TABLE III

Effect of Ethyl Alcohol/Hexane MixedSolvent Extraction of Prepressed Cottonseed Cake in a Small Extractor

Composition of mixed solvents[a]	Free gossypol (%)		Total gossypol (%)		Residual oil[d] (%)
	Wet meal[c]	Wet meal after steaming	Wet meal	Wet meal after steaming	
Ethyl alcohol/commercial hexane (20:80)	0.029	0.013	0.55	0.315	0.34
Ethyl alcohol/commercial hexane (30:70)	0.027	0.016	0.52	0.39	1.04
Ethyl alcohol/commercial hexane (40:60)	0.05	0.013	0.55	0.38	2.35
Prepressed cottonseed cake[b]	0.34	–	–	–	11.5

[a]Concentration of ethyl alcohol = 90% vol.
[b]Weight of cake in the batch extractor 40 kg; the total wt of mixed solvent = 120 kg.
[c]The wet meal after draining was used to recover the solvent with live steam.
[d]The residual oil in prepressed cottonseed cake = 11.5% and the free gossypol = 0.34%.

tor, the miscella could be recycled to create greater turbulence of the mixed solvent and thus enhance the extraction.

The quality of the cottonseed meal thus obtained entirely meets the requirements of animal feeds. In addition, the cottonseed meal, if desolventized at lower temperatures, can be substituted partially or wholly for soybean meal in making, e.g., soy sauce and foaming agents used in candy. The residual oil in the meal extracted by mixed solvent is ca. 0.5% or less. This again proves that the ethyl alcohol present in the mixed solvent is able to reduce the residual oil contained in the meal.

The fatty acid in the cottonseed oil is extracted by ethyl alcohol so that the acid number is ca. 2. Moreover, the mixed solvent can remove the gossypol and lecithin, e.g., so that the quality of cottonseed oil extracted by mixed solvent is better than that obtained by the usual hexane extraction method.

Because of the world's rapidly increasing population, scientists are worried about the protein shortage. Because cottonseed meal contains ca. 35-38% protein, the tremendous amount of cottonseed in the world, if extracted by the mixed solvent, would produce sufficient cottonseed meal for animal feeds. The resultant cottonseed protein can therefore be used as a substitute, partially or wholly, for soybean protein.

The gossypol extracted by hexane/ethyl alcohol might be used as a starting material for preparation of pure gossypol. Pure gossypol is now being used in China for birth control. The gossypol could also be used as mordant dye and in antitubercular drugs. Dianilinogossypol, a very stable compound with its antioxidant activity equal to that of gossypol on a molar basis, could be used as an antiagar in rubber industries (11). We expect, therefore, that the solvent extraction industry of cottonseed with hexane/ethyl alcohol as a mixed solvent will be further developed in the future.

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Soybean Protein Food in China

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ABSTRACT

This paper introduces the history of soybeans and soybean protein foods in China. For 4,000 years, soybeans have been one of the main crops cultivated in this country. The history of extracting protein to prepare a protein food (bean curd, tu-fu) is about 1,000 years old. Our ancestors had long been aware of the edible value of the soybean and had developed a technique for preparing many kinds of soybean foods. The traditional methods of preparing soybean protein foods such as bean curd (tu-fu), fermented bean curd (fu-ru) and dried bean milk cream (fu-tsu) are discussed.

The soybean is native to ancient China. The letters of "soybean" were found in the inscriptions on bones or tortoise shells of the Shang Dynasty (14th century B.C.). Along with wheat, rice and millet, soybeans were one of the main crops of the age. If soybean growing began at the time of the emperor Shennong, it has a history of more than 4,000 years. The cultural level was raised as economic productivity flourished. The soybean was important not only as a food but as a flavoring for food, as well. The earliest fermented soybean products were "du jiang" and "du chi." Du jiang is a fermented soy mass, and du chi is dried, fermented and salted soybeans. The preparation of these products was recorded briefly in *On Medical Emergency Treatment*, written by Si Yu during the West Han Dynasty (100 B.C.). Later, these procedures were described in detail in the *Peoples Agricultural Calendar*, written by Cui-Zi during the Han Dynasty (200 A.D.). Illustrations of techniques appeared in 600 A.D. in special chapters of *The Principal Methodology of Economics*, by Jia Si-Yi.

A major development in the technique of soybean processing was the ability to extract protein to prepare bean-curd as food. According to historical literature of the Min and Qing Dynasties, the preparation of bean curd was first recorded in *Han Zi*, written by Liu An, King of Huai Nan (179-122 B.C.). In the book of *Qin-Yi*, Tao Gu (907-960 A.D.) said that bean curd was a common food in the market of the south Huai district. It is therefore possible that bean curd was a traditional food which originated in the reign of the King of Huai Nan. It is almost certain that the technique of bean curd preparation is more than 1,000 years old.

Fu ru is the fermented form of bean curd. The earliest record of this is in a book called *Night Dialogue under the shade*, written by Li Ri-huo (1636-1661). He said that fu ru was prepared between summer and autumn in the Qi Men district and briefly described the procedure. In a famous book on Chinese herbal medicine, *Compendium of Materia Medica*, the author, Li Shizen (1518-1593), describes the preparation technique in detail.

