

Chapter Six: Biotechnology, IP Soybeans, Soyfoods, and Industrial Uses

Agricultural Biotechnology

The adoption of biotech crops, particularly herbicide-tolerant soybeans and cotton, has been rapid since their commercial introduction in 1996. For example, herbicide tolerant soybeans accounted for 87 percent of U.S. soybean acreage in 2005, leaping from 7 percent in 1996. U.S. farmers have broadly adopted the use of herbicide-tolerant soybeans because of lowered production costs and increased net yields due to reduced weed pressure and insect attack. USDA's National Agricultural Statistics Service (NASS) maintains statistics for all crops in the United States, including biotech crops. Statistics for biotech acreage planted for all crops in the U.S. can be found at <http://www.usda.gov/nass/pubs/pubs.htm>.

Today's biotechnology is an improved version of the same seed stock breeding process that has long been used to increase crop productivity, improve the food supply, and produce better, more nutritious foods. Researchers and scientists around the world have confirmed that there is no difference between health and environmental risks posed by plants that have been enhanced through modern biotechnology and those that were modified by conventional breeding techniques.

Biotech crops have enabled farmers to expand greatly their use of conservation tillage, which is better for insect and bird life, reduces soil erosion, and cuts the amount of CO₂ farming releases into the atmosphere. Biotech crops also deliver benefits to consumers and society at large, through more affordable food, feed and fiber that require less pesticides and hence a more sustainable environment. Most of the world's leading scientific institutions have confirmed that food containing biotech crops are safe, if not safer, than conventional agricultural methods. For more information on biotech crops refer to the following publications and websites.

“Dispelling the Myths” by Kimball Nill, USSEC Technical Issues Director
Available on the USSEC website: www.ussoyexports.org

“Global Status of Commercialized Biotech/GM Crops” by the International Service for the Acquisition of Agri-Biotech Applications (ISAAA)
Available on the ISAAA website: www.isaaa.org

Council for Biotechnology Information: www.whybiotech.com
Biotechnology Industry Organization: www.bio.org
Agriculture and Biotechnology Strategies, Inc: www.agbios.com

Identity Preserved (IP) Soybeans

To meet customers' demand, the U.S. soybean industry is focused on developing production methods that assure buyers that the beans they order are the beans they receive. This system of preserving the quality and identity of soybeans from seed to harvest to delivery is referred to as “identity preserved.” As demands for differing varieties of soybeans change, the U.S. identity-preserved system continues its decades-long reputation of being the world's best provider of IP soybeans – exceeding global demands.

Suppliers of IP soybeans typically contract for the production of seed-variety specific soybeans and work directly with seed suppliers, farmers, independent certification agencies, intermediate processors, and freight companies to deliver the pre-

ferred product within very tight tolerances, complete with sufficient documentation to trace it back to the producing farm and seed supplier.

IP soybeans are used primarily for human consumption in a variety of non-fermented food products including tofu (bean curd), yuba (soy protein extracts from soy milk), kinako (roasted soy powder), nimane (cooked beans), edamame (vegetable soybean), bean sprouts and soymilk. IP soybeans are also part of fermented food products including soy sauce, natto, miso, tempeh (Indonesia), thau-nao (Thailand), chongkuk-jang (Korea), dou-chi and doufuru (China), and kinema (Nepal, Bhutan, India).

Many superior IP soybeans have unique value-added quality traits such as high protein, low saturated fat, high digestible sugar, high isoflavone or improved texture and flavor. Breeders are working with food scientists on improving important nutraceutical characteristics and combining specific quality traits into specialty IP soybeans for functional soyfoods. In the future, new varieties with special nutritional attributes are expected to be released.

U.S. soybean farmers and grain handlers have become highly skilled in the IP process. This is clearly demonstrated by the consistent ability to deliver high-quality seed-variety specific soybeans concurrently with the rapid adoption of biotechnology. The U. S. food and agriculture system is the world's most experienced and motivated to supply future world IP markets.

Soyfoods

Soybeans contain all three of the macro-nutrients required for good nutrition: complete protein, carbohydrate and fat, as well as vitamins and minerals, including calcium, folic acid, and iron. Soybeans are the only vegetable that contains complete protein. Consumption of soy protein provides health benefits that may help prevent or treat certain chronic diseases. A great deal of research is being conducted to investigate possible health benefits of soy.

Whole soybeans can be cooked and used in sauces, stews, and soups. Whole soybeans can be roasted for snacks. Traditional soyfoods developed from whole soybeans include miso, natto, okara, soymilk, soynuts, soysauce, tempeh, tofu, yuba, and edamame.

Processed soybean protein products are divided into three categories based on protein content: soy flour, concentrates, and isolates. These three types of proteins are considered the starting materials for soy protein products. In some instances these materials may be processed further before they are incorporated into a food product.

