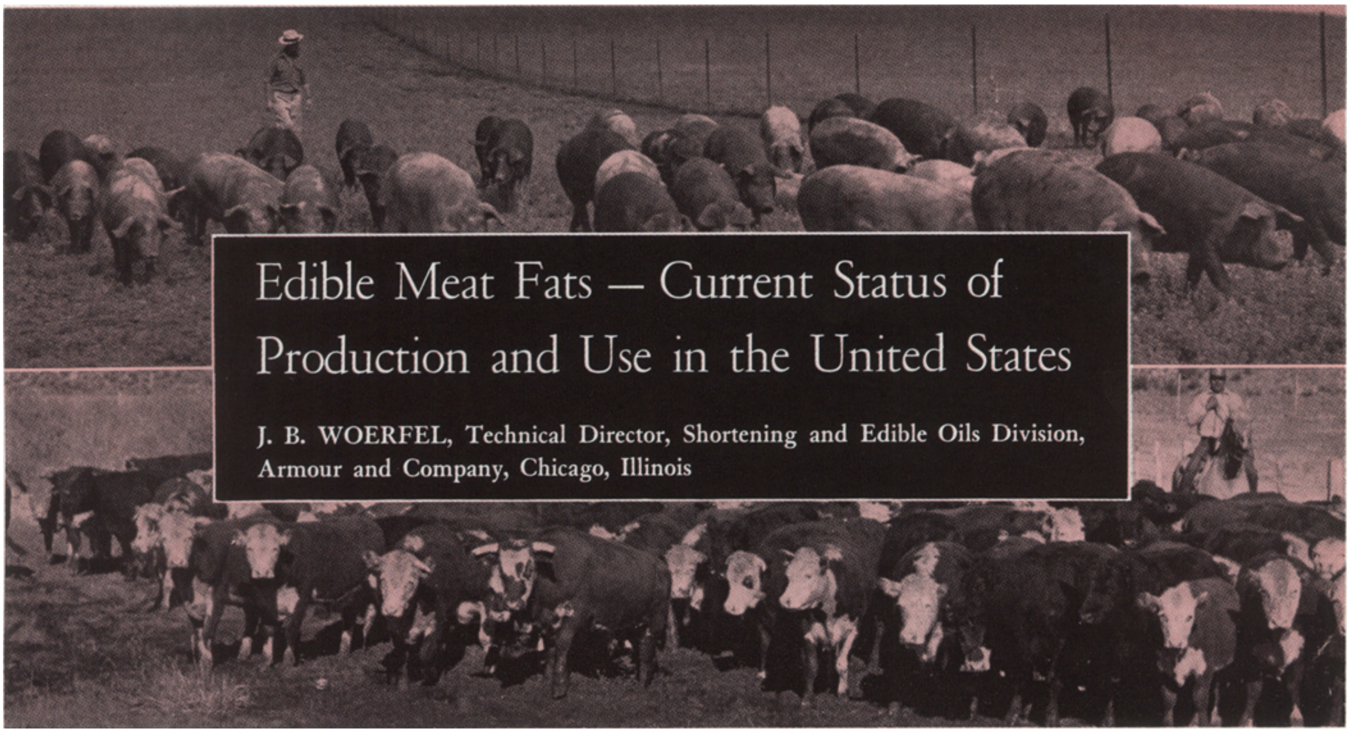

Edible Meat Fats — Current Status of Production and Use in the United States

J. B. WOERFEL, Technical Director, Shortening and Edible Oils Division, Armour and Company, Chicago, Illinois

Meat fats have been one of the most important sources of food fats for man ever since he became a hunter. The designation "meat fats" was recognized by the Meat Inspection Division of the USDA about 12 years ago as a proper labelling term for those edible fats which are by-products of the meat packing industry. The term "animal fats," which had previously been used, is obviously less specific since it includes any fat of animal origin including butter.

