

Soyabean

Soyabean article written by Dr Ignace Debruyne of the American Soybean Association, Brussels Office - www.oilseeds.org

The soybean is one of the oldest vegetables known to man. Soybeans have been grown and consumed for more than 5000 years in China and the Far East. They are, however, a relative newcomer to the Western consumer, particularly when looking at soyfood consumption only.

Soyfoods, for example, soymilk, soynuts, tofu and tempeh, are the most visible form of soy containing foods to the consumer. Soybeans and soybean products have a much wider application area. They contain all components necessary for optimal food and feed application. Soya is not only an excellent source of vegetable protein (34 – 39%, with a balanced composition containing all the essential Amino acids) and of vegetable oil (18 – 20%, containing all the essential fatty acids), it is also rich in fibre, carbohydrates, phytoestrogens, steroids, vitamins and minerals. The functional properties of soy protein based ingredients and the versatility of soybean oil based components add to its widespread use.

A more recent development is the application in technical areas. Oil derived products are already used as fuel (biodiesel), in lubrication, printing ink formulations, dust control and as pesticide and herbicide solvents. Technical protein applications still remain limited (wood adhesives, paper coatings).

Soybean Growing

Soybean has proved adaptable to a wide variety of climatic conditions. Although sub-tropical in origin, cultivation now extends much farther. Soybeans only arrived in the United States in 1804 and were a relatively minor crop until the 1920s. Since then, commercial growing has been continuously increasing. In the United States, nearly 400,000 farmers grow soybeans on more than 29 million hectares of land. At a record of \$17.7 billion, soybeans are the second most valuable US cash crop after corn. Since the early 1980s, South American farmers have also expanded their soybean planting area, with Brazil and Argentina adding considerable volumes to the world production and trade of soybeans. The Chinese production is huge, but is used exclusively for local consumption.

Processing

The number one soybean process is the crushing of the beans, i.e. extraction with the use of a volatile solvent. The major products of this bulk process are protein rich soybean meal (with 48 or 44% protein dependent on preliminary hull removal) and crude soybean oil. The natural emulsifier (lecithin) is a valuable by-product obtained by water-degumming this crude oil.

Large scale crushing plants are operational in not only the major soybean growing countries, but also in the importing countries where they provide a balanced use of protein and oil according to local needs. Plants differ in size from a few hundred metric tons per day to as large as 10,000 metric tons per day.

Soybean Trade

The soybean complex refers to the soybean and its two principal by-products (soybean meal and soybean oil) and their special inter-relationship throughout the production, processing and marketing processes. They are traded as separate commodities on a world market scale. Futures exchanges, such as the Chicago Board of Trade and the MidAmerica Commodity Exchange, provide vital functions for the market place, i.e. risk transfer and price discovery. Agri-business participants use futures to offset potentially adverse changes in price. The many factors influencing supply and demand converge on the trading floor and result in the determination of commodity prices.

FOSFA International contracts deal with the actual buying, selling, transport and delivery of soybeans and soybean oil on a world scale; while GAFTA contracts handle the soybean meal trade.

The United States exports almost half of its soybean production to the world market. It is also the world's largest consumer of soybeans, soybean meal and soybean oil. A growing world population, rising incomes and changing diets around the world are pushing up the market for soybeans and derived products. Vegetable protein and vegetable oils replace or add to animal protein and fats. Eating more eggs and meat requires the production of more animal feed.

The European Union is the major importer whilst China is the strongest growing market for soybeans, meal oil. Southeast Asian countries, Turkey and the Turkish Republics, are the other major growth markets for soybeans, meal and oil.

Feed Applications

The soybean's strong potential as a feed ingredient for poultry, cattle and swine is the primary driving force for its worldwide market growth. In feed applications, soybeans are used as such, or as soybean meal, the product obtained after solvent extraction of the oil. Soybeans always need an appropriate heat treatment to eliminate anti-nutritional factors (such as trypsin) and to stabilise the high product quality (enzyme and protein denaturation; eliminating lipid oxidation processes). Various toasting and extrusion processes are available to obtain this. Similarly, soybean meal is heat treated by thorough toasting after desolventising.

The widespread applicability of soybean commodities in the feed industry is first of all protein based. However, the soybean oil as such, or as a component of full fat bean products, is also a basic energy source in many feed formulations. As such, full fat beans replace both competing protein rich meals, for example, fishmeal and added oils and fats. Many high energy rations can be economically optimised by using appropriately treated soybeans as a protein and energy source.

For feed mill use, the crude soybean meal is handled as such or as pellets. A further size reduction might be needed for speciality feed product applications. Soy flour, for example, is obtained by milling solvent extracted soybean flakes or meal. For piglet starters and calf milk replacers, a much stronger denatured product is preferred. This is obtained, for example, in the production process of soy concentrates. Concentrates are produced by further alcohol washing the solvent extracted soybean flakes. The removal of carbohydrates and some of the minerals results in an increased protein content (65-70%).

Food Applications

Soybean commodities can also be processed to valuable, versatile and functional food ingredients. Crude and degummed soybean oil is refined, bleached and deodorised before use in food. During the chemical refining step, free fatty acids, soaps and remaining gums are removed. The bleaching process is used for the control of product colour. Deodorisation finally eliminates unwanted taste and flavour components. The refined, bleached and deodorised oil is commercialised as salad oil or for other low temperature applications. It is also a major ingredient in many oils and fats containing products, for example, shortening and margarine, biscuits, cookies and bread, chocolate type products and candy coating.

For many of these applications, refined and bleached soybean oil needs to be hydrogenated before deodorising. During hydrogenation, a more saturated fatty acid composition can be obtained, yielding products with a higher melting point. This results in a wide range of hardstocks with different melting characteristics. Combining these components enables the composition of shortenings and bakery margarines with adapted functional characteristics, for example, optimal plasticity and suitable spreadability.

White flakes (the defatted soybean flakes obtained after oil extraction) can be further processed for the production of soy concentrates (65-70% of protein) and soy isolates (more than 90% of protein). Concentrates and isolates are available with a wide range of functionalities, for example, with optimal emulsifying characteristics, improved water-binding capacity, enhanced fat-binding properties or adapted gelling characteristics. These speciality products are developed for applications in speciality meat and bakery products.

Soybean flour is an important ingredient for bakery products, either as a functional component or for protein enrichment. Indeed, protein fortification of foods is a major outlet for soybean flour in developing countries. Extrusion-type processes transform soybean flour, concentrates and isolates to textured vegetable proteins, which can directly be used as meat extenders and meat replacers.

The ever widening use of soybean oil and protein based ingredients in food is one of the major driving forces in the expanding world market of soybean seeds. Indeed, about 60% of all products in the Western market contain one or more soybean-derived ingredient. Soyfood products, however, remain very new in the Western diet; soybean milk and derived products (desserts, fermented, yoghurt-type), tofu, tempeh and miso.

The trend for health foods, together with the growing number of vegetarians, are major driving forces for the soyfood market expansion. The presence of natural, health promoting and sustaining components, for example, isoflavons, tocopherols and a balanced fatty acid composition high in mono- and poly-unsaturated fatty acids, is adding to this trend.