World high oleic soyoil markets, trends and patterns

This research report was commissioned by the Protein Research Foundation, and aims to establish what the current status of high oleic soybeans and soybeanoils are, on the international market.

Introduction

The food industry wants more oil – and it wants healthier oil. Reputable international commercial and academic sources report "a growing demand for healthy oils"[1,2], an "almost unbelievable demand for healthy oils"[3], and make statements such as "at a time when demand for healthy oils is at an all time high"[4,5,6,7.]

Although local oil pressers seem to not be too perturbed by the trend to healthy foods, new draft Regulations relating to the Labelling and Advertising of Foodstuffs have been published by the South African Minister of Health in terms of the Foodstuffs, Cosmetics and Disinfectants Act (Act 54 of 1972), in the Government Gazette No 30075 on 20 July 2007. Although labelling of industrially produced trans fats are addressed very pertinently, these are not banned. The option being currently considered by the National Department of Health is that the use of partial hydrogenated fats and oils in prepared foods manufactured in South Africa, as well as imported foods (pre-packed foods and bulk ingredients) will be banned. In the case of restaurants, fast food outlets and in-store food kitchens, replacement of oils and fats that contains more than 2% industrially produced trans fatty acids of total fat will be manadatory and not voluntary. [19]

Tray Thomas, an ag industry analyst with Contect network, says oilseed demand is likely to increase in the coming years. Despite growth in biodiesel, 90% of soybean oil demand will still be for food use. Soybean oil took a hit in January 2006, when the USFDA Food and Drug Administration, citing concerns about unhealthy hydrogenated fats causing heart and vascular disease, required all processed food products to list hydrogenated oils or trans fats on labels. Conventional soybean oil must be hydrogenated to up stability and shelf life. [8]. How has the international soy industry responded to the strong demand for healthy oils?

Background

Soybean oil is the most abundant vegetable oil in the world. In the US, more soybean oil is used than all other sources of vegetable oil combined, comprising about two-thirds of the edible oil usage. Common soybean varieties produce an oil high in polyunsaturated fatty acids. Although this property has known health benefits, it makes the oil unstable, easily oxidized and subject to becoming rancid. When heated, soybean oil develops objectionable flavors and odors, making it unsuitable for many applications.

The traditional solution to soybean oil instability has been to partially hydrogenate the oil. Hydrogenation is the addition of hydrogen atoms across the double bonds in unsaturated fatty acids. However, this chemical process adds to the cost of the oil and also introduces side reactions including conversion of double bonds from the *cis* to the *trans* molecular configuration, resulting in *trans* fatty acids.

Because trans fats have been associated with coronary health risks, the U.S. Food and Drug Administration (FDA) has mandated the labeling of foods containing these fats. As a consequence, food manufacturers now are trying to eliminate trans fats from their ingredient lists. This is a tall order, given that the food industry had been using over 7.5 billion pounds of partially hydrogenated soybean oil per year, all of which contained trans fats. [9]

Time for an oil change

Currently, the race to provide large quantities of trans fat free alternatives comes down to a few major crops, with rapeseed (or canola), soybean and corn leading the charge.[20]

Over six years ago, the United Soybean Board actively engaged processors and manufacturers as part of an initiative (Better Bean Initiative, Qualisoy) to start working on soybean enhancements to produce soybean oil that would better meet the evolving needs of the food industry and their customers. This solutions-oriented approach has resulted in a number of alternatives to hydrogenation that range from relatively simple processing techniques to complex seed breeding technologies.

Some of the alternatives to hydrogenation comes in the form of processing technologies that transform the composition of the oil so that the end product has few or no trans isomers. These include traditional interestification, enzymatic interestification and blending.

In addition to the wide variety of processing techniques that reduce or eliminate the need for hydrogenation, the industry continues to work on soybean trait innovations to produce healthier oil with superior functionality characteristics. Whether through traditional breeding or advancements in biotechnology, the ultimate goal is to anticipate and better meet the needs of edible oil end users.Currently, top targets for soybean trait modifications include:

• Reduced saturates (≤7%)
• Reduced linolenic acids (≤3%)
• Increased oleic acids (>50%)
• These modifications can be combined to produce soybeans with stacked-trait innovations.

