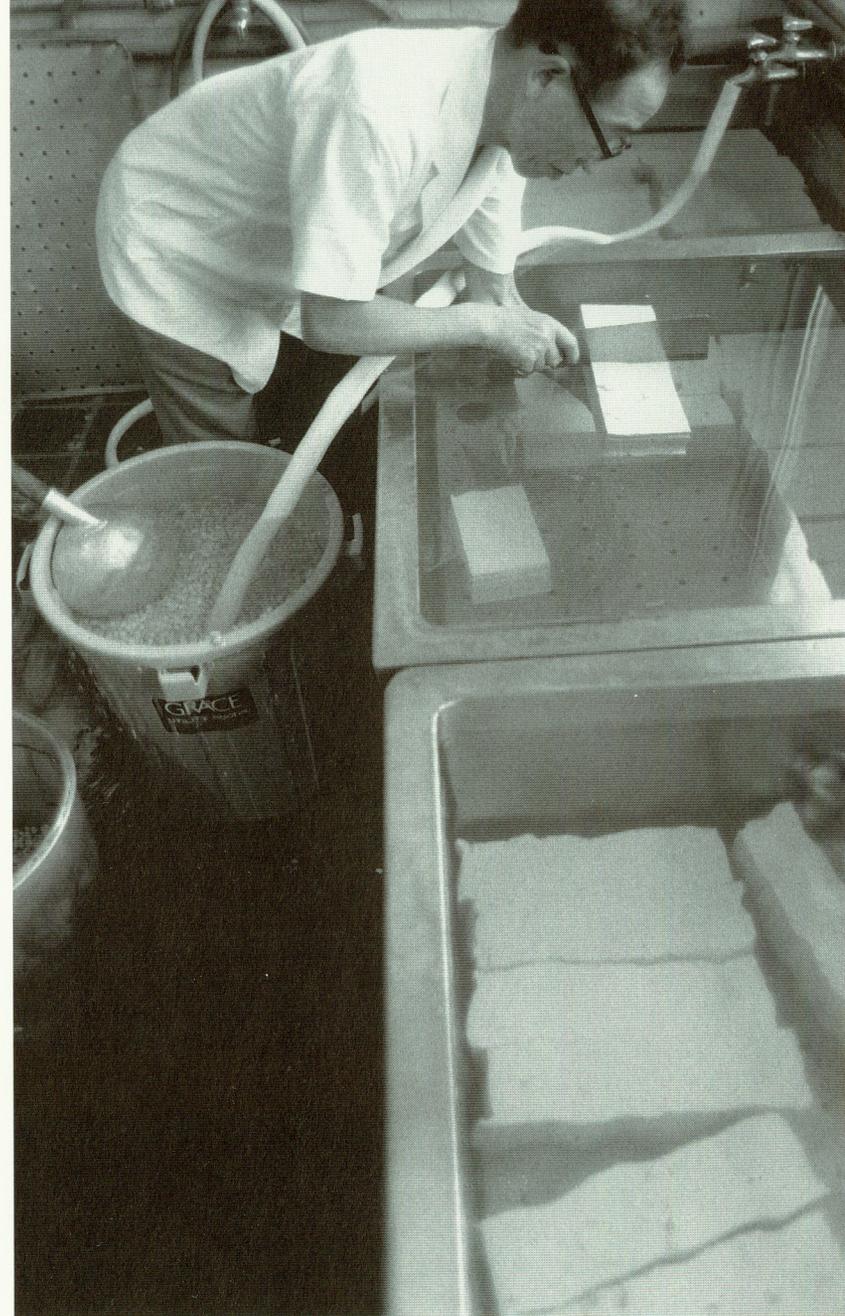


U.S. Crops in Asian Foods

Japan for many years has been America's number one customer for soybean exports. During the 1950's, however, that lucrative market was threatened. The Japanese use the whole bean in preparing foods like tofu and miso, a paste that is usually added to soup and generally eaten twice a day for protein and flavor. Complaints came from importers about certain characteristics of U.S. soybeans, such as broken beans, uneven cooking, dark-colored products, and undesirable beany flavors. Other Asian nations also reported difficulties in preparing traditional foods with American soybeans. Researchers at the Peoria laboratory were asked to evaluate typical U.S. soybeans in Asian foods.

