Industry News

Central Soya adopts VPA

Central Soya Co. Inc. has announced it has adopted automated direct gas chromatographic analysis of volatiles in soybean oil as a quality control and marketing procedure.

The original method of volatile profile analysis (VPA) was developed at the USDA Southern Regional Research Center in New Orleans with Harold Dupuy as the principal investigator.

Basically, what Central Soya has done is to automate Dupuy's system of determining the presence or absence of volatiles that could lead to off-flavor oil. The lack of volatiles in what Central Soya will term its "fingerprint" oils will be an indication of their consistency and quality, the company said during news conferences in Chicago and in Fort Wayne, Indiana.

Central Soya apparently is the first firm to use an automated gas chromatograph analysis as part of its routine quality control and marketing system, although other firms have or are using volatile analysis in laboratory or quality control work.

Central Soya said the method also may be used to monitor the effects of processing conditions, evaluate the effects of storage conditions, follow changes in oils during shipment, or even to monitor changes in quality of finished products.

Dupuy told the news conferences he developed the method as an alternative to taste panels. The automated system, he noted, was developed by correlating results with taste panels, but an instrumental method doesn't take holidays or vacations and should not be affected by the variables that might affect a taste panel member's perception of taste changes in oils.

Central Soya, which started marketing refined oils in the 1970s, believes the gas chromatograph analysis will assure suppliers of consistent oil quality and thus increase the firm's market share. If competitors adopt the same system, Central Soya believes, then the competitors also will have to adopt refining quality standards Central Soya maintains, which will make Central Soya's prices more competitive.

Central Soya's Mark Flanagan, vice president for refined oils, told of one processor who is using Central Soya soybean oils to replace coconut oil in a coffee whitener after a one-year shelf life test. That incident illustrates the quality of Central Soya oils, and why the firm was anxious to find an instrumental technique to validate the firm's claims of quality products, he said.

Dupuy said the original method was developed in cooperation with the AOCS Flavor and Nomenclature committee, other researchers at the USDA Southern Regional Research Center, as well as other throughout industry, academia and government.

Dupuy said Central Soya's adaption carries the instrumental approach to the furthest he has seen. "The level of instrument sophistication and automation is outstanding. Temperatures are controlled to a fraction of a degree and time is controlled within seconds to ensure the results can be reproduced. If this determination were to be applied throughout the food industry, the potential for product excellence would be limitless."

Dupuy believes the system has applications in other food systems as well. Since retiring from USDA he has become a professor with the Department of Food Science and Technology at Virginia Polytechnic Institute.

Staley buys plant

A.E. Staley Manufacturing Co. has purchased the Van Buren, Arkansas, plant of Diamont Shamrock Corp.

Staley, one of the nation's largest soybean processors and corn refiners, will use the facility to produce several petrochemical replacement products from carbohydrates. The company will begin the operation in early 1983 following modifications to the facility, which previously produced vitamin supplements for livestock feed.

The initial annual capacity of the plant is expected to be more than 30 million pounds. Raw material used will be corn products transported by rail from Staley corn refining operations in the Midwest.

Lilachim contract

The board of directors of Lilachim, Belgium, has signed processing contracts with Kenogard and Oleofina which will separately assume the marketing responsibility for their products. Lilachim is a joint venture company in which Oleofina and Kenogard hold equal shares. The company produces such cationic fatty acid derivatives as fatty amines, fatty diamines, quaternary ammonium salts and other fatty nitrogen compounds in a plant near Antwerp. Oleofina, the oleochemical affiliate of the Belgium Petrofina Group, sells fatty acids, glycerine, metal stearates, fatty acid esters and food emulsifiers produced in plants near Antwerp and Ghent. Kenogard, a Kemanobel company, produces specialty chemicals such as plant and wood protection chemicals and surface active agents. It is the largest Swedish chemical corporation.

TUNS funding increased

A $1 million program to improve fisheries research at the Technical University of Nova Scotia (TUNS) has been announced.

The funds will be available over a five-year period for a new center of advanced fisheries technology, to be known as the Canadian Institute of Fisheries Technology. The grant is designed to improve the laboratory capabilities to aid industry and to attract more graduate students into the field. Long-time AOCS member Robert Ackman is one of the key faculty members at the institute.

Feed additive market analyzed

Reflecting conditions in the European Economic Community's animal feed compounds market, sales of related additives are projected to increase modestly during the current decade.