Researchers are developing soybeans even richer in 0mega-3, to be used as an additive to fortify traditional oils, while significant research is also underway to develop soybeans with high stearic fatty acid content. Considerable medical research indicates that stearic acid may be cholesterol-neutral compared to other saturated fatty acids. [10]

In addition to trait improvements that would result in healthier oils, the Better Bean Initiative sought to improve the amino acid profile to make soy-based animal feed more digestible. This improvement would help to reduce animal waste, and would lessen the impact of livestock operations. [14]

Low-lin: The first enhanced soybean oil to emerge out of the research pipeline

Low-linolenic soybean oil can be used as a direct replacement for lightly hydrogenated oil in many applications, including light frying, sauces, rolls and pizza dough. Applications for mid oleic include usage as a spray oil for crackers, coating oil for baked goods and as a blending component for formulating numerous types of margarines and shortenings. Mid-oleics will help the baking industry develop trans-free products. This oil will have 50 percent or greater levels of oleic acid, while keeping linoleic acid at or below three percent. [12] High-oleic oil will further extend usage of soybean oil in bakery applications beyond the applications supported by mid-oleic. However, bakeries can expect competition from the heavy duty frying industry for supply of this high performance oil.[11, 12]

QUALISOY has set research priorities and quality standards for trait improvements, such as low-linolenic varieties. Low-linolenic soybeans that currently meet QUALISOY quality standards include Monsanto's VISTIVE™ family of products; Pioneer® brand low-linolenic soybeans; United States Department of Agriculture Research Service (UDSA-ARS) [12] and Iowa State University's Ultra Low-Linolenic Soybeans. [11] Monsanto reported that Vistive1 was grown on 500 000 US acres during 2006, and that demand from the food industry was outstripping supply. Pioneer Hi-Bred's Nutrium low-lin soybeans were planted on 200 000 US acres in the same period. [24]

Several companies are processing these beans, including:

Varieties with less than 3% linolenic

• Advantage LL Soybean Oil from Cargill
• VISTIVE™ Low-Linolenic Soybean Oil from ADM, Ag Processing Inc., CHS Inc., Perdue Farms and Zeeland Farms
• TREUS™ Low-Linolenic Soybean Oil, developed in partnership by Bunge and DuPont

Varieties with approximately 1% linolenic

• Asoyia Ultra Low-Linolenic Soybean Oil
• Zeeland Farm Soya [10]

- The low-lin DEKALB(R) soybean cultivar Vistive 32-53VR is a 3250 CHU RoundUpReady variety, complete with soybean cyst nematode resistance and the Rps 1k gene for resistance to Phytophthora Root Rot.[16]

Low-lin soybean oils will function as intermediary solutions to the supply challenges. [20]

Mid and high oleics in the pipeline

The next Monsanto Vistive development, which is focussed on mid to high oleic soybeans, should be available in 2009. The third generation, which will reduce saturates in soybean oils, will be available in 2012 or 2013. [13]

New oil testing results confirm a new, improved soybean oil trait from DuPont will deliver increased nutritional benefits with broader applications than other soy oil products currently on the market. The high oleic soybean trait is the next generation of improved oil products developed by DuPont Business Pioneer Hi-Bred as part of the Bunge DuPont Biotech Alliance. In addition to delivering at least 80 percent oleic acid, the high oleic soybean trait has demonstrated a linolenic acid content of less than 3 percent, and over twenty percent less saturated fatty acids than commodity soybean oil. [17]

To develop this product, scientists "silenced" a gene in the endogenous fatty acid pathway of soybean seeds using biotechnology tools. Suppression of this gene prevents the addition of a second double bond to oleic acid to form linoleic acid. The end result is greatly increased levels of oleic acid, and decreased levels of linoleic and linolenic acid in the seeds.[9] Rigorous testing of the product was required during the registration process to document efficacy and safety. In this testing, high oleic soybean was found to be no different than conventional soybean for:

- Nutrient content (other than oil profile), including proteins and isoflavones
- Allergenicity
- Yield
- Agronomic and other relevant characteristics [9]

The oil will be marketed as TREUS ™ brand High Oleic Soybean oil through the Bunge DuPont Biotech Alliance. This alliance also markets another type of oil – TREUS Low Linolenic Soybean Oil. While many uses will overlap, there are differences in the performance of the two oils for some applications. For example, the high oleic oil performs better for heavy-duty frying (e.g., deep fryers) and has potential for industrial uses. [9, 18]

High Oleic Soybean Oil Performance

Product application testing is critical to the success of new trans fat alternative oils. So far, extensive testing conducted at both university and commercial pilot facilities has shown that:

- Low linolenic soy oil, high oleic soy oil and blends are **attractive alternatives** to partially hydrogenated oils.
  - Test foods included french fries, fried chicken, potato chips, tortilla chips and salad oil.
- High oleic soy typically **equaled or outperformed partially hydrogenated soy** in standard oil quality measurements.
  - Polars, polymers, p-anisidine, free fatty acids and peroxide value were measured.

- High oleic soy generated **less objectionable room odor** compared to partially hydrogenated oil during frying studies.[9]

Food Uses

Product application testing continues to open up new uses for high oleic oils. Research has shown they can replace regular canola, soy, and partially hydrogenated canola and soy oils in edible applications where increased stability is required. For example, oxidative stability testing of high oleic soybean oil has demonstrated that it is two to three times more stable than regular soybean oil and at least as stable as commonly used partially hydrogenated oils.