The two important sources of meat fats are pork and beef. Mutton fats are in such relatively small supply as to be unimportant as an edible fat, although some processors render small quantities with their beef fats. The fats from pork are classified as lard and rendered pork fat. They are established by the regulations of the Meat Inspection Division, which exclude certain types of raw fats from lard production and specify that these fats be rendered separately and designated Rendered Pork Fat. Rendered Pork Fat, while completely wholesome, may be slightly inferior to lard in color, free fatty acid content and flavor. However, as a raw material for shortening or margarine production, it is essentially equivalent to lard.

Beef fats include edible beef tallow and the oleo products. Oleo products differ from ordinary beef tallow in that only the highest quality raw fats are selected and rendered at temperatures not exceeding 170F. Under these conditions a very desirably mild flavored fat is produced which is designated Oleo Stock. Some Oleo Stock is sold and used as such, but by far the greatest portion is fractionally crystallized to produce about 70% of a low melting fraction, Oleo Oil, and 30% of Oleo Stearine. It is interesting to note that the oleo process is an ancient one and the original source of fat for oleomargarine. Today, no oleomargarine is made from this source.

Currently, meat fats account for slightly more than 20% of the total production of edible fats in the United States. Since these are by-products, the volume produced is limited by the production of livestock. Table I gives the production of edible meat fats for a number of years.

In recent years, approximately 85% of lard and rendered pork fat was produced in federally-inspected establishments, 10% in other commercial establishments and 5% on the farm. As would be expected, farm production has shown a steady decline for many years. It is interesting to note that the production of lard and rendered pork fat has remained fairly constant at about 2,500 million pounds yearly for several years. In the case of lard, these production figures closely reflect the available supply of edible raw material for rendering since the market for edible fats is consistently above the market for inedible greases, and good business practices dictate saving the fat for edible use wherever possible.

In view of these conditions, it is somewhat surprising that the production of lard has not increased along with the increase in the number of hogs slaughtered. However, the long sought aim of the meat industry to market leaner meat type hogs is nearing realization and the yield of lard per hog is down sharply in the past five years even though the live weight of the hogs marketed has not decreased. In the two most recent years, hogs have yielded an average of just over 29 pounds of lard per head as compared to averages of 32–33 pounds five to ten years ago.

In contrast to lard production, the production of edible beef fats has moved steadily upward, more than doubling in ten years. Here the most important factor has been a steadily increasing demand for edible beef fats as shortening raw materials which has diverted them from inedible channels. This demand has greatly improved the market value of edible beef tallow; ten or twelve years ago, it sold as much as 4 cents a pound below lard, while in the past two years it has sold at approximately the same level and at times, slightly above the price of lard. This reflects improved technology

(Continued on page 13)

TABLE I
Production of Meat Fats
Millions of Pounds

	Avg. 1947–51	1954	1955	1956	1957	1958	1959	1960	1961	1962	Forecast 1963
Lard and rendered pork fat	2625	2567	2852	2614	2423	2679	2762	2484	2471	2480	2500
Edible beef fats	162	280	312	321	324	343	347	419	444	450	460

Source: "Fats and Oils Situation," Economic Research Service, USDA.

Edible Meat Fats . . . .

(Continued from page 4)

in the use of beef fats as a shortening material and increased acceptance by consumers of shortenings containing meat fats.

Rendering of Meat Fats

Meat fats have customarily been recovered from the fatty tissues by rendering, which in effect is the process of cooking to break down connective tissues and release the fat. The most commonly used method continues to be wet or steam rendering. Raw fats from the killing or cutting operations are charged to closed pressure tanks and steam admitted directly to the tanks to cook the fats for several hours under steam pressure. This treatment solubilizes the proteinaceous connective tissues and the fat is separated by settling the contents of the tank and drawing off the aqueous layer, called stick, and the fat separately.

