Getting Protein From Cotton Seeds

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From cotton we get more than 4 million tons of cottonseed a year, worth about 250 million dollars on the farm in 1950. From cottonseed we get shortening, margarine, cooking oils, and feeds that are high in protein.

Cottonseed meal and cake, of which we produce approximately 2 million tons annually by extracting the oil from the cottonseed, are an industrial source of raw materials for making adhesives and protein fibers. Further industrial utilization of the proteins would add much to the value of the cottonseed and strengthen the agricultural economy of the South.

Plywood glue from cottonseed meal is prepared by mixing 100 pounds of meal, 3 pounds of borax, 2 pounds of caustic soda, 1.5 pounds of potassium permanganate, 15 pounds of lime, and 8 pounds of copper sulfate with water. Combinations of cottonseed meal with casein, soybean meal, or synthetic resins also can be used to make a plywood glue that is water-resistant and nonabrasive.

Plastic compounds containing equal parts of phenolic resin, cottonseed hulls, and cottonseed meal have good flow properties and can be cured in a relatively short time at temperatures of 320° to 360° F. The water absorption of the plastic after molding is less than 0.8 percent in the first 24 hours, and the strength of cottonseed-meal plastic is about equal to the strength of phenolic plastics. Small radio cabinets have been made from plastics that contain phenolic resins and cottonseed products.

Fire-extinguishing liquids are prepared from cottonseed meal by mixing the meal with lime solution and heating the mixture at temperatures of 200° to 210° F. for 2 hours. The suspension is clarified by filtering to remove the insoluble part of the meal. The protein-lime solution is neutralized by the addition of mineral acid and concentrated by evaporation to 30 to 45 percent of solids. When this protein solution is stirred, a dense and stable foam is produced.

COTTONSEED PROTEIN is made by removing the oil from the seed and then extracting the protein from the cottonseed meal. The first step is to produce an oil-free cottonseed meal that contains proteins soluble in dilute salt or sodium hydroxide solutions.

The two general methods of removing the oil from cottonseed are mechanical pressing and solvent extraction. The solubility in different solvents of cottonseed protein in the meal is determined primarily by the temperature and the duration of heating or cooking to which the cottonseed kernels (meats) have been subjected before, during, or after extraction of the oil. Knowledge of the physical composition of cottonseed proteins is essential to the establishment and control of conditions that must be followed during removal of the oil from the kernels to produce an oil-free meal containing highly soluble and relatively unchanged protein.

If the oil is to be removed by mechanical pressing, it is customary to cook the kernels at temperatures of 175° to 250° F. for several hours before pressing. The cooking makes it easier to separate the oil from the other constituents of the seed. But cooking reduces the solubility of the protein of the residual meal, and, because the cooking practices vary in different oil mills, only about 15 to 50 percent of the total protein dissolves in sodium hydroxide solutions.

If the oil is separated from cottonseed kernels by extraction with organic solvents at room temperature and the oil-free meal is air-dried at the same temperature, about 95 percent of the protein dissolves in relatively concentrated sodium hydroxide solutions. If low-boiling solvents (petroleum naphthas and alcohols) are used to extract the oil at temperatures near the boiling point of the solvent and the oil-free meal is dried at temperatures of 120° to 150° F., however, only about 85 percent of the total protein is soluble in the same sodium hydroxide solutions.

To produce an oil-free cottonseed meal for the protein extraction, therefore, the oil has to be removed from very thinly rolled cottonseed kernels by means of organic solvents at low temperatures, whereupon it is possible to dissolve the protein in salt or sodium hydroxide solutions.

Six steps are necessary to extract the protein from cottonseed meal: (1) Preparation of a water-meal mixture (slurry) in a weight ratio of 10 pounds of water to 1 pound of meal; (2) addition of sodium hydroxide, salts, or other substances to dissolve the protein; (3) separation of the solution containing the protein from the insoluble part of the meal; (4) addition of coagulating chemicals, such as sulfur dioxide or sulfuric acid, to precipitate and coagulate the protein; (5) separation of the precipitated protein curd from the solution; and (6) drying of the curd. About 50 to 60 percent of the protein contained in solvent-extracted cottonseed meal can be separated from the meal in the form of dried protein.

PROTEIN FIBER is made from the protein contained in cottonseed meal. Cottonseed protein is mixed with water. Sodium hydroxide is added to yield a thick, molasseslike solution. The solution is forced through a die, which contains many small holes, into a solution of sulfuric acid and sodium sulfate. The protein is coagulated, and a threadlike plastic fiber is formed. The fiber is withdrawn from the acid-salt solution, stretched, and reacted with other chemicals. When it is dry, the fiber is yellow or orange and has the soft feel of wool. The process resembles the one the silkworm uses to make silk.

Cottonseed-protein fiber has potential value as a supplement to our domestic wool supplies and for use in furniture, mattress, and air-filter materials, in which its yellow-orange color is not objectionable.

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HISTORIANS BELIEVE cotton originated in India, perhaps about 3000 B. C. The ancient Brahmans, highest in the caste sysem, were required by one of their oldest laws to use sacrificial threads made of cotton. By the time the first European travelers reached India, the wealthier Hindus were wearing turbans of such finely woven muslin and calico that poets called them "webs of woven wind."