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Chapter 2

History of Chinese Fermented Foods

by

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Over the centuries, the Chinese have used fermentative microorganisms to convert agricultural commodities into foods. These fermented foods have contributed significantly to the improvement of the quality of the diets and the livelihood of the people. Furthermore, the early discoveries have laid the foundation for the present technology in food fermentations.

Perhaps because of climatic conditions, molds grow fast and luxuriously in many parts of China. Thus, not only have the Chinese long grasped the knowledge of growing molds, they also have continued to develop the technology of mold fermentation. This article briefly outlines the development of Chinese fermented foods.

Chu

Chu, written in hieroglyphics, indicates fermented products of wheat, barley, millet, and/or rice. According to Fang (1980), the first documentation of chu was found in one of the classical Chinese books, *Shu-Ching,* written during the Chou dynasty (1121-220 B.C.), which states that chu is essential for making chiu. Chiu in Chinese means alcoholic beverage. Early humans found that chu can convert the grains into chiu. As we know it now, chu serves as the source of enzymes to convert complex plant constituents into simple products. In Chinese history of making alcohol, malt was seldom used to hydrolyze starch into glucose.

Because moisture and temperature are two major factors determining mold growth, we can speculate that, because of the lack of proper storage and drying facilities in the ancient times, raw or cooked grains were vulnerable to mold growth on humid and hot days. It must be this naturally molded grain that they referred to as chu. If we speculate along this line, humans must have discovered chu soon after the discovery of wild plant seeds as food. It could have been 6,000-7,000 years ago.

When chu or molded grain was soaked in water, early humans noticed the fermented mixture turned into a delightful drink. Perhaps this delightful drink inspired them to imitate nature and resulted in the flourishing development of mold fermentations.

The earliest chu, undoubtedly, was made with uncooked grains; thus the in situ microflora of the raw materials were propagated. The resultant chu could have had colorful growth of many different species of molds and other microorganisms. As early as the Chou dynasty, however, the Chinese evidently had enough experience and knowledge in microbiology to prepare, selectively, the desirable chu with pure quality. The most popular one was yellow, indicating perhaps *Aspergillus oryzae* (Ahlburg) Cohn had been cultured at that time. The yellow color was said to be so lovely that the Emperor's yellow robes were known as chu-yi.

Up to then, chu usually was made in granular form (san-chu). By the Han dynasty (205 B.C.-220 A.D.), chu in the form of cake (ping-chu) was developed. The development of ping-chu was a significant advancement in alcoholic fermentation because, as we learned later, the growth of *Rhizopus* and yeast was much more abundant in ping-chu than that of *A. oryzae*. Thus, the socalled amylo-process was actually begun in the third century.

Written records on the method of preparing chu, however, could not be found until Chia Se-Hsia compiled a book in the early sixth century about agricultural technology in China entitled *Chi-Min-Yao-Shu* (Chia, 1930). Detailed descriptions for preparing chu and other fermented foods not only exposed the author's immense experience and knowledge in fermentation but also indicated that the basic technology of food fermentations had been established long before the sixth century. These early techniques have been carried on to the present. Although changes and improvements have been made, the fundamentals are the same. One of the most important contributions of modern microbiology, perhaps, is the selection and use of pure cultures. Following are the key products in the development of chu:

HUANG-CHU.—The first man-made chu was perhaps huang-chu, named after its characteristic yellow color. However, the responsible microorganisms, *A. oryzae* and *A. sojae* Sakaguchi and Yamada, however, were not identified until much later. Three types of huang-chu were described by Chia (1930): huang-yi, huang-tcheng, and nu-chu.

HUANG-YI. Huang-yi, or mai-wan, was usually prepared in the middle summer (July). Cracked wheat was washed, soaked in water until sour, and steamed. After steaming, the wheat was spread over a mat to cool and then gathered to a pile about 6-cm deep and covered with leaves of *Miscanthus sacchariflorus* Benth. et Hook. f. or *Xanthium sibirium* Patrin. After 7 days, the wheat would be covered with a layer of yellow mass (mycelia and spores) indicating the grain had converted into chu and it would then be sun dried. Interesting to note in this method, is that sour wheat was used and the yellow mass was not removed, suggesting that early humans knew a great deal about microbiology.

HUANG-TCHENG. Huang-tcheng was made the same way as huang-yi except that wheat flour was used instead of cracked wheat. Wheat flour was first mixed with water to form a ball or cake, steamed, cooled, and then covered with leaves to ferment.

NU-CHU. Unlike huang-yi and huang-tcheng, nu-chu was made from rice. Cooked rice was shaped into a cake and then covered with leaves of the herb, *Artemisia apiacea* Hance. After about 3 weeks, the rice cake was covered with yellow growth resulting in nu-chu, and sun dried.

Huang-chu was widely used for alcohol fermentation as well as for fermentation of soybean foods. Even today, *A. oryzae* is an important organism for soybean fermentation.

TSAO-CHU OR TSAO-YAO-CHU.—Tsao-chu, developed in the Tsin dynasty (265–430 A.D.), was made by fermenting a mixture of rice flour and herbs. Rice flour was mixed with grasses, foliages, and juices from *Pueraria lobata* (Willd.) Ohwi, shaped into small oval forms, and then fermented for a month with the herb *Artemisia apiacea* to become tsao-chu. Tsao-chu was used for making an alcoholic beverage from glutinous rice. Perhaps the present-day starter for making lao-chao (tien-chiu-niang) in China and the ragi for making tape ketan in Indonesia originated from tsao-chu. Since the herbs and grasses used in making tsao-chu were often used in treatment of illness, tsao-chu was also used in medicine.