Numerous improvements in the steam rendering process have been introduced in recent years. These include hashing the fats and rendering at higher pressures to decrease the rendering time. Settling and drawing the tanks while maintaining the pressure, also results in decreased time as compared to the older practice of releasing the pressure before settling. A third improvement consists of vacuum drying and filtering the lard, rather than settling in tanks to reduce the moisture and protein residue. Alternately, centrifuges have been successfully used to separate residual moisture and protein. In addition to substantial reduction in time and space requirements, these improvements result in substantially better quality lard.

Dry rendering, using open kettles or more commonly dry melters, is the oldest known method of recovering meat fats. Its popularity as a method for rendering edible fats is declining because of certain inherent difficulties in achieving the quality desired in today's market, although when properly performed, excellent quality fats may be produced. Some of the problems which are encountered are high color, if the temperature is carried too high, and a difficult-to-remove proteinaceous residue and soluble phospholipid material which, unless removed, gives difficulty in further processing of the fats. Many existing installations for dry rendering lard are still in use, although little edible tallow is currently rendered by this method. Some attempts at improving the dry rendering process which were described several years ago have not gained widespread acceptance.

The most important development in edible rendering processes in recent years has been continuous low temperature rendering. Several processes are currently being marketed and have proven extremely successful. These depart from the traditional concept of rendering by cooking and depend instead upon sophisticated mechanical devices to separate the fat. Typically raw fats are hashed and comminuted to rupture the fatty cells. They are then rapidly heated to moderate temperatures in a heat exchanger. The fat and protein residue are then separated in a series of specially designed centrifuges. The yield of fat from continuous low temperature rendering is not as high as from conventional steam or dry rendering. However, this is not a serious disadvantage since the residue from these systems may be used edibly in sausage and similar products and when so used, has substantially higher value than the residues from the other methods which are only usable in animal feeds. The protein portion is described as partially defatted beef or pork fatty tissue depending upon the species from which the raw fats were taken.

Continuous rendering plants are extremely compact, reducing space requirements substantially. The accompanying illustration shows a complete package system set up and ready for shipment. Such plants process up to six tons per hour. Alternately, many users prefer to purchase the individual elements and do their own engineering in adapting the process into their existing plants.

Continuous rendering has been particularly useful for rendering edible beef fats. Here it has very successfully replaced the low temperature open kettle rendering of fats for oleo oil production. In this application it has proved much more economical than the older process, while producing a higher yield of better quality oleo stock. The quality improvement results from the more rapid handling of the fats and the more complete removal of proteinaceous materials.

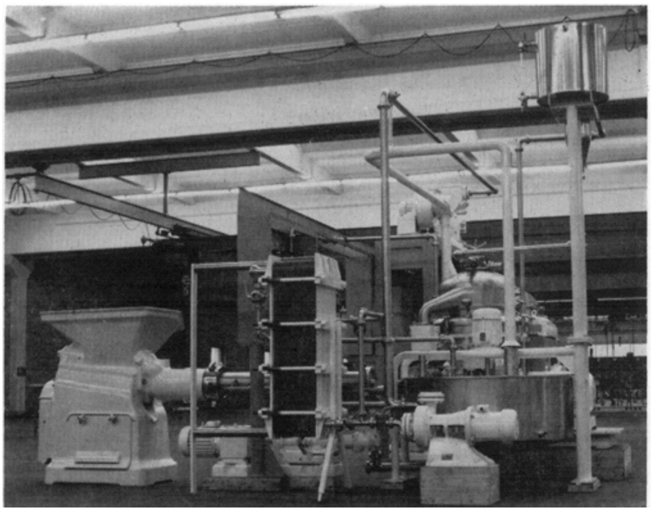

FIG. 1. A complete package system for continuous rendering, set up and ready for shipment and capable of processing up to six tons per hour, reduces space requirements substantially.

The acceptance of continuous rendering for lard production has not been as rapid as for edible beef fat production. The economic advantages over steam rendering are not sufficiently great in many cases to justify the additional capital outlay to replace a satisfactory existing system. In new plant installations, however, the economics are very favorable for the continuous systems because of space requirements, and most new packing plants are including them in their design.