The research, part of a market development program of USDA's Foreign Agricultural Service and American Soybean Association, was carried out with the help of Japanese food technologists. The NRRC team first cracked soybeans into grits and removed the seedcoats, cutting the fermentation time in half. Seedcoat removal, it turned out, eliminated the greatest single cause of the unsuitability of some American soybean varieties. It removed any black hila, or eyes, which caused objectionable dark spots in the miso, and it increased both protein content and uniformity. In time, miso made in the Peoria laboratory was judged equal in quality to the Japanese product.

Tofu, a soybean curd now familiar to American consumers, is made by soaking, wet grinding, cooking, and filtering soybeans to produce an emulsion. A chemical is added to coagulate the protein and the oil. The tofu is molded into a soft, white cake used in soup or fried in deep fat. The Japanese Ministry of Agriculture evaluated American soybean varieties and judged several equal to Japan's for tofu production. Japanese imports of U.S. soybeans began to climb, until today Japan buys about 4 million metric tons a year. And tofu, frozen and otherwise, caught on in the American market. NRRC has been the major source of technical information for this expanding new American business.



Researchers in Peoria helped expand the Japanese market for U.S. soybeans by finding ways to make acceptable versions of popular Asian foods like tofu, a soybean curd.

NRRC research continued on fermented foods popular in Asia. Scientists learned to make tempeh, a traditional Indonesian food made in that country by fermenting soybeans wrapped in banana leaves. A mold, *Rhizopus oligosporus*, transforms a practically inedible cake of beans into a flavorful, easily digestible food. Tempeh, which is always heated before eating, can be sliced and fried or cut up and added to soups and stews. The NRRC team experimented with it and came up with a flavorful tempeh made from wheat and soybeans. The protein content of the improved tempeh was more balanced than that of tempeh made with wheat or soybeans alone. Tempeh can also be made from oats, barley, rice, and rye.

Further NRRC soybean studies produced American versions of many more oriental foods, including sufu, a Chinese soybean cheese, and kori-tofu, a dried soybean curd popular in Japan. Experimenters even developed a couple of new fermented soybean items—hakko tofu, a high-protein food with smooth texture and relatively bland flavor, and soy yogurt, made from an improved soy milk. These products may yet appear in American supermarkets.

Meanwhile, at the Western lab, food researchers were turning out moist, Chinese-style steam bread and noodles to find out how flour from California wheats measured up. Chinese bakers had complained that flour made from some California hard red wheats made the dough too sticky. A food technologist blended a hard white variety of wheat with the red. The resulting flour gave steam breads the smooth, glossy-white finish prized by bakers in China, and it proved just as acceptable for noodles. The wheats are now exported to China under the name California Blend.

Another WRRC scientist has developed a process to reduce the salt in soy sauce by 50 percent. He also increased the potassium content five times without sacrificing the sauce's rich flavor or causing bitterness. High salt intake has been linked by medical researchers to hypertension. The new WRRC technique works not only for soy sauce but for other high-sodium, fermented liquids as well, including oriental fish sauce and tamari sauce.

The Extraordinary Enzymes

Enzymes are very large protein molecules that make possible the many complex biochemical processes necessary to maintain life. All enzymes are catalysts. They speed up and direct the thousands of chemical reactions that take place in all living things without being consumed themselves.

In human bodies, enzymes aid digestion by helping break down large molecules in the food we eat into smaller molecules. Other enzymes guide these small molecules through the intestinal wall into the bloodstream. Still others promote the creation of complex molecules to produce the constituents of our cells. Enzymes are also responsible for respiration, the storage and release of energy, vision, reproductive processes, and every other aspect of metabolism. Enzymes are indispensable to life.

Enzymes are specific; each one is able to promote only one type of reaction. Further, there is only one area or region of an enzyme that can bind its substrate. That area is known as "the active site," and the mechanisms by which substrates bind to enzymes are known in only a relatively few cases. Most extraordinary of all is the speed and efficiency of reactions catalyzed by enzymes. In a living plant or animal, an enzymatic process is typically lightning-fast. When scientists try to duplicate the same process in the laboratory, it proceeds much more slowly and is often incomplete.

Much remains to be learned about the science of enzymology. It has been only 65 years since the first enzyme was isolated, and researchers today know that each living cell contains up to 50,000 separate enzymes. Many scientists believe that enzyme research will continue to prove one of the most productive areas of biochemistry and will lead to the creation of many exciting new products and processes.