were up about 9%. This phase was completed in June. July to early August should drop back to only 1% over last year. This should be followed by a 4% higher rate through August and September. Then the indicated rate is lower for several months. As for farrowings next December to May, we will watch the hog-corn ratio this fall. There is a good correlation between this ratio and farrowing decisions (Fig. 6). Lard prices? They look steady to easier into July. Then some recovery this summer. A little easier in the fall. Then stronger.

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cleavage is lower than that for more unsaturated oil and fewer low molecular weight fragments are formed. Other applications where high-oleic safflower oil has a potential economic advantage will be discussed.

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ISOMERIC PHENYLSTEARIC ACIDS AND RELATED COMPOUNDS. COMPOSITION AND PARTIAL SEPARATION

F. D. Smith and A. J. Stirton

The effect of variables such as aluminum chloride ratio and order of addition of reactants was explored in the Friedel-Crafts reaction of benzene with oleic acid, oleyl alcohol and oleonitrile. In each case the product was a viscous oil which failed to crystallize.

Gas-liquid chromatography of the ketone fraction obtained by chromic acid oxidation showed phenylstearonitrile, phenylstearic acid, and phenyloctadecanol were mixtures of 11, 12 and 13 isomers with the benzene ring attached at carbon numbers 7 to 17, 6 to 17 and 5 to 17 on the aliphatic chain resepectively. A partial resolution of the oily reaction products by analytical GLC showed a similarity in composition. Partial resolution by preparative GLC effected isolation of the 17-, 16- and 15-phenyl isomers in a pure state from phenylstearic acid; and of the 17- and 16-phenyl isomers from phenylstearonitrile and phenyloctadecanol.

Repeated low temperature crystallization from acetone separated the 17-phenyl isomer from phenylstearic acid, phenyloctadecanol, phenyloctadecyl acetate, and phenylstearonitrile. Because of a higher melting point (42.2–42.9C vs. 31.0–31.8C) low temperature crystallization of methyl phenylstearate gave the 16-phenyl rather than the 17-phenyl isomer.

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CORRELATION OF FATTY ACID STRUCTURE WITH PREFERENTIAL ORDER OF UREA COMPLEX FORMATION

J. L. Iverson and R. W. Weik

The selective order in which methyl esters of fatty acids form urea complexes was correlated with fatty acid structure. Detailed information about the preferential order in which inclusion compounds are formed was obtained by fractionating complex oils (e.g., butter, lanolin, cod liver and a special polyunsaturated fraction of cod liver oil). The preferential order was correlated with GLC retention times and the detection of trace amounts of fatty acids (<0.1%) was possible. Urea adduct valves (UAV) are proposed as a useful means of expressing preferential order at the formation of inclusion compounds. The preferential order can be used to identify structural isomers of unsaturated fatty acids and tentatively indicate the presence of additional members of a homologous series of compounds such as multibranched isoprenoid acids.

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FATTY ACID COMPOSITION OF COD LIVER OIL DETERMINED BY UREA FRACTIONATION AND MODIFIED PTGC

J. L. Iverson

Cod liver oil contains all odd and even chain length saturated fatty acids from C_{12} to C_{24} and branched chain iso and anteiso acids from C_{14} to C_{24}. A series of multibranched acids composed of a basic saturated isoprenoid unit beginning with a C_{18} member, including the C_{20} member (3,7,11,15-tetramethyl hexadecanoic acid) and extending to a C_{28} member has been found together with several additional unidentified saturated components. The presence of monounsaturated acids, including positional isomers, from C_{14} to C_{28}, and polyunsaturated acids, including positional isomers, from C_{18} to C_{28} has been confirmed. In addition, trace amounts of C_{28}, C_{30} and C_{32} polyunsaturated acids of undetermined structure have been detected.

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MOLECULAR SIEVES AS CATALYSTS FOR CYCLIC FATTY ACID FORMATION

R. A. Eisenhauer and R. E. Beal

A method has been developed for producing cyclic fatty acids by the use of molecular sieves to catalyze the reaction. Previously, the triene system of linolenic acid was cyclized by heating with excess alkali in an appropriate solvent. To recover the cyclic fatty acids, soaps and excess alkali were neutralized with acid. Alkali addition and subsequent neutralization are eliminated with the molecular sieve procedure. To conduct the reaction, molecular sieves, linseed fatty acids and dodecane solvent were heated and stirred in an autoclave. Such reaction variables were investigated as type of sieve, sieve-fatty acid ratio, solvent ratio, temperature and time. GLC data show that cyclic fatty acids made by both methods contain the same isomers; however, the predominant isomers differ. The cyclic fatty acids produced by molecular sieve catalysts are similar to those from a thermal treatment.

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STUDIES ON THE AUTOXIDATION OF HUMAN SERUM LIPOPROTEINS USING ULTRAVIOLET SPECTROPHOTOMETRY

W. L. Robison and Gary J. Nelson

Changes in the ultraviolet spectra of purified human serum lipoproteins isolated by ultracentrifugal procedures are a sensitive measure of autoxidative changes in the lipoprotein molecule. The extent of the autoxidative changes can be determined quantitatively by the intensity of ultraviolet absorption in the region from 250 to 350 mμ. In this study total serum lipoprotein with density 1.21 gm/ml, high density lipoproteins (HDL3), and a low density lipoprotein fraction, Sf_{3-9} were isolated ultracentrifugally and then exposed to oxygen. The ultraviolet spectra were recorded at various intervals up to one week after the initial isolation. In addition, solutions of fatty acid-free bovine serum albumin (BSA) and various pure fatty acids—saturated, monoene, and polyenes—were exposed to oxygen using the same conditions. BSA, saturated and monoene fatty acids showed little change in their ultraviolet absorption, but the spectra of the polyunsaturated fatty acid underwent changes similar to those of the lipoprotein samples. When double sector cells were used with BSA in one compartment and autoxidized polyunsaturated fatty acids in the other, the spectra of the autoxidized lipoproteins could be approximated. Hence, it was concluded that the changes in the ultraviolet spectra of the autoxidized lipoproteins were due to the autoxidation of the polyunsaturated fatty acids in the molecule. Ultracentrifugal flotation patterns on autoxidized lipoproteins were found to be essentially normal despite gross alterations in the ultraviolet spectra of the samples, and, hence, are a poor criterion for the degree of autoxidation of a lipoprotein sample.

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QUANTITATIVE DETERMINATION OF GLYCERYL ALK-1-ENYL AND ALKYL-ALKENYL ETHERS IN NEUTRAL AND PHOSPHOLIPIDS

Randall Wood and Fred Snyder

A quantitative method for the simultaneous determination of glyceryl alk-1-enyl and alkyl-alkenyl ethers is described. Complete hydrogenolysis of carboxylate and phosphate esters of neutral and phospholipids was achieved with lithium aluminum hydride. The hydrogenolysis products of the glyceryl ether-containing lipids, glyceryl alk-1-enyl and alkyl-alkenyl ethers and alcohols, were identified by thin-