Industry News

Peanuts
A Billion-dollar Crop in the U.S.

In the United States, the term "peanuts" often is used to refer to (1) something of little value or (2) a cartoon strip featuring small children and a rather precocious beagle named "Snoopy."

But the commodity peanuts is, in fact, a billion-dollar farm crop, annually among the top ten cash crops in the United States.

Peanuts are the world's third largest oilseed crop, and peanut oil ranks No. 7 in production worldwide, according to the U.S. Department of Agriculture. In the United States, peanuts are the No. 4 oilseed crop, behind soybeans, cottonseed and sunflowerseed, while peanut oil ranks fifth among edible oils domestically, USDA says.

Peanuts are cultivated in tropical, subtropical and warm temperate climates in more than 70 countries. They are known as groundnuts in much of the world, where their primary use is as a source of oil. In the United States, peanuts are consumed primarily as food (peanut butter, confections and roasted nuts), not as oil. The peanut's high protein content (26%) and its oil content, combined with its widespread growing area, have led many food specialists to view it as a crop that could help alleviate world hunger.

In 1973, Jasper Guy Woodroof, in his second edition of *Peanuts: Production, Processing, Products*, wrote, "It may be said that peanuts are the most unexploited and neglected food crop in the United States. The potentialities for developing additional food products utilizing proteins, lipids, vitamins, minerals and flavor are as great as for any crop in the world."

There are many peanut research projects under way. However, with a quota program to reduce peanut production in the U.S., there are fears that research efforts also will be cut. Warning of this, James L. Butler, 1981-1982 president of the American Peanut Research and Education Society (APRES), said, "We must explore other uses for peanuts besides the traditional edible and vegetable oil market."

Peanuts were discovered many centuries ago. The plant was cultivated in Brazil, Peru and Bolivia more than 3,000 years ago. Explorers and traders carried samples from the New World back to Europe and on to Africa and Asia. It is popularly believed that peanuts were introduced to the American colonies by slave traders who fed peanuts to their captives while on ship, but Ray Hammons, in *Peanut Science and Technology*, said this has not been documented by historians. The legume was not cultivated extensively in the United States until after the Civil War, and then crops were chiefly confined to Virginia and North Carolina. Peanuts were first used in the United States for fattening pigs, turkeys and chickens.

Two developments occurring around 1901 expanded the peanut market, according to Ray Hammons: (1) F. W. and H. S. Mills came out with a penny-in-the-slot peanut machine in Chicago, and (2) confectioners in New York and Norfolk began making peanut candy on a large scale. "By 1900, the industry had reached the point where, if some less laborious method was not found than hand picking the pods from the vines, peanut culture would have to be discontinued," Hammons said, adding that the first successful machine for this purpose was made in Richmond, Virginia, in 1904.

Inventions to aid in planting, cultivating, harvesting and shelling were later followed by technology for roasting, blanching, salting, making peanut butter and packing.

Discoveries by botanist George Washington Carver that the peanut could be used in many food and industrial products helped promote peanut consumption (see accompanying article).

Between 1909 and 1920 the boll weevil caused serious damage to cotton crops, forcing many Southern growers to switch to peanuts—"goobers," as they are frequently called in the South (from the Congolese word "nguba"). Increased demand for peanut oil as food during World War I also encouraged production. During World War II, demand for U.S. peanuts for oil, food and feed sparked acreage expansion and construction of more shelling plants. After the war, other countries resumed raising peanuts, diminishing export markets for U.S. peanuts and forcing shelling plants to close. A shift to larger and fewer shelling plants occurred. Today, one large shelling plant operating 24 hours a day can shell more peanuts than ten did during 1945. Between 1960 and 1980, substantial peanut production increases occurred, largely as a result of improvements in yield.

Peanuts are considered soft seeds for crushing. They are cleaned and graded in shell, the shells are removed and unsatisfactory peanuts culled. The remaining peanuts are regraded based on size and other characteristics. The skin is removed for many food applications because it imparts off-colors and because the tannins it contains make products bitter and dark-colored. The small peanut germs, or hearts, at one end of the kernel are also frequently removed when making mild-

India, China top producers

India and China are the leading peanut-producing countries in the world. The United States, growing 10-12% of the world peanut crop, ranks third in production but is the leading exporter of peanuts, with at least 25% of international trade.

About two-thirds of the world crop is crushed for oil. In the U.S., however, peanuts are grown primarily for food use. Peanuts used to produce oil in the U.S. are those diverted from the edible food trade because of oversupply, lower grade or damage. The leading peanut-producing states are Georgia (which raises 43% of the domestic crop), Alabama, North Carolina, Texas, Virginia, Oklahoma and Florida.