Usage of Meat Fats

Substantial quantities of lard, and limited quantities of edible beef fats, primarily oleo oil, are explored. Lard exports go mostly to European and Latin American countries. In recent years, bulk shipment of lard in tanks to Europe has almost entirely replaced shipment in drums, cartons and boxes which were common a few years ago. Lake ports such as Duluth and Chicago have become major shipping points since the opening of the St. Lawrence seaway. Shipments to Latin America are commonly in 5-gallon cans holding 37 pounds each and in smaller 3- or 5-pound cans or 1-pound cartons. The volume of export is influenced by a great many factors which cause it to vary erratically. In the years 1952–1963, exports have varied from 394 million to 662 million pounds yearly.

Except for that exported, almost all of the edible meat fat produced goes into food use. The major part of the lard goes into retail and wholesale consuming channels as lard. This outlet is, however, shrinking as evidenced by the figures of per capita consumption of lard sold as such. In 1940, the per capita consumption was more than 14 pounds while in recent years it has been between 7 and 8 pounds.

The most dramatic change in the consumption of meat fats in recent years has been their rapidly increasing use in shortening and, to a lesser extent, in margarine. The use of meat fats in shortening is not new, since it dates back to shortly after the Civil War when beef fats were blended with cottonseed oil to make "Lard Substitutes." Substantial production of these products continued until about 1940, but then rapidly declined because of pressures from hydrogenated vegetable oils. In 1946 only 20 million pounds of lard and 58 million pounds of edible tallow were used in shortening production, or only about 5% of the total fats and oils used for this purpose. From this low point, the production of meat fat shortenings has shown a steady improvement as illustrated by the bar graph in Figure 2. In 1962, meat fats accounted for more than one-third of all of the raw material used in shortening manufacture.

The resurgence of meat fat used in shortening has in a

(Continued on page 16)

(Continued from page 13)

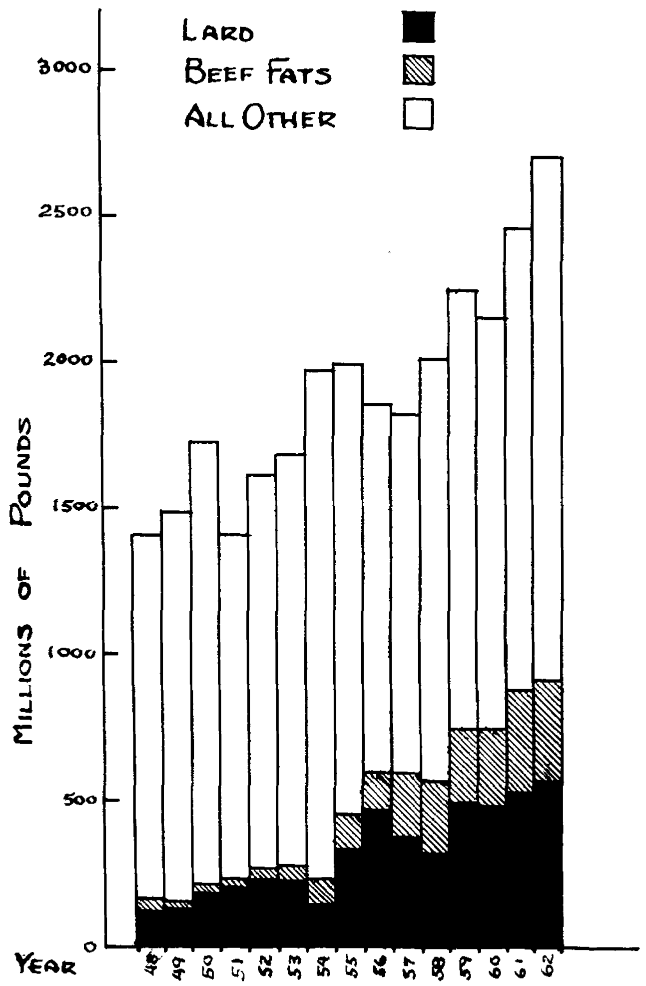

FIG. 2. Fats and oils used in shortening manufacture.