Soybean products were prepared manually until recently, when mechanization was introduced in large cities. Various soybean foods include sprouts, du jiang, du chi, soy sauce, wei jing, soy milk and soy protein foods, such as fu ru, fu tsu and various bean curds.

Bean curd products include tender bean curd, medium bean curd, tough bean curd, bean curd sheet, vegetable chicken and fried bean curd.

Some methods of preparation follow.

Bean Curd (Fu Fu)

Bean curd is the most popular soybean product. The steps taken in bean curd production are cleaning, crushing, dehulling, soaking, grinding, separation of residues, boiling, adding coagulant, wrapping and pressing.

Cleaning, cracking and dehulling. The time required for soaking the soybeans to modify color and flavor is shortened by cracking and dehulling. The cleaned bean is crushed into 1/6-1/4 granules in a crusher, then dehulled by air separation, in which 5% of its weight is separated as hull.

Soaking. In soaking, the soybean absorbs water until its texture is softened so it can be easily ground and disintegrated. This facilitates the extraction of protein, while dust and some foreign materials may also be washed off. The speed of water absorption by soybeans is related to the temperature of the water. Soaking time is shorter at higher temperatures and vice versa. At 15 C, the soaking time is 3-4 hr.

Grinding. The soaked soybean is ground in order to increase the extractability of the protein. In grinding, a stone mill or steel disk mill is used. Water is added to increase the fluidity of the mass. The amount of water added is ca. 2 times the weight of the soaked soybean.

Separation of the residues. The ground mass of soybean contains "soluble" protein and carbohydrates, as well as insoluble fiber and hull, e.g., which must be separated. The mass is diluted with ca. 5 or 6 times this amount in water, filtered with a basket-type centrifuge through a filter cloth and washed once or twice with an appropriate amount of water.

Boiling. The density of the soy milk is regulated to 6.5-7 Be' and heated to boiling for ca. 5 min with direct steam. The protein is considerably denatured through boiling to become more easily digestible. After boiling, the urease and antitrypsin are deactivated and the soybean milk is sterilized.

Addition of coagulant. Boiled soy milk is coagulated by adding a coagulant such as calcium sulfate, thus forming bean curd. The yield and quality of the bean curd is relative to the temperature of coagulation, amount of coagulant added and the concentration of the soy milk. Generally, the concentration (represented as density in Be') should be adjusted to 6-7. Coagulant is added when the milk is cooled to 75-85 C. If the temperature is too high or the amount of coagulant added is too great, the rate of coagulation of the protein will be too fast and the texture of the bean curd will be coarse. The amount of calcium sulfate added is 3-3.5% by weight of the soybean. The kinds of coagulant used vary according to the kind of product. For example, the rate of protein coagulation is slow when calcium sulfate is used and the texture of the bean curd is very smooth. Calcium chloride is used for preparing fried bean curd because it swells well while frying. The coagulant must be dissolved in water; the water solution is gently added to the soy milk with stirring. After 10 min, the soy milk coagulates as a gel.

Pressing and packing. The soy milk gel is poured into a wooden tray which is lined with a piece of fine cloth. The gel is then wrapped and placed into a press that is capable of reaching a suitable pressure. If the time of pressing is short, the product will be tender, and if the time is longer, the product will become more tough. After pressing, the product is unwrapped. Generally, the total pressed solid is about 15% of the original bean curd mass. In different regions of China, the tenderness or toughness of the bean curds deviate considerably according to the traditions of the natives. In southern China, the bean curd is tender, whereas in northern China, it is tougher.

Bean curd derivatives. Using bean curd as a base, derivatives can be produced, such as tough bean curd, dried soybean sheets, fried bean curd and vegetable chicken. The tough bean curd is prepared by pressing the wet curd to a piece 30 x 30 x 15 mm in size, of which the total solid is ca. 30%. The tough bean curd may be flavored or smoked to prepare curds of special local flavor. In Beijing, for example, suzhou is a smoked, tough bean curd. Bean curd sheet is made by pressing the bean curd into a sheet of 200 x 300 mm and 1-2 mm in thickness (total solid content: 40%). Vegetable chicken is prepared by rolling the bean curd in a thin layer of sodium carbonate powder and sealing the roll. These rolls are soaked in flavored liquids and boiled to increase toughness and to impart certain special flavors.

Fermented Bean Curd (Fu Ru)

Fu ru is a fermented product of bean curd. Part of the protein is converted to amino acids by mucor fungi and these amino acids, together with the hydrolyzing, nonprotein products of other substances and added spices give fu ru its delicious flavor. The general process includes soaking, grinding, residue separation, boiling, adding coagulant, wrapping and pressing, cutting, fermentation, salting, packing in earthenware and aging. The steps are similar to those used in making bean curd, with some important differences.