Other major peanut exporters are China, Argentina, Gambia, Sudan and India. Senegal, Argentina, Brazil and China are the leading peanut oil exporters. The major export markets for U.S. peanuts are Canada, France and the United Kingdom. Chief peanut importers overall are the E.E.C., Canada, Japan and Switzerland. (For a look at leading producers, consumers and exporters of peanuts and peanut products, see *JAOCS*, December 1981, p. 901A.)

USDA estimated the 1982-1983 world peanut crop at 17.7 million metric tons, 4.1% lower than the previous season's 18.5 million metric tons. Poor weather conditions in India and Senegal were a chief reason for the decrease. Reduction in U.S. plantings due to changes in the peanut price support programs accounted for almost three-fourths of the decline in acreage harvested but, because of high yield, represented only 35% of the decrease in world production. Peanuts harvested in the U.S. totaled 3.44 billion pounds, down 14% from 1981, but set a new average yield record of 2,703 pounds per acre.

In 1983, world exports of peanuts and peanut products are expected to increase as trade patterns disrupted by the U.S. drought-reduced 1980 crop return to nearer normal. However, some permanent changes may have occurred on the world peanut market. China, for instance, has become a major supplier of edible peanuts, particularly for the Japanese market. Meanwhile, U.S. sales of oil stock peanuts to such markets as France have fallen during the past three years because of growing competition from Senegalese peanut oil and other African exports. Increased sunflower oil consumption in France also has weakened demand there for peanut oil.

Demand for peanut oil decreased in 1980 with the 42-43% drop in U.S. peanut production. High prices compared to those for cottonseed and soybean oil helped depress demand.

"High price of peanuts and the variable supply of oil stock peanuts (which can be affected by acreage allotments) are probably major reasons for declining demand for peanut oil in the U.S., " USDA's Robert Ory said.

Peanut oil's decline on the world market has been continual since the early 1970s. In 1971, an acute shortage of peanut oil caused by poor crops in West Africa drove the price up. At that time, J. E. Th. M. Randag, then president of the International Association of Seed Crushers, said, "The great danger in even quite short periods of high prices is that markets become permanently lost because of the introduction of substitute products. For example, peanut oil in France accounted for more than 80% of their liquid oil consumption in the past but in 1970 it was hardly more than 50%. In the U.K., the last three years have seen the share of peanut oil fall from 47% to 26%."

In the 1980s, weaker export demand resulted in fewer contracts to growers for 1982 crop peanuts. The strength of the dollar overseas and the world economic recession, as well as a world surplus of oilseeds, continued to dampen demand in Europe, the major market for U.S. peanuts.

Since the 1930s, the United States government has restricted peanut production and supported prices. In 1981, the Agriculture and Food Act reduced the national poundage quota and discontinued acreage allotments. The 1981 act set a poundage quota of 1.2 million short tons of peanuts - 17% below the 1.44 million tons in 1981 - for the 1982 marketing year and outlined 3% reductions each year through 1985. This allows production of 1.1673 million tons in 1983, 1.1347 million tons in 1984 and 1.1 million tons in 1985, eligible for the higher priced domestic edible use and quota loan rate. Any U.S. farmer can produce "additional peanuts" (those in excess of the quota) but these can be marketed only for export or domestic crush and not for food or seed use. The 1983 support price is $550 per short ton for quota peanuts and $185 per short ton for additional peanuts.

"Very few farmers plant over quotas because it usually isn't profitable," the University of Georgia's W. Cecil Hammond said.

The federal legislation, which reduces the quota nearly one-fourth between 1981 and 1985, is designed to bring production for domestic edible use in line with market demand, to minimize government cost of operating the peanut program. Also, according to USDA's publication *U.S. Peanut Industry*, changes in the domestic peanut program through the 1977 and 1981 agricultural acts included provisions for lowering support levels for peanuts entering world trade, to make them more competitive.

In 1982, 1.27 million acres of peanuts were harvested in the U.S., 14% below the previous year and the lowest since the 1930s. USDA said the decline was growers' reaction to the new government peanut program. Acreage and production figures for recent years are shown in Table I.

While peanuts' share of the U.S. oilseed market—and peanut oil's share of the world oil market (see Table II)—has dropped in the past two decades, scientists have improved the yield per acre substantially. "In contrast to soybeans, the yield per acre of peanuts has tripled in the last 25 years," USDA's Ray Hammons said, adding, "We have turned out varieties far more productive."

According to *U.S. Peanut Industry*, "In the absence of production controls (the acreage allotments discontinued in 1982), peanut acreage might rise in southwest Georgia and sections of Florida, which have cost and soil advantages. Market conditions and agronomic restraints will now be the major limits on production increases."

However, USDA adds, the potential for increased demand for U.S. peanuts is limited. "Although other U.S. oilseeds have played a major role in supplying a rapidly expanding foreign market for vegetable oils and high-protein feedstuffs, peanuts have not been a significant part of this market," *U.S. Peanut Industry* authors said, adding, "Unless peanut yields increase substantially so that the cost of producing oil and meal declines significantly, it is unlikely that peanuts will share in this market. There is greater potential for increased edible peanut exports."

flavored products because the germs impart a grey color and a bitter taste. In many food processes, peanuts are heated to deactivate antinutritional factors (e.g., trypsin inhibitors) and enzymes (e.g., lipoxygenases). *Food Chemical News* (Jan. 10, 1983) also reports that Europeans now use microwave energy for peanut roasting.