large measure been due to changed technological concepts. Whereas earlier meat fat shortenings had been sold as cheap substitutes, first for lard and later for hydrogenated vegetable oils, improved technology has enabled meat fats to be used in the production of high quality shortenings which are accepted on their performance merits and not on the basis of price alone. In today's market there is a growing tendency to disregard the old classifications of shortenings based on raw materials and instead to accept them on the basis of performance. Simultaneously, the development of convenience foods and mechanization of conventional food processing has created a need for highly specialized shortening products to fit these manufacturing operations. Under these circumstances, shortening manufacturers have seen fit to use all of the available raw materials in the most efficient manner and to interchange them freely for greatest economy.

While a few years ago meat fat shortenings were largely the province of the meat packer as an outlet for his by-product fats, today practically all shortening manufacturers have adopted the use of meat fats. Of the 18 manufacturers listed in the directory of the Institute of Shortening and Edible Oils, 16 have Meat Inspection in one or more of their plants to permit them to use meat fat. Several of these were exclusively vegetable oil processors until recent years. Simultaneously, meat packers have found it desirable to enlarge and improve their refineries to produce completely processed shortenings, from both meat fats and vegetable oil, or to eliminate their refineries and sell their rendered fats as raw materials to shortening manufacturers. Many in the industry foresee the time when the largest part of lard production will move into consuming channels in the form of shortenings, margarine and other highly processed fats.

Meat Fats as Shortening Raw Materials

Quality criteria for meat fats used as raw materials for shortening vary in some respects from the traditional quality criteria for refined lard. However, the refiner who is processing both refined lard and shortenings prefers the raw material to be useful for both types of product.

Free fatty acid has been an accepted criterion of meat fat quality. Free fatty acid increases with the length of time the fat is held before rendering. Prime steam rendering normally results in a higher free fatty acid content than does dry rendering or continuous rendering. Commonly, in the past, a maximum free fatty acid of .50% for lard and 1.00% for edible tallow has been considered reasonable. While a high free fatty acid content in itself is not detrimental for most uses, it is frequently indicative of other defects. Most importantly for processing, however, the free fatty acid will be proportional to loss in deodorizing. As a rule of thumb, the deodorizing loss will be double the free fatty acid content. Therefore, there is an economic incentive to keep free fatty acid at a minimum, and most processors establish specifications for their raw materials at the values mentioned above or even lower.

As has been mentioned before, dry rendered lard may contain an appreciable content of proteinaceous and soluble phospholipid material. At high temperatures this material will pass through a conventional filter. Filtering at a low temperature or water washing is required to remove it. If this material is not removed prior to hydrogenation and deodorization, color problems are encountered resulting in dark off color shortening.

The color of rendered beef tallow is in itself not of prime importance. Bleachability is a better criterion of quality. The natural pigments of beef fats may contribute a very dark color, but they are easily removed by a very light bleaching. However, some fats which have the color "set" by overheating may resist bleaching and cause considerable difficulty in bleaching. An acceptable quality edible tallow can be bleached to less than 1.0 red color (5¼″ Lovibond) using the standard AOCS procedure.

Modern deodorizing practices will remove any of the off flavors and odors likely to be encountered in meat fats. However, off flavors in lard are persistent through the normal refining used in producing packaged lard and, hence any off flavor raw material must be segregated and used only in deodorized shortenings. Obviously, this is a distinct disadvantage in a plant producing both lard and shortening and, therefore, off-flavor product is subjected to rejection or discount.

The stability of meat fats is greatly enhanced by the addition of antioxidants. The effect is greatest when they are added to fats with good initial stability. It is considered good practice, therefore, to add small quantities of antioxidants to meat fats being shipped as raw materials to another plant to reduce the effect of oxidation during the shipping and storage. BHA or a combination of BHA, Propyl Gallate and Citric acid are commonly added at a fraction of the levels permitted by the MID. These are almost quantitatively removed by the deodorization process and additional amounts are added to the finished shortening.

