SOYBEAN OIL INNOVATIONS

Superior Functionality • Improved Nutrition • Trans Fat Solutions

Blending +

Antioxidants +

QUALISOY™ +

Trait Innovations +

Interesterification +

Brought to you by the United Soybean Board +

6TH EDITION

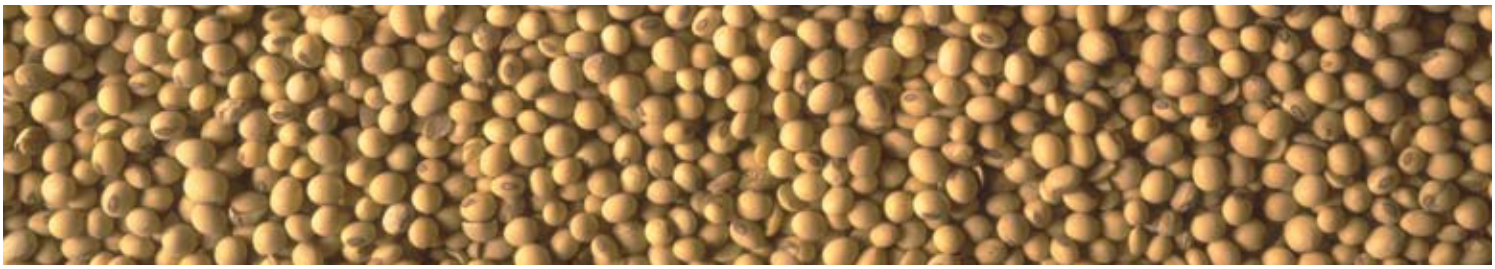
The Advancement of Edible Oils

An increase in consumer demand for healthy foods requires farmers and soy oil processors to change with the times. Providing healthful ingredients to the food industry has become more important than ever, and encourages everyone from farmers to food manufacturers to benefit from the growing trend in creating healthier foods.

After the Food and Drug Administration mandated the labeling of trans fatty acids on the Nutrition Facts panel in 2006, the soybean industry recognized the food industry's need for oil alternatives that could reduce or completely eliminate trans fat from foods. Through several coordinated initiatives, such as QUALISOY™, the soy industry pulled together to address the trans fat issue and offer soy-based solutions to the marketplace.

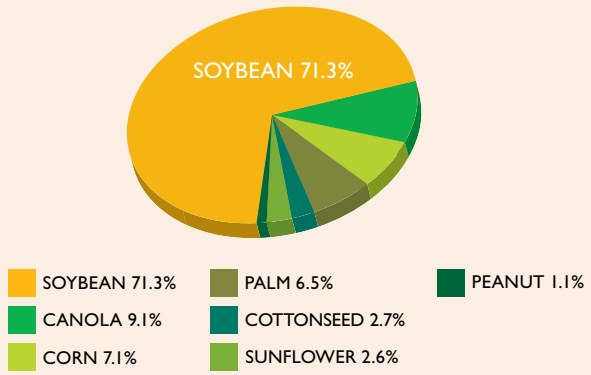
But adaptation of alternative products isn't as easy as it might sound. With fat replacement, processed foods experience changes in flavor, stability and overall functionality, requiring a laborious reformulation to maintain quality standards. The soybean industry recognizes this challenge, and continues to strive to develop oils that make the transition as simple as possible. The United Soybean Board (USB) is dedicated to educating the food industry about these options, driving adoption by farmers to increase supply and championing the innovative processes used to produce healthier soybean oils, while continuing a dialogue with food companies about the evolving needs of consumers.

The innovation doesn't stop at addressing the trans fat challenge. In addition to changing the oils of our past, the soy industry also recognizes opportunities to create new products that contribute other important functionality and nutrition benefits. Research is underway to develop products that deliver nutrition benefits consumers demand now, and those predicted to become dietary trends in the future.



The Future is Bright

U.S. Edible Fats & Oils Consumption*

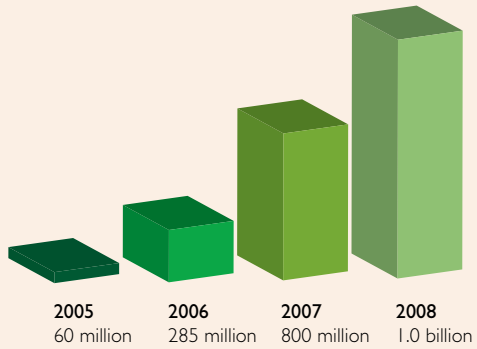


Source: U.S. Department of Agriculture, Economic Research Service: *2008 ERS Oilseed Yearbook*
*Chart represents market share of all major vegetable oils consumed in the U.S.