Recovery of peanut oil is done through hydraulic press, expeller and solvent extraction, either separately or in combination. Peanut oil is usually alkali refined, bleached and deodorized to obtain salad or cooking oil. Unless degummed, crude oil when heated will discolor and will foam due to residual free fatty acids. Although crude peanut oil has excellent flavor, such foaming is a problem in continuous frying operations.

While half of U.S. peanuts go into edible products and related uses, about a fourth are exported and the remaining fourth are crushed for oil and meal, used for seed and feed, or lost on the farm. USDA figures show that on a farmer's stock basis, Americans have increased annual peanut consumption from 6.5 pounds per person in 1950 to about 9 pounds now.

According to Robert L. Ory, research leader for biochemical mechanisms research, USDA Southern Regional Research Center (SRRC), "The most outstanding property is the delicious flavor and aroma of roasted peanuts. No other roasted nut confection has this strong flavor. This is why 55% of the edible U.S. peanut crop is used in peanut butter manufacture and 25-30% more goes into candies, cookies and confections. The creamy consistency of peanut butter is also unique,

TABLE I

U.S. Peanut Harvests

Crop year	Acreage harvested	Average yield per acre (pounds)	Production (billion pounds)
1979	1,519,700	2,611	3.97
1980	1,398,800	1,650	2.30
1981	1,493,300	2,668	3.98
1982	1,274,900	2,703	3.44

TABLE II

World Peanut Oil Production Compared to Total World Production of All Vegetable Oils

Crop year	Peanut oil production	Total edible vegetable oil production	Peanut oil as percentage of all vegetable oils (%)
	—(1,000 metric tons)—		
1969/70	3,302	24,495	13.4
1974/75	3,182	30,414	10.5
1978/79	3,357	37,560	9.1
1979/80	3,130	41.611	7.9
1980/81[a]	3,093	39,704	8.6

[a]Preliminary figures.
Source: USDA's *U.S. Peanut Industry*, 1982.

Aflatoxin-resistant peanuts?

Although less than 3% of the U.S. peanut crop is contaminated by aflatoxins in a normal year, such contamination is a major concern to the industry.

USDA researcher A. C. Mixon believes one of the best approaches to control aflatoxin contamination would be to develop cultivars resistant to toxin-producing strains of *Aspergillus flavus*: "Research has indicated that the genetic resistance to *Aspergillus* spp. thus far reported is effective for a short period of time (5-8 days). The combined use of (a) a genetically resistant cultivar, (b) preventive measures such as crop rotation and good cultural practices (including irrigation) to prevent plant stress and maintain rapid growth of healthy plants, and (c) safe harvesting and rapid drying procedures of peanuts dug at optimal maturity will reduce aflatoxin contamination by *Aspergillus* spp. fungi in peanuts. Although the genetic resistance now available will not eliminate contamination, it is believed that resistant cultivars that will effectively reduce aflatoxin levels in peanuts may be developed."

In the U.S., the peanut aflatoxin control program is administered by the Peanut Administrative Committee composed of peanut growers and shellers.

When peanuts containing aflatoxins are crushed, alkali refining and bleaching eliminate aflatoxin in the oil. The meal, however, remains contaminated and can be used only for fertilizer, not feed.

Aflatoxins can infect peanuts before digging, in the windrow, after harvest and in storage. While damaged peanuts can be expected to be contaminated, researchers also are finding low level aflatoxins in apparently sound peanuts. T. H. Sanders et al., in the December 1981 *JAOCS*, wrote, "Peanuts without obvious damage can be invaded by *Aspergillus flavus* and contaminated with aflatoxin in the field before digging. Although the exact circumstances have not yet been fully delineated, severe prolonged drought stress during the last 4-6 weeks of the growing season favors invasion of peanuts by *A. flavus*."

very likely because of the ratio of oil (50-55%), protein (27-39%) and carbohydrates (8-12%). Some companies, especially after the 1980 peanut shortage caused by heat/drought, tried to make substitute 'butters' from other oilseeds (e.g., sunflower), but the texture and flavor were not the same. These alternate products just didn't fill the gap."

