and to some extent of castor oil has become apparent although neither of these oils was used for this purpose in the past. The characteristic odour of linseed oil in soaps is minimized by appropriate production measures which consist of the use of refined oil, inhibitors, and blending agents. The price of linseed oil is subsidized to the consumer and therefore does not afford an economic barrier to its use. This is not the case with castor oil which is quite costly and can only be used in products having high ceilings.

The use of tall oil for soap manufacturing has not achieved much acceptance by the trade. Two reasons may be given, namely: that the refined product is too high in price to permit its usage and the lower priced crude product is too dark and odiferous to be acceptable.

The extensive use of sulphonated oils has necessitated considerable substitution by the oil processor. During the period of castor oil shortage we have seen trade acceptance of sulphonated products from non-hydroxylic fatty oils which were not previously acceptable in place of castor. In particular, I would mention the use of sulphonated soya, sperm, and fish oils. Even the textile industry has been required to make certain adjustments and substitutions; for example, the use of olive and peanut oils as wool lubricants has given way to the use of lard and neatsfoot oils. In the production of cloth oils there has been a trend towards the use of mineral oils to which a saponifying agent has been added. Some of the specialty products may even be stabilized emulsions of fatty oil in soap solutions. The net result has been that the specialty oil manufacturer has effected considerable savings.

Substitutions have been made in many industries. In some cases temporary hardship has been felt as in the case of the stuffing grease requirements of the leather industry. As you know, "stuffing" grease invariably contains a high percentage of wool grease which, on account of its flat viscosity-temperature curve, is unexcelled for leather exposed to high and low temperatures, assisting the leather to retain reasonably normal flexibility. While it was not possible to duplicate the properties of wool grease, such products as hog degras and blown fish oils overcame the initial difficulty. Today we obtain our limited requirements from United States production and, in addition, we have commenced the production of a technical wool grease in one of our own plants.

In broad outline I have endeavoured to sketch for you something of our position and problems. My presentation is a failure if I have not made clear that there has been a growth of commercial and economic interest in the oils and fats industry, a field which was heretofore not regarded as particularly important to the Canadian economy. However, due to the war emergency Canada has embarked on a series of industrial developments, and it remains to be seen how much of this development we shall be able to maintain and nourish to economic maturity.

A Spectrophotometric Method for Differentiating Between Lard and Hydrogenated Vegetable Oils

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ON SEVERAL occasions this laboratory has experienced a need for a simple and direct means of determining whether a given sample of fat was lard or a hydrogenated vegetable oil. The ordinary chemical tests are of little value in this regard although certain specific or semi-specific tests have been developed which are of some assistance as supporting evidence. The Halphen test has been devised for the identification of cottonseed oil; but lard from animals fed on cottonseed meal will give a positive reaction (14, 15) and hydrogenated oil reacts only slightly or not at all (14). The Villavecchia test for sesame oil has been used successfully as a specific test (14, 15), but it is of value in regard to this one oil only. The cholesterol and phytosterol identification tests (15) seem to be the nearest chemical approaches to the solution of the general problem of distinguishing vegetable fat from lard; but the methods are tedious and time-consuming.

The presence of small amounts of tetra-ethenoid acids (principally arachidonic) in swine depot fat has been reported by various workers (4, 6, 7). These acids containing four double bonds are not found in vegetable oils except in the oil from *Parinarium laurinum*, which is not a commercially important oil. Hilditch stated that this is the only known instance of a vegetable fat containing a tetra-ethenoid acid (6), but Brice *et al.* have recently reported the presence of a tetra-ethenoid acid in perilla oil (3). Arachidonic acid has also been reported as present in the fat from man (5), rat (16), and ox (8), as well as in human milk fat (1). A simple method, then, for the identification of such components would be of considerable value in establishing the source of the fat.

The chemical detection of small amounts of the unsaturated acids containing 3 or 4 double bonds on the basis of their bromination products is difficult, and the results are frequently open to question. The separation of small amounts of these "polybromides" into their hexabromide and octabromide components is still more difficult and unreliable. The solution of this type of problem has been greatly facilitated through the use of ultraviolet spectrophotometric studies of the alkali-isomerized soaps of the fatty acids in question. It has been known for several years that treatment of fats with strong alkali at high temperatures produces a conjugated system of double bonds in the polyethenoid components and that these conjugated systems exhibit characteristic absorption spectra in the ultraviolet region (2, 9, 10, 12, 13).