In terms of U.S. consumption, soybean oil significantly outpaces all other types of edible oils combined. The competitive cost, availability, neutral flavor and balanced fatty acid profile make for a winning combination for food companies. The soybean industry recognizes the need to build intrinsic value into new varieties, and every link in the chain is committed to improving the nutritional value and overall stability of soybean oil.

QUALISOY™

Estimated Low-Linolenic Soybean Oil Supply (in pounds)



Recognizing the food industry's need for improved soybean oils, USB helped form QUALISOY — a collaborative effort throughout the soybean industry to help bring improved traits to the marketplace. Through QUALISOY, the soybean industry has identified the value of various enhanced oil options to food companies, and drives the adoption and communicative outreach about varieties available now as well as those in the research pipeline.

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; and Iowa State University's Ultra Low-Linolenic Soybeans.

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

* Please note that these numbers reflect normal ranges, and may vary slightly according to environmental and growing conditions.

Soy Solutions to Reduce or Eliminate Trans Fats

Many different methods of eliminating or reducing trans fats using soybean oil are already available to the food industry, illustrating the versatility of soybean oil as a highly stable product with neutral flavor and nutrition characteristics consumers demand. From chemical processes to seed improvements, the soy industry continues to introduce oil options offering improved nutrition and functionality.

BLENDING

One popular method of reducing or eliminating trans isomers involves combining a fully hydrogenated soybean oil (a hard stock which does not contain trans fats) with a non-hydrogenated oil such as traditional liquid soybean oil, trait-enhanced varieties, or alternative vegetable oils.

Additionally, some blends include a portion of partially-hydrogenated soybean oil, but in a quantity that does not produce a significant enough amount of trans to warrant labeling. The FDA requires that any serving size with 0.5g of trans fat or more be included on the label. A serving size containing fewer than 0.5g does not require labeling, although the ingredient list must state that partially hydrogenated oil was part of the oil blend.

This process, in some cases, blends fully hydrogenated soybean oil and non-hydrogenated oil to create a final product without trans fats.

INTERESTERIFICATION

Interesterification is a processing technique that rearranges the fatty acids within and among molecules of oil (triglycerides). Unlike the hydrogenation process, interesterification does not cause isomerization, and no trans fatty acids are formed.

Traditional interesterification changes the melting profile of a blend of saturated and unsaturated fats. During this process, the fatty acids of the triglycerides are randomly shifted and exchange positions. This provides an option for modifying the melting point to improve structural stability and creaminess without producing trans fatty acids. The most commonly used catalysts are sodium methoxide and sodium ethoxylate.

Another method for interesterification utilizes enzymes and allows for more control and precision in achieving specific melting profiles. Different types of enzymes can be used, including lipases that randomize all fatty acids or 1:3-specific lipases that rearrange fatty acids in the 1- and 3- positions of triglycerides. The reaction is relatively slow and can be stopped at any given time to ensure the right degree of interesterification. There are extensive lines of zero and reduced-trans oils and fats produced through this process.

INCREASED USE OF ANTIOXIDANTS

Typically, edible oils used in food applications require the addition of a natural or synthetic antioxidant to prevent rancidity and extend shelf life. The most commonly used natural antioxidants are tocopherols, found in soybean oil up to 1,000 ppm. While processing removes some tocopherols, companies can modify deodorization conditions to make sure an appreciable amount remains to help prevent oxidation.

The most commonly used synthetic antioxidants are:

- Butylated hydroxyanisole (BHA)
- Butylated hydroxytoluene (BHT)
- Propyl gallate
- Tertiarybutylhydroquinone (TBHQ)

For vegetable oils such as soybean oil, TBHQ is considered one of the most effective antioxidants.

Studies have shown that adding 0.02 percent TBHQ increases stability by almost four times that observed in soybean oil without added antioxidants. This creates another option for reducing oxidation and enhancing stability without utilizing the hydrogenation process, particularly when used in conjunction with some of the aforementioned technologies.

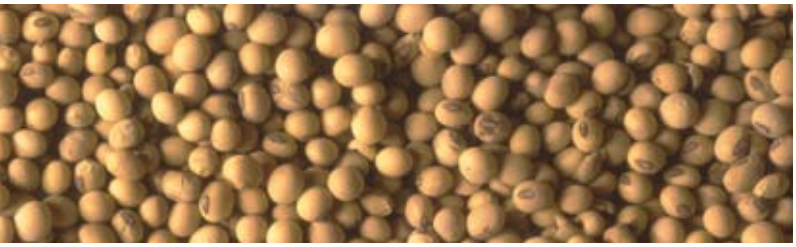
IMPROVED HYDROGENATION

Some companies can now modify the hydrogenation process itself to minimize the formation of trans fatty acids.