Peanut oil is a high quality oil used in margarine, in compound cooking fats and as a cooking or salad oil. It normally is a relatively expensive vegetable oil and, as such, cannot compete economically with other oils for some uses. Because of its taste, however, it is preferred by some commercial firms in making such foods as potato chips and snack items, and for Chinese and Oriental cooking. It is an excellent fat for pan or deep-fat frying because it has a high smoke point (440 F) and can be clarified and reused many times. Peanut oil has a melting point of 33-36 F, refractive index of 1.4682, and iodine number of 90-94. It is quite stable compared to other oils and may be stored at room temperature for long periods. Fatty acid composition of peanut oil is 17-20% saturated, 80-83% unsaturated. The saturated part consists mainly of palmitic acid, with stearic, arachidic and other acids present. The unsaturated acids of West African peanut oils are approximately 60% oleic and 20% linoleic; the composition of peanut oils from other sources is nearer 40% oleic and 40% linoleic acid. While immature peanut seeds contain small amounts of linolenic acid, it disappears when the peanuts mature.

Ory said it is difficult to pick a particular geographic area that produces the best oil. "Area, temperature and irrigation can all affect the fatty acid composition of peanut oil. In general, the farther north the peanuts are grown, the cooler the growing temperatures and the higher the ratio of linoleic to oleic acid."

In an August 1982 *JAOCS* article, T. H. Sanders of USDA's National Peanut Research Laboratory wrote, "The increase in unsaturated fatty acids generally associated with cooler climates during the fruiting period may be related to increased oxygen concentration in developing fruit." Natural peanut oils possess markedly nonrandom structures of highly asymmetric positional placement of the long-chain saturated fatty acids. In one study cited by Sanders, Early Bunch and Florunner varieties had higher linoleic acid percentages when the peanuts were grown in a cooler climate. In another study with four varieties grown at four locations, linoleic acid concentration increased and oleic acid concentration decreased as temperatures decreased.

"The data presented make obvious the fact that environment affects not only fatty acid composition of peanut oil, but also, although apparently indirectly, the spatial arrangement of those acids on the triacylglycerol molecules. Because peanut triacylglycerol structure and composition and total oil composition have been associated with such factors as atherogenic potency and oxidative stability the far-reaching implications of different growing locations are obvious," Sanders concluded.

In addition to edible uses, peanut oil can be used in soaps and detergents and forms the base for some face creams, shaving creams, hair lotions and other cosmetics. It has been used to massage polio patients, to carry adrenalin to treat asthma, or, in homogenized form as a fatty drink, to fortify patients before or after surgery.

The Edible Oils Research Group at SRRC studies ways to use peanut oil. According to its findings, peanut oil cannot be used successfully in Votator-type chilling units for margarine production. Also, mayonnaise made with peanut oil breaks into constituent parts if exposed to cold temperatures. Researchers continue to seek ways to winterize peanut oil to make it economically competitive. A potential problem to be overcome is graininess in all-peanut oil shortenings and margarine.

Peanuts, rich in protein and high in calories, can be prepared in many food forms with only simple roasting and grinding. Peanut meal is valuable as a high-protein feed, with significant amounts of vitamins thiamin and niacin, but lacks some amino acids that must be provided through supplements. These include methionine and lysine, while threonine content is borderline, Ory said.

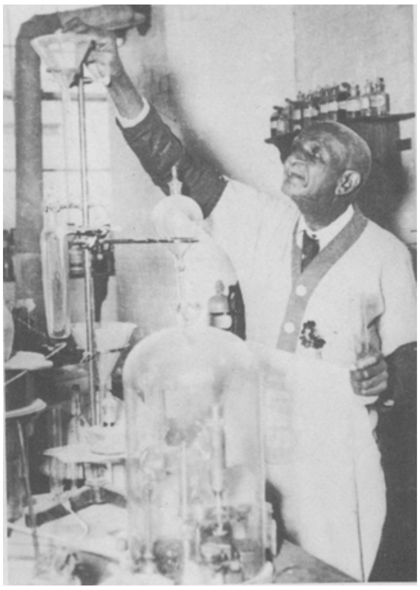
Peanuts are used as flour, protein concentrate and isolate and, in India and Africa, as peanut milk and cheese.

Carver: 'Peanut Wizard'

George Washington Carver, known as the "Peanut Wizard," developed many new uses and products for peanuts.

Born in 1860 in Missouri to slave parents, Carver taught himself to read and write and managed to attend school intermittently. F. Roy Johnson's book *The Peanut Story* describes Carver as a frail youth who secretly grew a garden and dubbed himself the "Plant Doctor."

In 1890 he enrolled at Methodist-supported Simpson College in Indianola, Iowa. There he met Etta Budd, a faculty member whose father was professor of horticulture at Iowa Agricultural College at Ames. As a result of her encouragement, in 1891 he enrolled as the first black student at Iowa Agricultural College. During his studies there, he developed a love for chemistry and was particularly fascinated with tearing things apart to learn their components. He became an assistant botanist and was put in charge of the greenhouse. There he devoted special attention to bacterial laboratory work in systematic botany and started a mycological collection that grew to 20,000 specimens. His childhood fantasy of "Plant Doctor" had come true. He graduated from Iowa Agricultural College in 1894 and



George Washington Carver

two years later received his master's degree in botany.