Soy Flour

Soy flour is made from roasted soybeans ground into a fine powder and contains 50 percent protein. Soy flour comes in three forms: natural or full-fat, defatted, and lecithinated. Natural or full-fat contains natural oils found in the soybean. Defatted has the oils removed during processing. Lecithinated has lecithin added. Soy flour is gluten-free, so yeast-raised breads made with soy flour are dense in texture. Soy grits are similar to soy flour except that the soybeans have been toasted and cracked into coarse pieces.

Soy Protein Concentrate

Soy protein concentrate (SPC) is made wholly from defatted soy meal; soluble carbohydrates that are present in the meal, flour or TSP are removed by further processing. It is a flour-like product consisting of about 70% protein. Soy protein concentrate is used in a variety of meat systems, baked goods, and dairy applications. It is highly digestible and well suited for children, pregnant and lactating women, elderly, people who are ill, and situations where protein nutrition is of utmost importance. This product can also be fortified with various micronutrients and minerals.

Soy Protein Isolates

When protein is removed from defatted flakes the result is soy protein isolate (SPI), the most highly refined soy protein. Containing 90 percent protein, isolates possess the greatest amount of protein of all soy products. They are a highly digestible source of amino acids and because of the bland taste can be added to foods without jeopardizing flavor or characteristics. SPI can be used as an ingredient in high-protein foods including dairy foods, nutritional supplements, meat systems, infant formulas, nutritional beverages, cream soups, sauces, and snacks. It is also the source of protein in milk replacers. Due to its high protein content, soy protein isolate is highly suited for those people who have high protein needs due to, for example, growth (children), famine (acute needs), and chronic diseases (HIV/AIDS and tuberculosis). This product can also be fortified with various micronutrients and minerals.

Textured Soy Protein (TSP)

Textured soy protein (TSP) usually refers to products made from textured soy flour and textured soy protein concentrates. It is used as a meat extender or analog and can be added to a meal to increase its protein content. TSP has a texture similar to ground beef or other meat products and must be rehydrated with water before use.

Textured soy flour is made by running defatted soy flour through an extrusion cooker, which allows for many different forms and sizes. It contains 50 percent protein as well as the dietary fiber and soluble carbohydrates from the soybean. When hydrated, it has a chewy texture. It is widely used as a meat extender. Often referred to as textured soy protein, textured soy flour is sold dried in granular and chunk style and is bland in flavor.

Textured soy protein concentrates are made by extrusion and are found in many different forms and sizes. Textured soy protein concentrates contain 70 percent protein as well as the dietary fiber from the soybean. When hydrated, they have a chewy texture and contribute to the texture of meat products.

For more information on uses of soyfoods, distributors and manufacturers of soyfoods and general health-related information, refer to the following websites.

www.talksoy.com - Sponsored by the United Soybean Board
www.soyfoods.org - Soyfoods Association of North America
www.thesoyfoodscouncil.org - The Soyfoods Council

Industrial Uses of Soybeans

While most soybeans are further processed for feed or food uses, up to 15% of soybean oil is used for industrial purposes. Soybean oil can be used as emulsi-

fiers, lubricants, plasticizers, surfactants, plastics, solvents, and resins. Research and development approaches take advantage of the natural properties of soybean and other vegetable oils. These oils have superb environmental qualities, such as being inherently biodegradable, having low ecotoxicity and low toxicity towards humans, being derived from renewable resources, and contributing no volatile organic chemicals.

Biodiesel is a clean burning alternative fuel developed from soybean oil. The use of biodiesel reduces exhaust toxins by 90 percent and results in a substantial reduction of unburned hydrocarbons, carbon monoxide and particulate matter. Biodiesel is less toxic than petroleum diesel fuel and is readily biodegradable. But these environmental benefits do not negatively affect performance. Tests show that blending even a two percent blend of biodiesel into petroleum diesel can increase lubricity by more than 65 percent. For more information on soy-based biodiesel, refer to the National Biodiesel Board at www.biodiesel.org

Another example of products that enhance environmental and worker safety is soy-based engine oils. The oil is readily biodegradable, virtually nontoxic and exceeds the performance requirement of the International Organization for Standardization (ISO) global specification, the world's toughest standard for this type of lubricant. Soy-based engine oil emits fewer harmful emissions than petrochemical-based oil for increased worker safety.

Methyl soyate, the main ingredient in soy-based solvents, is another example of how biobased products enhance environmental and worker safety. Methyl soyate is low in volatile organic compounds (VOCs) and does not generate Hazardous Air Pollutants (HAPs). It can reduce hazardous waste generation and lower costs for disposal, insurance and regulatory reporting. Testing shows that soy-based solvents may improve flammability safety due to a very high flash point. They are readily biodegradable and lower in toxicity than most common solvents.

For more information on industrial uses of soybeans and soybean products and a listing of suppliers, refer to the Soy Products Guide available on the United Soybean Board website: www.unitedsoybean.org.