Methods used in this process include:

- Change in processing parameters
- Modification to processing equipment
- Utilization of new analytical techniques to closely monitor and control the process

By using improved hydrogenation techniques, a number of basestocks used to formulate multi-purpose and specialty shortenings can now be produced with 10 percent or less trans fats, and reductions to 5 percent or lower are being achieved.



Soybean Traits in the Research Pipeline

SOYBEAN TRAIT INNOVATIONS

In addition to the wide variety of processing techniques that reduce or eliminate the need for hydrogenation, the industry continues to work toward developing soybean varieties with enhanced compositional traits to produce healthier oil with improved 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, leading targets for soybean trait modifications include:

- Reduced saturates (maximum of 7%)
- Reduced linolenic acid (maximum of 3%)
- Increased oleic acid (minimum of 50%)

These modifications can be combined to produce soybeans with stacked-trait innovations.

The first trait innovation to become commercially available was the low-linolenic variety. Major food companies have made the transition to low-linolenic soybean oils from partially hydrogenated oils for frying and processed food applications. Decreasing linolenic acid increases the flavor stability and supports the oxidative stability of the oil, thus resulting in a product that can be used in place of partially hydrogenated oil in many applications.

The breakthrough of low-linolenic soybean oil will continue to benefit the food industry.

While supply was limited in the first few years of availability, an estimated one billion pounds of low-linolenic oil was produced in 2008.

INCREASED OLEIC

For improved oxidative stability with superior flavor stability, researchers are developing soybeans with increased levels of oleic fatty acid. Products requiring high heat during processing will benefit from this oil because of a superior resistance to flavor breakdown. Most varieties of increased oleic will also have a reduced linolenic acid content.

LOW-SATURATE

While soybean oil has a low-saturated fat content relative to many competing oils, significant research is underway to develop varieties with reduced saturate content, especially reduced palmitic fatty acid, to support cholesterol reduction and improve heart health.

INCREASED OMEGA-3

Alpha-linolenic acid (ALA) from soybeans and soybean oil is the primary source of omega-3 fatty acids in the U.S. diet. Researchers are developing soybeans with increased levels of stearidonic (SDA), eicosapentaenoic (EPA) and docosahexaenoic (DHA) omega-3 fatty acids. Clinical evidence suggests that these forms of long-chain omega-3 fatty acids have strong cardioprotective effects in the human body.

The goal of these enriched soybeans is to create an affordable, land-based, renewable source of omega-3 fatty acids. The resulting products will most likely be used as an additive to fortify traditional oils.

HIGH-STEARIC

Research on a soybean variety with high-stearic fatty acid content is also underway. Considerable medical research indicates that stearic acid may be cholesterol-neutral compared to other saturated fatty acids. High-stearic soybean oil would be highly stable and neutrally flavored, serving as an option for applications requiring a solid fat, such as baked goods. While nutrition labels do not currently segment the various saturated fatty acids, research proving stearic acid is a cholesterol-neutral fat could initiate change in labeling regulations.

How Do I Use It?

Blending can be used to produce a variety of shortenings that generally have flatter, or more gradually sloped, solid fat content profiles than alternative hydrogenated shortenings. It is a cost-effective technique compared to other methods of producing shortenings containing zero or low amounts of trans fats.

Interesterification enhances functionality beyond basic blending and can yield basestocks and shortenings similar to hydrogenated shortenings. With sharper, steeper sloped solid fat content curves, interesterified shortenings can be formulated for nearly any bakery application.

For any application using liquid oil, or for single-use frying applications, the use of **antioxidants** can support improved performance and oxidative stability.

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 soybean oil** 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. **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 frying industry for supply of this high-performance oil.

High-stearic soybean oil appears to offer the best direct alternative to the partially hydrogenated basestock used to formulate a wide range of shortening products.

UNITED SOYBEAN BOARD

Making Your Checkoff Pay Off.

DEDICATED TO THE FUTURE OF EDIBLE OILS

As consumer demand for soybean oil increases, the United Soybean Board (USB) is committed to ongoing research and continuous improvement of an already superior product. USB has established a core team of exceptional academic and industry professionals who are developing enhanced soybeans that will result in soybean oils that better meets the needs of food industry professionals, and provides additional health benefits to consumers. A farmer-led organization comprised of 68 farmer-directors, USB oversees the investments of the soybean checkoff on behalf of all U.S. soybean farmers. For more information, please visit: SoyConnection.com.

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