In 1896 he accepted a position to head the newly organized agricultural department at Tuskegee Institute in Alabama founded by Booker T. Washington in 1881 to educate black students. In 1897, he was named director and consulting chemist of a state-established experiment station for blacks at Tuskegee.

In his Tuskegee laboratory, Carver discovered over a hundred ways of preparing peanuts for human consumption and for inedible uses. The peanut products he developed included mock chicken, mock goose, mock oyster, mock veal cutlet, soups, peanut hearts, dyes for cloth and leather, shampoo, shaving cream, antiseptic soap, soap stock, beverages, breakfast foods, candies, cookies, asparagus substitute, vinegar, diesel fuel, wood filler, printers ink, paints, medicines, bleach, rubbing oil, axle grease, glue, charcoal, laxatives, nitroglycerine and coffee.

For his work, Carver was elected a Fellow of the Royal Society of Arts in Great Britain in 1916 and was called before the U.S. Ways and Means Committee in 1921 to talk about peanut products. In 1923, Kansas presented him with the Spingarn Medal for distinguished research in agricultural chemistry. He also received two honorary Doctor of Science degrees–from Simpson College in 1928 and from Cornell University in 1941.

He died in 1943 at the age of 83 and was buried at Tuskegee where he had done so much to promote peanuts.

The vegetative portion of the plant is used for hay. The shells fuel generators powering shelling plants and also can be used as filler for fertilizers, mulch for plants, roughage for cattle feed, building insulation, filler for plastic wood and veneer boards, or as high-grade activated charcoal.

Due in part to the relatively high cost of animal protein and to FDA's approval of vegetable protein use in the school lunch program, new protein types, including peanut, are being developed as meat extenders. In a 1981 article in *Peanut Science*, Esam M. Ahmed and Roger L. West said ground meat patties and loaves with nonextruded peanut meal exhibited similar cooking losses to those extended with either extruded peanut meal or 100% beef products. "Peanut protein was used to extend meat products without adverse effects and thus it could have a role in sharing the projected markets of soybean protein," they wrote, adding that the most important factor–consumer acceptance–will depend on how much is added, its effect on the appearance of the uncooked product and on the texture and flavor of the cooked product. "Findings have shown peanut-extended patties exhibited better aroma than soybean-extended patties," they noted.

While current prices and limited oil stock supplies are deterrents to wider use of peanut flour in the United States, Ory said it is an ideal source of edible protein for less developed countries.

"When the oil is removed, the meal residue contains 55-65% protein that can be pulverized to a flour for better utilization in food products," Ory said. Peanut flour contains less than 1% of the flatus-causing oligosaccharides, less than soybean and cottonseed flours. These sugars are removed in an additional processing step to produce protein isolates. Peanut flours are prepared as full-fat, partially defatted and fat-free, for different end uses by USDA laboratories, universities and in several industries. Research shows many types of meat, bakery and milk-like analogs can be prepared from peanut flour.

Meanwhile, chemical engineer Joe Pominski of the SRRC has developed a simple process for preparing a peanut milk-type drink which does not require homogenization to obtain a stable beverage. "This could have applications here and abroad," Ory said.

Another product developed at the SRRC and now in domestic markets is partially defatted peanuts which roast like full-fat peanuts but have 50% or more of the oil removed by hydraulic pressing. "They are re-swelled to their original form, roasted, to a higher protein nut that tastes the same but is lighter and crunchier," Ory said, explaining they are used as protein sources in a breakfast bar and several other products.

Kay McWatters of the Department of Food Science at the University of Georgia Experiment Station has worked on expanded food uses of peanut protein products. McWatters and John P. Cherry, formerly at SRRC and now with USDA's Eastern Regional Center, have coauthored a chapter, "Potential Food Uses of Peanut Seed Proteins" for *Peanut Science and Technology* and each have prepared a chapter for *Peanuts Worldwide, 3rd Edition,* a 1983 book published by Avi Publishing Co.

Expansion of U.S. peanut or peanut oil production cannot be expected without higher yield varieties, higher prices for peanut meal and flours, or reduced crushing costs, J. L. Ayres of Gold Kist said at the 1982 World Conference on Oilseed and Edible Oil Processing.

David Hsi, 1982-1983 president of APRES, believes that expanded use is possible "in the area of human consumption–oil, peanut butter, nuts, meal or flour."

"We need to find as many uses as we can and do marketing, promotional work for peanuts," Hsi said. "Unlike soybeans, which have been well promoted, we for years have limited our field of peanut products and markets." The chief limiting factors, he believes, have been acreage and poundage quotas.

"It is important that we promote peanut uses and exports," Hsi said, adding that this role belongs to the National Peanut Council, not APRES, which is concerned mainly with research and education. "APRES' main objective is to increase the unit production of quality peanuts while cutting down the costs, thus bringing the maximum benefit to producers and consumers," Hsi said.