High oleic vegetable oil has been used successfully in snack food preparation for frying or spraying to enhance mouth feel and palatability. As a pan release oil, high oleic oil forms a barrier in pans that allows for clean release of the cooked product without flavor contribution. The increased oxidative stability of high oleic oil results in lower polymerization and less gummy build-up on equipment. Products such as breads, cakes, muffins and pizza also can benefit from this oil.

Industrial Applications

In addition to food uses, high oleic oils also have industrial applications. The industrial oleochemicals business is investigating the use of high oleic vegetable oils to act as feedstock for the production of numerous products. These products not only have the ecological benefit of being biodegradeable and derived from a renewable resource, but they also lend different and increased functionality.

High oleic vegetable oil is being tested and utilized in the cosmetics business and as a machine lubricant (e.g., high temperature engine, transmission, hydraulic, gear and grease applications). Independent testing has shown these new oils actually may perform better than petroleum-based products in some uses.

Long-term projections indicate that continued advancement in industrial applications research could result in an even greater volume requirement for high oleic oils in industrial applications than in edible applications.

Registration Status

United States**:** The high oleic soybean oil trait is on track for 2009 commercial introduction in the U.S., pending regulatory approvals.

Importing Countries**:** Following U.S. submission (December 2006) and other submissions globally, Pioneer submitted the high oleic soybean oil trait for EU import, food and feed use, and processing approval. This submission was officially received by the European Food Safety Authority (EFSA) in June of 2007.

Advancement of High Oleic Soybean Varieties

The Pioneer Product Development Group is rapidly advancing varieties with the high oleic soybean oil trait in anticipation of commercial introduction in 2009, pending regulatory approvals. Several experimental varieties that contain key defensive traits (soybean cyst nematode, *Phytophthora*, and brown stem rot resistance) in relative maturities ranging from early Group II to mid-Group III were nominated for winter production increase in Chile. Breeding efforts will be expanded at five soybean research centers in 2008 and 2009 and the number of experimental lines in yield trials will triple in 2008, achieving a broader range of maturity groups and more varieties with combined traits. [9]

The marketing edge

Soy has earned quite a reputation for a plethora of health benefits, ranging from cancer prevention to warding off coronary heart disease. In fact, the Food and Drug Administration awarded a health claim for soy's cholesterol lowering properties in 1999. Soy's protein reputation appears to have had a "halo effect" on soybean oil, too. According to the 2005 "*Consumer attitudes about nutrition survey"*, consumers consider soybean oil to be among the healthiest of all vegetable oils and rank it higher than canola and sunflower oil. [12]

The breakthrough of low-linoleic soybean oil will benefit the food industry and consumers, and could add an estimated US$100 million per year to the value of soybean commodities. After the 2006 soybean harvest, approximately 400 million pounds of high linoleic oil was expected to be available to the food industry, according to Qualisoy, while it was predicted that more than one billion pounds of low-linoleic oil would be available by 2007. [15]

Yum Brands represents the second major US brand to switch to low-linoleic soybean oil. Yum Brands announced on 26 October 2006 that the company's 5 500 KFC restaurants across the United States would switch from partially hydrogenated veg oils to low-lin soybean oil. This follows on Kellogg Company's December 2005 announcement that it would reformulate, using low-lin soybean oil in an effort to eliminate trans fats from a number of its food products. [13]

Developments elsewhere

Australia: Low-linoleneic soybeans are considered to offer an opportunity, although the local infrastructure (registered premises for food production, storage segregation, quality/traceability, drying and handling facilities, soft handling and post harvest) is considered as barriers/threats. Better understanding of the culinary attributes for soybeans is considered to be a key issue.[21] The market for specified soy oil in Australia is relatively small. [22]

The Australian food authority FSANZ, are reviewing the content of trans fats in Australian foods as a matter of priority. Questions are being raised on possible sources of healthy oils when transfat labelling does come into play in Australia. Imports from the US, in the form of low-lin oils from the Vistive soybean produced by Monsanto? Or perhaps Canadian Natreon canola oil derived form Nexera canola seed sold by Dow Agrosciences? [24].

No references could be found in the public domain to high oleic soybean research in South America.

Conclusion

The early successes with trans fat free oils and the overall health changes blowing in the wind have prompted a flurry of R&D efforts in the soybean industry, which has enjoyed its role as the top cooking oil provider in the US throughout the hydrogenated glory days. The first three low linolenic soybean oils out of the gate created enough oil in 2005 to address a significant portion of the food manufacturers needs. After that, soy's next big move was to succesfully breed high oleic soybeans – and other enhanced trait soybeans. [20] Soy, which is currently the primary competitor to the canola industry, has more ongoing investments in end use oil profiles and protein enhancements than canola. Indeed, much of the current investment in soy oil modification is driven towards making soy oil more competitive with canola oil for food markets. [23] The international soybean industry owes the USB a vote of thanks for its Better Bean Initiative and for the formation of Qualisoy.

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