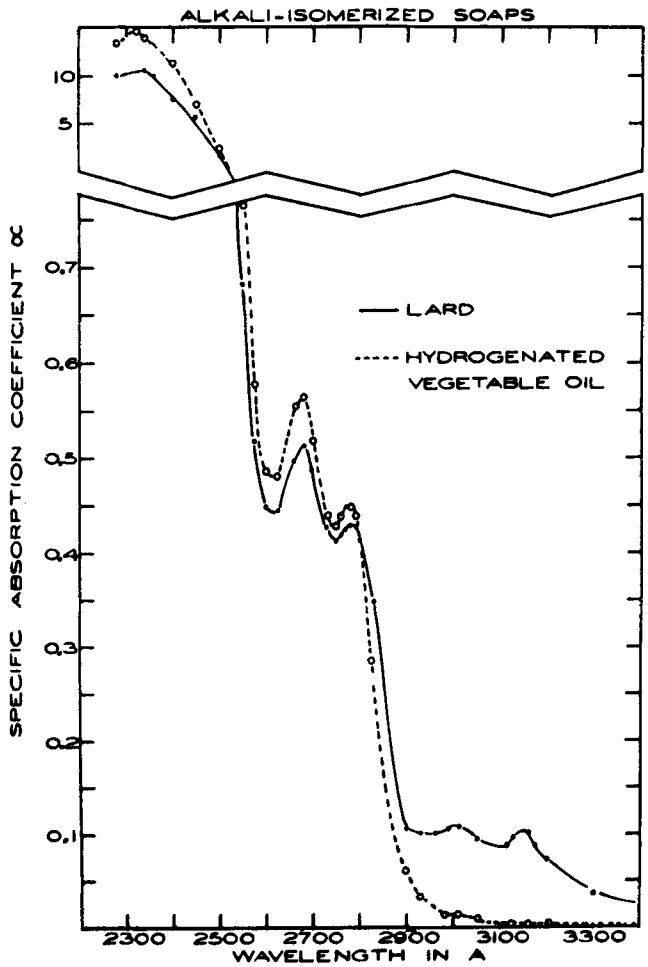

FIG. 1.

A spectrophotometric method of fat analysis for the linoleic and linolenic acid contents developed by Mitchell, Kraybill, and Zscheile (12) was extended by Beadle and Kraybill (2) to include arachidonic acid. By the use of this method those polyene constituents which are conjugated or which may be alkali-isomerized to form conjugated systems may be detected in amounts as low as 0.1 per cent or less with respect to the total fat present. This method of analysis has been used extensively in our laboratories and has confirmed the reported presence of a tetra-ethenoid acid in lard. During the examination of about 200 samples of lard and of hydrogenated vegetable oils arachidonic acid was detected in every sample of lard, without exception. In no instance was there evidence of this acid in the hydrogenated vegetable oils. These observations not only confirm the statements in the literature concerning the presence of arachidonic acid in lard, but provide a basis for a simple, direct, and rapid method for distinguishing between lard and a hydrogenated vegetable oil.

The suggested method of examining a sample of fat for identification is simply as follows: weigh out 0.1 gram of the melted fat and subject it to 25 minutes' isomerization in alkaline glycol at 180° C., according to the method of Mitchell *et al.* (12). Cool the isomerized soaps, dilute to 250 ml. with pure ethanol, and examine the absorption spectrum between 2900 A. and 3200 A. by means of a suitable instrument (the Beckman model DU photoelectric spectrophotometer is used in this laboratory). The absence of well-defined maxima at 3010 A. and 3160 A. is excellent evidence that the fat is not lard. The total time for preparation of the sample and making the spectrophotometric observations is approximately ninety minutes.

Figure 1 shows the ultraviolet absorption spectra of two typical samples of shortening (lard and hydrogenated vegetable oil) after alkali isomerization. Note that the lard curve possesses definite absorption maxima at 3010 A. and 3160 A. and that there is a complete absence of such peaks in the curve for the hydrogenated vegetable oil. The maxima in the curve for lard are due to the presence of a conjugated tetraene system, and are interpreted as originating from the arachidonic acid present. The amounts, calculated from standard reference values (2), vary in different samples from 0.2 to 0.6 per cent of the lard.

Discussion

Because the amount of arachidonic acid in lard varies in different samples, the method described is qualitative only. The arachidonic acid may be determined quantitatively, but it would not indicate with accuracy the amount of lard in a mixture. The presence of lard in mixed shortenings can be established only if there is sufficient arachidonic acid to fall within the sensitivity of the method. In our experience identification was definite in mixtures containing 50% lard and 50% hydrogenated vegetable oil, but in samples containing 25% lard the absorption maxima were so slight as to lend some doubt to the interpretation of the results. Mitchell and Kraybill (11) reported traces of tetraene conjugation in certain refined vegetable oils due to bleaching, but the liquid nature of such oils obviates the need for a laboratory method for distinguishing them from lard. The presence of such conjugated materials may be detected by spectrophotometric examination prior to subjecting the sample to the isomerization procedure. The method described in this paper is particularly applicable in those instances where the fat has been deodorized so that organoleptic observations are of little value. It provides the chemist with a quick and easy means of making an identification which would otherwise be possible only after a series of elaborate chemical procedures.

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