The National Peanut Council's more than 250 members includes peanut farmers, shellers, special processors, brokers and manufacturers handling peanuts. According to Perry A. Russ, National Peanut Council president, the council encourages the development of peanut research as well as the increased use and marketing of peanuts. It serves as a national information center for the industry and supports campaigns to sell U.S. produced peanuts and peanut products.

Russ said the council works co-

Peanut oil studied for fuel value

Peanut oil shows a number of characteristics supporting its use as a diesel fuel substitute for farm use. Because peanuts are high oil producers, agricultural engineers at the University of Georgia at Athens report, an acre can produce 145-200 gallons of peanut oil, compared to 50 gallons of soybean or sunflower oil. In addition, breeding techniques would make it possible to distinguish peanuts grown for fuel from those for edible purposes.

According to L.E. Samples in a March 1981 *Progressive Farmer* article, "Peanut breeders already have the genetic material that allows peanuts to be identified with special marks on the leaves and seed so that peanuts for fuel could be kept separate from the peanuts for food."

Among vegetable oils, only palm oil produces more BTU per gallon than peanut oil does. According to samples, more than 7 million BTU are needed to sow and harvest an acre of peanuts that could yield 3,250 pounds of peanuts with a potential of over 44 million BTU of energy.

Peanut oil has no linolenic content. And, with a low phosphatide content, it is lower in gums than soybean or sunflower oil. It is a little more saturated than other oils, causing fewer deposits in engines. Because peanuts are relatively soft for crushing, a simple expeller can extract the oil. This makes extraction a feasible operation in an on-farm situation.

There is also indication that substantial genetic improvements could boost the oil content to 57-60% from the current 50-52%. Whether this higher oil-content peanut would be practical for other U.S. needs is questionable, particularly as peanuts are grown here for protein content, not for the oil. Also, according to USDA research geneticist Ray Hammons, higher oil-bearing varieties, with oil content of 4-5% more than varieties now grown in the U.S., yield less than half as many peanuts per acre. Robert L. Ory of USDA's Southern Regional Research Center pointed out that even if other countries were interested in such a peanut, the oleic/linoleic acid ratio would have to be taken into account to keep the stable quality of the oil.

Primary limitations on fuel use are the comparatively high price of peanut oil to other oils and the limited amount of acreage devoted to peanut cultivation. According to W. Cecil Hammond, head of the Extension Engineering Department at the University of Georgia's College of Agriculture, there is little interest to develop peanut oil as a fuel "chiefly because the quota system creates uncertainty of availability and price." But peanut oil can be used in many diesel engines without major engine modifications. University of Georgia extension agriculture engineers, working with the Georgia Peanut Commodity Commission to demonstrate how peanut oil could be used as a diesel substitute, found audible knock and smoke level were less with peanut oil and that, in the Georgia climate, the engine started easily.

Such experiments with peanut oil are not new. Dr. Rudolph Diesel, the German inventor, for whom the diesel engine is named, exhibited an engine built by the French Otto Company and powered by peanut oil at the 1900 Paris exposition.

John W. Goodrum, associate professor in the Division of Agricultural Engineering at the University of Georgia, said in another experiment undertaken there, two campus buses were powered by peanut oil/diesel blends. Goodrum said the buses were run the first 10,000 miles on 30% peanut oil and 70% diesel fuel and the second 10,000 miles on 50% peanut oil and 50% diesel fuel. Both were operated eight hours a day, five days a week. "It was very successful," Goodrum said, adding, "We found no significant problems in dispensing or burning these blends in the buses."

operatively with the people it represents to promote peanuts through National Peanut Month (March) and marketing campaigns, such as a recent effort by a national ice cream manufacturer to sell peanut-flavored ice cream. It also sends teams on trade missions to other countries.

"We feel we're going in the right direction. It's just a matter of doing more of it," Russ said, explaining that a key is to promote the nutritional values of peanuts and peanut products.

Challenges facing peanut researchers for increased use of peanut products include improving flavor and stability, identifying nutritional adequacy and fortification requirements, eliminating antinutritional factors, developing new products and improved processes, and eliminating aflatoxin problems. Higher yield and grade performances, meanwhile, are principal breeding aims. Current research also includes developing improved storage methods, exploring how drought and cooled soils slow peanut maturation, reducing or eliminating mycotoxins and toxigenic fungi from peanut foods and feeds, developing low-oxygen atmosphere bulk containers for use in export shipment and storage, and monitoring the effects of microwave vacuum drying.

While research is under way to increase oil content in peanuts in such countries as Senegal, Sudan, China and India, one emphasis in the U.S. is to improve the oil quality through breeding. "We are concerned with monitoring the oleic/linoleic ratio for shelf-life stability of the oil," USDA research geneticist Ray Hammons said, explaining that the lower the linoleic content, the more stable the oil. He added, however, that there is little U.S. interest to increase the oil content of domestic varieties because peanuts are not grown for oil in the U.S.

