Cottonseed Oil and Meal

The cotton plant produces three important commodities, of which cotton fiber is only one. The other two, both derived from cottonseed after it is ginned, are oil and meal. Cottonseed production in the United States runs between 3 and 6 million tons per year, depending on the size of the cotton harvest. Price fluctuates with production, and the value of cottonseed in recent years has fallen as low as $304 million (in 1985) and risen as high as $718 million (in 1988). About 80 percent of U.S. cottonseed production is crushed for oil; most of the cottonseed meal that remains after oil is extracted is used to feed cattle.

Except for the size of the dollar figures, the words above might have been written 50 years ago, when the Southern center was under construction. Farm production of cottonseed has neither increased nor decreased much since then, nor has production of oil and cottonseed meal. And the meal is still used primarily for cattle feed.

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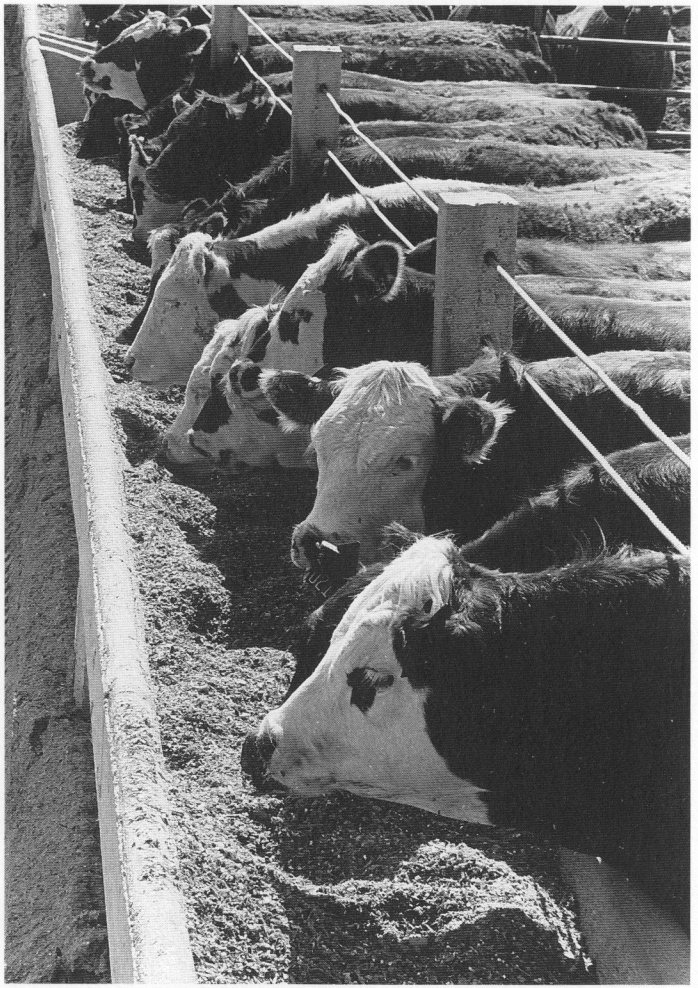
Chief reason for the absence of industry growth has been competition from other vegetable oils, just as cotton fiber has suffered from competition from synthetics. Like the SRRC textile scientists, oil and protein chemists at the Southern lab have had to run very hard for five decades to help keep the cotton industry in about the same statistical place. When one considers all that has happened in the last half century, however, their achievements have been nothing short of remarkable. SRRC research has led to new or improved methods in every phase of processing cottonseed and contributed materially to the overall operating efficiency of oil mills and to new and improved cottonseed products.



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Cottonseed oil was the first domestic vegetable shortening marketed in the United States. Cottonseed had been crushed and oil extracted ever since the mid-19th century. For many years, most of it went into soap. In 1911, Crisco, made from hydroge-

nated cottonseed oil, appeared on the market. Along with several competing shortenings, it is still sold today. For many years, lard was its only competitor, and when the regional labs began, cottonseed oil shortenings were a well established product.

But there were drawbacks as well as advantages to being an older industry. For one thing, oil processors at the end of World War II had a substantial investment in outmoded equipment. More than half the U.S. cottonseed oil in 1946 was extracted with hydraulic presses, and another 25 percent was squeezed from seed with old screw presses. Change came slowly. At an industry clinic held in 1952, an SRRC scientist described a new cottonseed solvent extraction process called filtration-extraction. It was the first of several new extraction procedures devised in the next 10 years. Some form of solvent extraction is used widely throughout the world today for many different oilseeds.