According to a study by Frost & Sullivan Inc., New York, production in such categories as antibiotics, antioxidants, coccidiostats, emulsifiers, stabilizers, surfactants, colorings, minerals, growth factors and vitamins will escalate about 8.8% between 1980 and 1991. However, production of flavors is projected to jump 143%, from 142,000 metric tons to 345,000 metric tons, while sales of crop preservatives are predicted to climb 348%, to 179,000 metric tons from 40,000 metric tons.

Rutgers gets grant

National Starch Company has once again donated $5,000 as an unrestricted grant for research and teaching in the Food Science Department at Rutgers University. "Such grants enable the Food Science Department to maintain high standards of research and teaching," department Chairman Stephen S. Chang said.

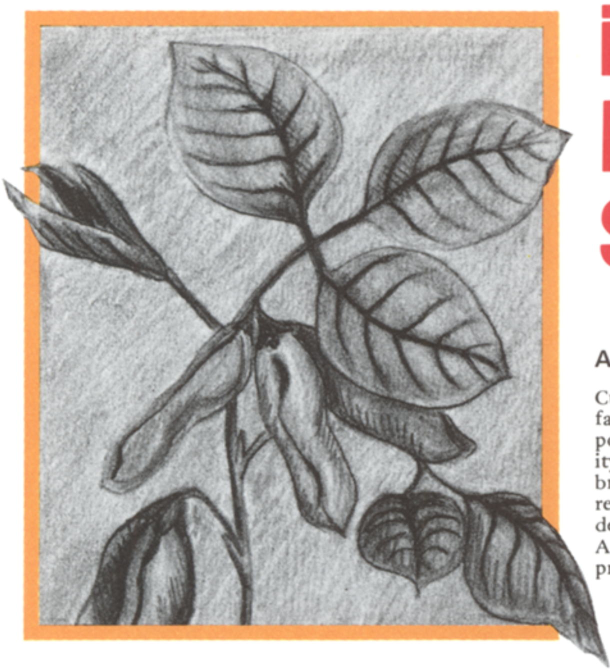
Soy oil brochure published

"America's Renewable Oil Resource" is the title of a new American Soybean Association flyer on use of soybean oil as a chemical feedstock. Chemical firms interested in obtaining a copy should contact David Erickson, Soy Oil Programs, American Soybean Association, PO Box 27300, St. Louis, MO 63141. The flyer discusses soy oil's availability, cost, as well as current and potential uses in the chemicals industry.

Stepan Hall dedicated

A $9.3-million chemical research facility was dedicated October 2-3 by the University of Notre Dame. Named Stepan Chemistry Hall after the Stepan Chemical Company of Northfield, Illinois and its founder, Alfred C. Stepan Jr., the five-story structure has 45,000 square feet of laboratory and instrumentation space, as well as offices, seminar rooms, animal rooms, computer terminals and machine, electronics and glass shops.

Researchers Report Gains in Hunt for Low-linolenic Soybeans



ABSTRACT

Current U.S. soybean varieties produce an oil with 7% to 9% linolenic fatty acid content. Edible oil producers spend 3 to 5 cents per pound to partially hydrogenate soybean oil to avoid flavor instability problems associated with lineolenic fatty acid content. Plant breeders are seeking to develop a commercial soybean variety with reduced linolenic content, preferably under 4%. Several researchers describe their efforts to isolate a low-linolenic soybean variety. Another major hurdle is breeding that trait into strains that will produce yields comparable to today's varieties.

Reducing linolenic acid levels in soy oil will not be an easy task. Relatively high linolenic acid levels make soy oil more expensive to process than other vegetable oils. Processors hope researchers can develop varieties with naturally low linolenic acid levels.

Several researchers are tackling the problem—and with some progress. At least one existing line with naturally low linolenic acid levels has been identified by U.S. Department of Agriculture (USDA) scientists in Illinois. Researchers in Iowa have bred low linolenic acid levels into another line. But other agronomic factors need improvement, so seed will not be available on a commercial basis for many years.

When seed does become available, there is no guarantee that soybean growers will plant it without some extra incentive from industry, or a natural incentive, such as improved disease and insect resistance or higher yields.