("The major reason that peanuts in the United States are not grown for their oil and meal is apparent when comparing the cost of oil and meal from peanuts with soybeans," authors of *U.S. Peanut Industry* wrote, adding that in 1981 the cost of providing oil from peanuts was 48 cents a pound versus 15 cents a pound for soybean oil, and 15 cents a pound for 50% protein peanut meal versus 8 cents a pound for soybean meal with a similar protein content.)

Much research work on peanuts is under way at a number of U.S. laboratories. At USDA's National Peanut Research Laboratory in Dawson, Georgia, research microbiologist and laboratory director Richard J. Cole, says the Peanut Quality Research Unit is studying the effect of aging, area of growth and maturity on market quality; determining environmental effects on peanut composition as related to food quality; developing chemical and physical methods of evaluating peanut quality; studying the effects of packaging peanuts by carbon dioxide sorption process on maintaining quality during storage; developing screening methods for mycotoxins; and studying factors relating to aflatoxin contamination. A Mycotoxin Research Unit, meanwhile, studies mycotoxin invasion of peanuts and evaluates possible prevention methods. A third group, the Peanut Handling and Environmental Research Unit, is working on improving methods for growing, drying, cleaning, handling, storing and shelling peanuts to maintain quality; on enhancing domestic and foreign use of peanuts; and on reducing energy consumption and unit cost.

Meanwhile, the Biochemical Mechanisms Research Group at the Southern Regional Research Center seeks to improve the quality and stability of raw and roasted peanuts for use domestically and abroad. One discovery has been a white skin peanut that could be marketed for use as vegetable protein because of its blandness.

In other research pioneered by Dr. Harold Dupuy, A. J. St. Angelo of SRRC last year reported that gas chromatographic "fingerprints" could be used to identify peanuts with stable, desirable flavor. St. Angelo said this means peanut breeders, farmers and processors can learn quickly from a handful of peanuts whether a new

How they grow

Peanuts are the fruits or pods of *Arachis hypogaea.* Flowering takes place above the ground. After the flower withers, at the completion of fertilization, the gynophore, or peg, elongates, penetrates the soil surface and pushes the ovary underground. One or more seeds (but no more than five) mature inside the pod below the ground and are commonly called nuts, peanuts or groundnuts. It takes four to five months from planting for the peanuts to mature.

There are four main types of peanuts grown in the United States – Runner, Virginia, Spanish and Valencia. Runners have become the dominant type, of which 60% of the U.S. crop is used in peanut butter. Virginia peanuts account for most that are roasted and eaten out of the shell. Spanish peanuts are used primarily for salted nuts, confectioneries and peanut butter. Valencia, which are the sweetest, usually are roasted for eating out of the shell.

Peanuts belong to the same legume family as soybeans. They grow best in light sandy soil, making them easier to harvest. Harvesting is done by uprooting the plant, inverting it and letting the peanuts dry in the field.

"If it rains then, you're in trouble as the peanuts rot," W. Cecil Hammond, head of the Extension Engineering Department for the University of Georgia's College of Agriculture at Athens, pointed out.

Because weather conditions do not allow complete drying of peanuts in the windrow, nearly all are artificially dried with mechanical dryers, either on the farm or at commercial drying facilities. Peanuts normally remain in windrows for only one to three days before being combined.

A ton of farmer's stock peanuts (those which have not been shelled, crushed or cleaned) yields approximately 58% shelled edibles, 17% oil stock and 25% hulls. According to Cecil Hammond, Florunner varieties in Georgia can yield 3,200-4,000 pounds per acre in the shell, about 70-75% of which are nuts and 25-30% shells, on a weight basis. Of the nuts, generally 50% is meal, 50% oil. Hammond said an acre can produce 145-200 gallons of oil.

It is because average yields have nearly tripled due to improved varieties and farm practices that production has more than doubled since the early 1950s even though total acreage planted has not increased. Florunner has been responsible for much of the yield increase since its introduction in the early 1970s.

variety has suitable qualities to merit further development.

Also at the SRRC, Ory reported, "We have found a bioregulator that, when applied to the growing plants at flowering, knocks out 40-60% of the lipoxygenase activity (the enzyme that peroxidizes linoleic acid in the oil). We are investigating the mechanism of action and looking at possible effects on other components."

In other research, the atherogenic potential of peanut oil in rabbits and monkeys and possible health implications for humans are being examined. The SRRC in New Orleans is synthesizing stereospecific triglycerides of peanut oil for feeding tests with primates to test the effect that peanut oil fatty acids have on blood lipids, heart, liver and selected blood vessels.

The University of Georgia, meanwhile, has received U.S. Agency for International Development funds for an extensive international peanut research program. The project is expected to aid people in developing countries who depend on peanuts for food as well as U.S. farmers who may benefit from findings shared by foreign scientists on low cost production methods and disease control.