Addition of coagulant. An inorganic salt, such as calcium sulfate, is inappropriate for making fu ru. The coagulant used is derived from the mother liquor which is pressed out of the bean curd. The liquor sets for 2 days until the pH reaches 4. This coagulant shortens the time of natural fermentation for the bean curd.

Ten min after the coagulant is added, the soy milk coagulates. It is then wrapped and pressed. The liquid should be pressed out as much as possible to prevent the accumulation of too much water which will affect the growth of the filamentous fungi. Then the pressed curd is cut into small pieces. The total solid content should be 35%.

Fermentation. The pieces of bean curd are arranged on wooden frames and put into the fermentation room at 18-20 C. Natural fermentation follows for 3-4 days. The hyphae of filamentous fungi grow to ca. 10 mm thickness on the surface of bean curd.

Salting. After fermentation, the bean curd is salted by arranging them in the large vats and spreading every layer with table salt. One day later, the hyphae will have adhered to the surface of the bean curd. Salt water (ca. 18 Be') is then added. The salting period lasts for 10 days.

Packing in earthenware. The fermented bean curd pieces are transferred to a small earthenware jar and spices are added. The pieces of bean curd are soaked in the spicy liquid. The spices usually are Chinese prickly ash seed, anise and red pepper. Red fu ru is prepared by adding Red Koji (a fermentation product used as coloring matter in food) as a tint to make the fu ru a crimson color and give it a different flavor. There are 10 or more varieties of this fu ru on the market.

Aging. The small earthenware jars filled with fu ru are placed in a room to age at 30 C. The aging period is generally 6 months.

Dried Bean Milk Cream (Fu Tsu)

When the soy milk is heated in a shallow pan, a film consisting of oil and protein is formed on the surface. This film is rolled out and dried until it resembles a cut of bamboo, hence the name "Fu tsu." Its composition is similar to textured vegetable protein. The procedure includes soaking, grinding, separating from the residue, boiling, skimming and drying. The initial preparation is like that of the soybean milk already described.

Skimming. The concentration of the soy milk should be ca. 7 Be'. The boiled soy milk is poured into shallow pans (3 m x 0.6 m x 0.1 m) which are divided by wooden plates into 10 equal parts. The pans are heated by indirect steam. The temperature of the bean milk is maintained at 90-95 C. The surface film is skimmed, rolled out and hung over a rod. The thickness of this film is ca. 0.15 mm. The percentage yield of fu tsu is ca. 60% of the original soybean.

Drying. The wet fu tsu is dried at 50 C in the drying room. After 24 hr the moisture content drops to below 10%.

Soybean protein products are among the favorite foods of the Chinese. In addition, vegetarians or those who suffer from hypertension need these products for good nutrition. Even though some new products, such as soybean milk powder and texturized soy flour, are being marketed, the demand for traditional protein products is increasing.

A Review of the Detergent Industry in China

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ABSTRACT

This paper is a general review of the development of the detergent industry in China. Examples include alkylation with aluminum ingot, dehydrogenation catalysts, double-film SO_3 sulfonator and enzymatic detergent.

In China, cleaning materials were available centuries ago. Some of these were straw ash, soap pod, teaseed cake and alkali-blended pig pancreas. The modern soap industry began in 1903 and soap is still the main laundry product in this country. The synthetic detergent industry, which started in the late 1950s, has developed rapidly. In 1979, the production of soap and detergent was rated at 734,000 and 397,000 tons, respectively, indicating a low level of consumption per capita (ca. 1.3 kg), compared to the developed countries. The annual production for the past two decades of soap and detergent is shown in Figure 1. In general, the annual increase is ca. 10%. The production of soap in 1977 was estimated to be 8 times higher than that in 1949. Production of detergents has risen from 6% of total cleansing products in 1964 to 35.8% in 1978. Greater expansion in the detergent industry is expected in the future.

China's soap-making technology is conventional. It induces a cooling process for laundry soaps and a milling process for toilet soaps. There are laundry soaps containing 53, 56, 65 and 72% fatty acids. Toilet soaps contain more than 78.5% of fatty acids. Laundry soaps total 90% of soap production.

Among detergents, the powdered products are predominant, making up 95% of the total. There are several grades of detergent powder on the market containing 20, 25 and 30% of active material. Paste-type detergent is estimated at 10,000 tons. In addition, liquid and cake products are also available. In China, home laundering is done mostly by hand. Washing machines are not very common in households, although they are popular in laundries, hospitals and hotels.

Also available is a wide variety of surface-active agents in which linear alkyl benzene (LAB) is the predominant ingredient. Two processes are used to produce LAB. In the first, the normal paraffins from the molecular sieve or urea extraction are subjected to chlorination, and benzene is then alkylated with the chlorinated paraffin to produce LAB. In the second process, paraffin wax is thermally cracked to olefins of different molecular weights, a fraction of which is reacted with benzene to produce LAB. The production capacity of both processes is nearly equal. The total production of LAB was 37,700 tons in 1979. A new alkylate plant (UOP process) with a capacity of 50,000 tons/year was scheduled for start-up in 1980.

A higher paraffin fraction (C_{15}-C_{18}) from urea extrac-