There were many successes. By 1966, an estimated $533,000 in oilseed processing research in New Orleans had resulted in a cumulative net value added of more than $41.4 million. New products made from cottonseed oil emerged from basic research on fats and oils, creating new markets for surplus oilseed crops. One new group of chemicals discovered at SRRC were acetoglycerides, derived from fatty acids. Some of these new compounds can be formed into thin, stretchable films for a variety of uses in the food and cosmetic industries. Since the films are edible, for example, they can be used harmlessly as lubricants on machinery that comes in contact with food. They are also useful as emulsifiers, plasticizers, and coatings to retard oxidation and moisture damage. Today, six American manufacturers sell more than 1,000 tons of acetoglycerides annually.

Sucrose esters were another chemical invention—doubly valuable because they were made in part from derivatives of two surplus crops: sucrose or table sugar, from sugar cane or beets, and fatty acids from cottonseed oil. The compounds are used today as emulsifiers, stabilizers, and texturizers in baked goods, baking mixes, biscuit mixes, frozen dairy desserts, and whipped milk products. They are also components of coatings for apples, bananas, and pears to retard spoilage, and a highly publicized (but not yet approved) fat substitute appears to be based on SRRC research on sucrose esters.

Cocoa butter, from which chocolate candy is made, is solid at room temperature but melts when placed in the mouth. SRRC scientists chemically modified cottonseed oil, giving it properties similar to that of cocoa butter. (This research is comparable to similar transformations effected with animal fats, mentioned in the previous chapter.) The confectionery fats from cottonseed oil are now being used by the candy industry.

Patients recovering from serious wounds or surgery, and who have to be fed intravenously for long periods, often lose weight when they need their strength most. SRRC chemists developed a high-calorie, nontoxic fat emulsion for intravenous feeding now used by many hospitals for postoperative care. The fat is provided by purified cottonseed oil; the emulsifier is egg lecithin. Patients fed with the emulsion, including wounded military personnel, make satisfactory weight gains and heal more quickly than before.

Cottonseed foots, the settlings from stored crude cottonseed oil, were used to make soap until petroleum-based detergents turned them into a surplus product. SRRC researchers found that treatment with wood alcohol turned the foots into a methyl ester product, now marketed as an additive for high-protein feed.

Haunting the industry, however, like two evil spirits, have been gossypol and aflatoxin. Gossypol is a toxic yellow pigment that is contained in tiny pigment glands no larger than a pinprick. They are scattered throughout the kernel of a cottonseed. While cattle can eat cottonseed meal containing gossypol without ill effects, it is unsuitable for feeding poultry and swine. Chickens fed meal high in gossypol, for example, lay eggs with pink whites and green yolks. A major aim of SRRC research, therefore, has been to expand the market for animal feeds by getting rid of the gossypol.

Aflatoxin, a potent carcinogen created by two molds that can grow on cottonseed and other commodities under certain environmental and storage conditions, has also occupied researchers in the Southern lab since its effects were first

observed in the 1960's. Aflatoxin posed a serious problem for cottonseed processors, who were unable to market seed and meal because the extent of contamination was not known. SRRC scientists developed reliable analytical methods for aflatoxin detection and provided standard samples of aflatoxins. These became the official analysis methods for oilseeds and have been used for 20 years by oilseed processors to guarantee a supply of toxin-free products for feed (see "Food Safety," p. 97).

One answer to gossypol was the liquid cyclone process, invented in New Orleans in the 1950's. Agitating the seeds in a solvent such as hexane separated cottonseed meal into two fractions. One fraction, which contained very little gossypol, could be ground into a high-protein cottonseed flour for human consumption. The other, containing 50 percent protein and most of the gossypol, still made a satisfactory feed for cattle. Satisfactory flour and poultry feed were produced from the process, which has been tried on a small scale in this country and abroad, but competition from other products has so far prevented widespread adoption.

So has discovery by a California ARS researcher of a glandless cotton containing little or no gossypol. It has so far been unpopular with many growers, who report lower yields and insist that the absence of gossypol leads to increased insect damage to the cotton. It appears likely that toxic gossypol is a natural defense of the cotton plant against insect pests. Enough glandless cotton is currently planted, however, to supply a plant in Texas that manufactures cottonseed flour, and this industry could expand in future years with increased world demand for protein. Cottonseed flour is a highly nutritious product with up to 70 percent protein, and it can be added to almost any food without changing the taste or texture.