David G. Cummins, agronomy professor at the University of Georgia, Agriculture Experiment Station at Griffin, Georgia, developed the organizational plan for the Collaborative Research Support Program, as it is called, and serves as program director. Projects include introducing superior varieties and breeding lines into Cameroon, Mali and Niger in Africa and several Caribbean countries. Collaborative breeding and testing programs are expected to speed up the introduction of disease-, insect- and drought-tolerant germplasm into U.S. varieties and lower production costs.

Despite the casual use of the term 'peanuts' to describe something as of little worth, facts show peanuts hold a respectable position as an oilseed, both in the U.S. and in the world. Success of research programs under way could make this billion-dollar U.S. crop worth even more in future years.

Soy use may double by year 2002

World demand for soybeans and soy products may increase to more than seven billion bushels by the year 2002, according to an American Soybean Association-sponsored study, with U.S. soybean producers supplying 4.2 billion bushels of the world's total.

Presently, world demand is about 3.5 billion bushels a year, with U.S. growers providing about two billion bushels annually.

The report entitled "2002: a blueprint for soybean" was released during the ASA's 1983 meeting in early August. The study was cosponsored by Elanco Products Co., a major supplier of crop chemicals for soybeans.

U.S. soybean acreage could reach one billion acres by 2002, the report said. Yields are expected to rise to about 46 bushels per acre, and might reach 55 bushels per acre under favorable circumstances. At the present rate of increases, yields would be 37 bushels an acre by 2002, the report said. Closer planting, better chemicals, more productive seed varieties are expected to permit the above-trend yield increases.

On the demand side, the report's emphasis was on the importance to U.S. growers of building and solidifying markets overseas.

Traditional U.S. markets of Western Europe and Japan will continue to be of primary importance, but "efforts must be intensified in emerging livestock economies in Eastern Europe, the Middle East, Southeast Asia and China," the report said. "Increased buying interest in centrally planned economies, which favor long-term trade agreements and barter, will necessitate re-thinking traditional ways of doing business."

Dennis Sharpe, ASA project manager for the study, noted the study indicated soy protein for human consumption could climb to 1.9 billion pounds by the year 2002. "Soy protein must be promoted as a new food product, not as a substitute for traditional foods," Sharp said.

The ASA meeting came just as U.S. soybeans were entering a critical stage and the hot, dry weather was reflected in rising prices on the Chicago Board of Trade. Ten days after the ASA meeting, the USDA released a 1983 crop forecast of 1.84 billion bushels of soybeans. That forecast reflected crop conditons as of Aug. 1, the date of the survey, but continued hot, dry weather to mid-August led many observers to say the crop actually will be smaller. U.S. soybean farmers should harvest about 62 million acres this fall. The USDA Aug. 1 outlook was for an average national yield of 29.8 bushels per acre – but the actual figure probably will be lower. At 29 bushels per acre, the crop would total 1.79 billion bushels; at 28 bushels per acre, the total would be 1.74 billion bushels; at 27 bushels, 1.67 billion bushels; at 26 bushels, 1.61 billion; and at 25 bushels, 1.55 billion.

While the weather was driving up soybean prices toward $10 a bushel in late August, an increasingly strong dollar was discouraging foreign purchase of soybeans. As the U.S. normally markets about 55% of its soybean crop overseas, the stronger dollar plus higher prices may mean reduced overseas sales during the 1983-84 marketing year. Some market analysts were predicting stronger demand for soybean oil, which is essentially a human food component, than for soybean meal, normally fed to livestock and entering the food chain as meat and poultry. Rising feed costs were making beef and poultry operations less profitable, therefore the number of animals being fed was being reduced, thus decreasing potential future demand for meal.

The 1983 U.S. soybean crop may be the lowest in the past five years. In 1980, another dry year, the crop totaled 1.79 billion bushels. A U.S. harvest of 1.74 billion bushels would still be larger than any harvest before 1977.

ASA expands

The American Soybean Association has opened a new field office in New Delhi, India. ASA field offices help to promote the use of soybeans and soybean products throughout the world. Similar offices are maintained in Europe, Latin America and elsewhere in Asia.

S.C. Singhal, president of the Oil Technologists' Association of India, has been selected as director for the new office.

ASA also has named Lawrence Beauregard as associate director of soy oil programs with responsibility for industrial uses of soybean oil. Beauregard previously was director of research and development for ITT Paniplus Corporation. He holds a doctorate in biochemistry from Georgetown University.

Pryde honored

Dr. Everett H. Pryde, research leader at the USDA's Northern Regional Research Center, received the American Soybean Association's 1983 Utilization Research award during the ASA annual meeting.

Pryde was cited for his work on industrial uses for soybean oil and on developing products from renewable resources, including present NRRC efforts on the possibility of using vegetable oil as diesel engine fuels.