Another factor is the nutritional value of linolenic acid. Researchers are finding out more about the metabolism of this nutrient. Its longer chain derivatives seem to be important in lipids of the brain, eyes and central nervous system. Vegetable oils, especially soy and rapeseed, supply linolenic acid in appreciable amounts, reports Joyce Beare-Rogers, chief, nutrition research bureau, Canadian Department of Health and Welfare, Ottawa, Canada.

Linolenic acid levels now run from 7–9% in soy oil, says Keith Smith, American Soybean Association (ASA) director of research.

Linolenic acid is often blamed for most of soybean oil's flavor stability problems. Its three double bonds make linolenic acid very susceptible to oxidation, explains Dave Erickson, ASA soy oil programs director.

In the 1940s, soybean oil was introduced into a technology geared for cottonseed oil. Since soybean oil was more susceptible to oxidation than cottonseed, more processing was required. Industry developed a process to lightly hydrogenate and winterize (LHW) soy oil. This produced a bland and stable product, comparable to cottonseed oil.

The process was expensive. Eventually, improved processing led to a refined, bleached and deodorized (RBD) oil acceptable to most large-scale users. The improved process saved 3–5 cents a pound.

Fatty acid content is affected by

growing conditions such as planting date and location, temperature during bean development and day length, Smith says. Fatty acids are synthesized by the soybean plant at different rates during pod filling, with linolenic acid percentage in soybeans decreasing rapidly during the first 30 days, then remaining constant, he explains.

Linolenic acid is formed from linoleic and oleic acids by consecutive desaturation. There is also some selective fatty acid utilization in triglyceride synthesis. "It should be possible to regulate the composition of soy oil genetically through control of oleic acid desaturation and/or the regulation of triglyceride synthesis," Smith says.

"But in some of our breeding programs, we've found genetic manipulation is often overpowered by environmental factors. "We've found the plant's environment has a major influence on fatty acid levels of the seed."

Crude soy oil's green beany flavor is removed during RBD. The flavor may reappear during storage, creating quality problems. Researchers theorize this off-flavor occurs when the linolenic acid oxidizes. Soy processors can reduce linolenic levels by hydrogenating oil, but as energy costs increase, so do processing costs. Smith estimates it costs 3-5 cents a pound to partially hydrogenate linolenic acid to acceptable levels.

Breeding out linolenic acid or reducing its levels would reduce processing costs, eliminate isomers created by the hydrogenation process and reduce off flavor problems, says Smith.

Several years ago, ASA funded research programs to determine if varieties exist that would produce naturally low linolenic acid levels or if the trait could be bred out of soybeans.

Researchers find the structure of the plant makes genetic changes difficult. "The genetic mechanism of altering fatty acid levels is much more complex in soybeans than in corn or rapeseed," Smith says.

Desaturation of oleic acid in corn is a fairly simple procedure. Two genes are involved in lowering erucic acid levels in rapeseed. But linolenic acid in soybeans is controlled by four or five genes, says Smith. Some researchers say it's too early to know precisely how many genes are involved.

Breeding progress has been slowed by lack of variability in germplasm resources, complexity of genetic control of fatty acids and environmental factors which influence formation of fatty acids.

"If we can't change linolenic acid levels genetically through new lines, then we'll have to continue to process it out," Smith says. "This research hopefully will help settle that question."

The research will help in other ways, too. "We're learning a lot about how the seed and fatty acid are put together. These are basics we need to genetically engineer the plant, for whatever reason," Smith says.

Some research employs conventional breeding techniques, while other scientists are working with mutation breeding. Still others are testing existing lines of naturally occurring low linolenic acid levels.

Walter Fehr and Earl Hammond, Iowa State University researchers, are seeking answers through conventional and mutation breeding programs. Of the two, mutation breeding seems to have brought the most encouraging results.

Fehr and Hammond treated seed from the FA9525 line with ethyl methanesulfonate (EMS), rinsed and planted the seed at Aimes, Iowa, in 1978.

After two generations were grown in Puerto Rico, seeds were planted in 1979 at Ames and the fatty acid composition analyzed. A line, designated as A5, had a linolenic acid percentage of 3.9, compared with 6.3% for the parent FA9525. The A5 line was reevaluated in 1980 at Ames and produced a 4.1% linolenic acid, compared to 6.3% for its parent. In Puerto Rico, A5 tested at 2.9%, compared with 4.3% for FA9525.