Both lard and edible tallow vary considerably in their physical characteristics. The greatest difference is in internal and killing fats which are higher melting or "harder" and the external or cutting fats which are lower melting or "softer." These differences can be extremely important in producing meat fat shortenings since it necessitates varying the proportion of different ingredients to make shortenings of uniform characteristics.

Large integrated meat packing plants will normally have uniformly hard fats, while establishments which do no slaughtering and render cutting fats exclusively will have substantially softer ones. Table II lists the range of SFI congeal and IV for beef tallow and lard which are commonly encountered today.

Shortening Manufacture

Meat fats are today processed by all of the customary

(Continued on page 38)

Edible Meat Fats . . .

(Continued from page 16)

TABLE II

Typical Range of Physical and Chemical Properties of Meat Fats

	Edible tallow	Lard
Solids Fraction Index at 50F	30–46	24–37
70F	20–35	18–31
80F	16–31	13–20
92F	13–28	4–8
104F	7–19	1–5
Iodine Value	48–37	67–58
Congeal °C	35–42	26–33

methods of the fats and oils industry including bleaching, hydrogenation, deodorization and chilling and tempering. The shortening manufacturer employing a variety of raw materials uses the same basic equipment, and variations dictated by the raw material are only in operating techniques related to the art of manufacture.

The one process which is most specifically adapted to lard is molecular rearrangement. This process, which was commercially introduced to lard processing in 1952, has such a profound effect on the physical characteristics of lard that in many plants molecular rearranged lard is considered a separate and distinct raw material. Rearranged lard has a number of advantages over straight lard in certain types of shortening. In fact, without rearrangement, lard cannot be used in some of these products. Shortenings for use in bakery items such as cakes and icings, where the shortening enters into the creaming or aeration process, are typical. Rearrangement also overcomes the tendency of lard to undergo crystal transformation which causes unstable shortening textures and loss of surface gloss.

Hydrogenation is not used as widely on meat fats as it is on vegetable oils. Since meat fats are naturally plastic fats, completely satisfactory shortenings can be made simply by selection and blending without the expense of hydrogenation. However, where maximum stability is required, such as for deep fat frying or for biscuit and cracker use, moderate hydrogenation is used. This rarely exceeds an iodine value change of 15 points and benefits are obtained with as little as 2 or 3-point change. Completely hydrogenated tallow and lard may be added to relatively soft fats to control plasticity and increase plastic range. Levels of up to 15% of fully hydrogenated tallow or lard are used. Lard sold as lard can only be hardened with hydrogenated lard. In shortenings, hydrogenated tallow is preferred because it directs crystal formation to the desired form.

Bleaching of meat fats is normally very easily accomplished. Good quality meat fats ordinarily require only the lightest treatment with bleaching earths or in many instances, may bleach sufficiently under the high temperature in the deodorizer.

The deodorization of meat fats is easily accomplished in modern equipment. While the high free fatty acid content produces appreciable losses, the removal of flavors and odors is rapidly accomplished to produce very bland shortenings.

Almost all meat fat shortenings contain antioxidants. Those commonly used are propyl gallate, NDGA, BHA and BHT. Usually they are used in combination with a chelating agent such as citric acid. Stabilized meat for shortenings have excellent oxidative stability and resistance to flavor reversion. Typically, stabilized meat fat shortenings will have a minimum stability by the AOM method of 75 hours or, if hydrogenated, of 100 hours.

With the growth of convenience foods and the centralization and mechanization of bakeries and other food processing establishments, there has been an increasing demand for specialized shortenings. Processors making single items in large quantities benefit greatly by having shortenings specifically designed for optimum performance in this one particular operation. A wide array of shortening types are made today containing meat fats alone or combined with vegetable oils.

Index to Advertisers