During 1981, researchers tested the seed in Georgia, Illinois, Indiana, Iowa and Maryland. At each location, linolenic acid content in A5 was rated lower than any soybean in the United States, including over 5,000 introductions from other countries. Average percentages were A5, 3.8; FA9525, 5.9; Corsoy, 7.6; and Weber, 10. A5 matures about 8 days earlier than Weber.

The linolenic acid percentage of A5 was right at 3% in Georgia tests. In 1982, more seed was planted in North Carolina. Researchers were aiming at getting enough oil with a 3% level or less for food chemists to test for improved quality characteristics.

There are still major obstalces. One is yield. Fehr says A5 was not evaulated for yield, but the plant was less productive than existing cultivars.

"We want to give the material to food processors this year to evaluate the oil," he notes. "But we're a long way from offering seed for commercial use. We still have to incorporate the trait into high-yielding material."

Researchers also are looking into existing lines. At the USDA Northern Regional Research Center in Peoria, Illinois, Bob Kleiman is reviewing nearly 10,000 samples from collections at Urbana, Illinois, and Stoneville, Mississippi.

"We'd like to find one with less than 3% linolenic acid," the reasearch leader says. "But we haven't found it and we're about through with the search.

"We've found one with 4–5%, depending on the environmental conditions under which it is grown," he adds. That sample came from PI-361088B, from the Urbana, Illinois, germplasm collection.

Since fatty acid composition depends on genetics and environment, finding a variety that works in the field has been tricky. "We've found 10 or 12 numbers under 5% in analysis, but when we grew them, we found a lot of variability. We've found only one that was consistent in tests in five states," Kleiman says. A consistent, commercial variety with a 4% linolenic acid level will be a great improvement, compared with existing levels.

Working with a more conventional technique are Joe Burton and R.F. Wilson, researchers at North Carolina State University. They're using recurrent selection, a method commonly employed in corn breeding but seldom seen in soybeans. They've established one line with a 4.2% linolenic acid level, and Burton thinks researchers will eventually find the right combination. "I'm confident the trait is heritable. It can be genetically manipulated," he says.

"The primary problem we have now is that the material is not agronomically suitable. It has poor yields and seed quality is not as good as established lines.

"But once we develop low linolenic acid germplasm, then we can try to incorporate it into existing cultivars. It'll take a good bit of work, but we can change it in the long run."

Another unanswered question is just how low must acid levels go to be acceptable to processors.

"That's what we also want to find out," says Burton. "Some hydrogenated cooking oil contains 3% linolenic acid. Perhaps that's the goal for researchers. But it's a question food scientists and chemists will have to answer."

There is some evidence that suggests some linolenic acid should be retained. The body cannot manufacture or store linolenic acid.

"Linolenic derivatives seem to be important in lower blood cholesterol and in heart disease prevention," says Maxine Isert, ASA nutrition specialist. "But we're still learning a lot about these pathways."

Soy and rapeseed oil are two primary sources of linolenic acid, and in the United States, soy oil is the major supplier of this essential fatty acid. Only a small amount seems to be required, about 0.5% of calories.

It is an important ingredient, and a healthy person consuming a varied diet probably would not develop a deficiency.

At least one case of linolenic acid deficiency has been reported by Dr. Ralph Holman, of the University of Minnesota's Hormel Institute. A patient receiving intravenous feeding for several months experienced bouts of numbness, weakness and inability to walk. She also reported pain in her legs and blurred vision. Analysis of fatty acids revealed linolenic deficiency. When the regimen was changed to emulsion containing linolenic acid, the neurological symptoms disappeared.

Erickson outlines another option besides breeding new low linolenic soybeans and current processing of oil from existing varieties.

He thinks consumers would find the refined-bleach-deodorized (RBD) oil acceptable and processors need not go through the more expensive lightly hydrogenate and winterize process. "I think consumers will accept an optimally processed (RBD) soybean oil. If properly processed, it wouldn't make much difference in quality to the consumer for home use," he says. "Some large-scale customers, however, may still require the more expensive LHW soybean oil."

Eventually, linolenic acid levels may be a plus in the consumer market when you talk about health, he adds. Soybean oil is the only edible vegetable oil now in the U.S. market with significant quantities of linolenic acid, and consumers may regard that as a positive factor.

Meanwhile, researchers continue to search for a viable commercial soybean variety with reduced linolenic content. They're getting closer to success.