Based on the accounts given by Chia (1930) and in the twelfth century book *Bei-Shan-Chiu-Ching* by Chu (1939), wheat was the main grain used for making chu in the early times. As time went on, however, more

varieties of chu were developed and the use of rice, herbs, and species also increased steadily. Herbs and spices were getting so popular in the twelfth century that more than 30 different kinds were commonly used and as many as 16 were used in making one type of chu. The most commonly used was said to be liao (*Polygonum*). These reports stated also that the use of wheat for chu originated in the northern part of China and the use of rice in the south. In China, wheat is mainly produced in the north and rice in the south.

SHEN-CHU.—A written account of shen-chu in the seventeenth-century treatise on Chinese technology, *Tien-Kung-Kai-Wu* (Sung, 1976), indicated shen-chu, which differed from the chu for alcohol fermentation, was developed in the Tang dynasty (618-906 A.D.) especially for medicinal purposes. Wheat flour was mixed with juices from herbs such as *Artemisia apiacea, Xanthium sibirium,* and *Polygonum* to form a cake covered with leaves, and allowed to ferment. Shen-chu was a most common ancient medicine and was frequently used with malt for digestive disorders.

DA-CHU.—Da-chu is the name given now for a group of chu blocks or cakes used in making alcoholic beverages. Puen-chu of the northern and southern dynasties (420-488 A.D.) and yen-chu of the Sung dynasty (960-1279 A.D.) were all considered to be da-chu. The method for preparing da-chu is fundamentally the same as that for preparing the early chu.

Coarse flour of wheat, barley, and peas was mixed with water and pressed to form blocks (about 22 × 22 × 4.5 cm), stacked into piles, and left in a room for 10 days or until the blocks became molded. They were then sun-dried and powdered. Species of *Aspergillus, Rhizopus, Mucor, Monascus, Saccharomyces, Lactobacillus,* and *Acetobacter* have been found in da-chu. To prepare alcoholic beverages such as sorghum spirit, steeped and steamed sorghum was mixed with 20% powdered da-chu. The mixture, having a moisture content of about 50%, was tightly packed into a container, sealed, and placed in a mud-made cellar. After keeping it in the cellar for several weeks, the fermented mass was distilled to yield sorghum spirit.

Distilled liquor was probably developed in the Tang dynasty (923-935 A.D.). However, there are not enough written accounts to verify this.

Mou-tai, another spirit popular at the present time, was also fermented with da-chu made with wheat flour at a temperature above 60 °C. This da-chu has an abundant bacterial growth responsible for the attractive flavor and aroma of mou-tai.

FU-CHU (BRAN-CHU).—In the last few decades, many studies have been made to improve da-chu. The major contributions have been the use of pure cultures of *Aspergillus* strains, *A. oryzae* or *A. niger* van Tieghem, and also the use of bran (fu) for substrate. Thus, the name of fu-chu was given. When mutants of *A. niger* were used, the chu was known as bai-chu (white chu) because of the light-brown spores.

Fu-chu is used for industrial alcohol fermentations as well as for alcoholic beverage and vinegar fermentations. White spirits made from fu-chu, however, lacked the flavor and aroma of that made from da-chu.

SIAO-CHU (CHIU-YAO).—Siao-chu probably was derived from tsao-chu of the Tsin dynasty. Made of rice flour in the shape of a ball or cake, it was used in making alcoholic beverages from rice. Siao-chu, as well as tsao-chu, was covered with white growth, the characteristic white mycelia of the dominant microorganism *Rhizopus*.

About 40% of alcoholic beverages in China were made with *Rhizopus* as a saccharifying agent. Some were made only with siao-chu and some were made with combinations of da-chu and siao-chu. The most popular cultures were *R. tonkinensis, R. japonicus* Vuillemin, and *R. chinensis* Saito.

KAN-JIAO (DRY YEAST).—The twelfth century treatise (Chu, 1939) stated that in Northern China, where jiao (yeast) was not used in making alcoholic beverages, the fermentation progressed with difficulty. This statement suggested the Chinese had recognized the function of jiao in alcoholic fermentations long before the twelfth century. The dry yeast was prepared by collecting the effervescent froth, mixing with some powdered chu, and then drying in the sun. This method probably originated in southern China.

WU-YI-CHU.—Because of its dark color, Wu-yi-chu was also known as hei-chu (black chu). It originated along the southeastern coast line of China perhaps as early as the Tang dynasty. Wu-yi-chu was made from acid-soaked rice with black mold (*A. niger*) grown on the surface of the grain and red mold (*Monascus*) grown in the center. The chu was said to have very high saccharifying action. Today, *A. niger* is widely used in China and is the most important culture for citric and gluconic acid fermentations.

HONG-CHU (RED CHU).—Developing and preserving hong-chu had to be one of the most important Chinese accomplishments in the field of microbiology. As we know it now, *Monascus*, the mold characterized by slow growth, is the dominant microorganism in hong-chu. In empirical

fermentations, this mold had to compete with other fast-growing molds such as *Aspergillus* and *Rhizopus* for survival. Preservation of this mold was a most difficult task.

Hong-chu appeared to exist in the early Sung dynasty. One can reasonably speculate that hong-chu must have been derived from progressive changes of Wu-yi-chu. When rice was contaminated with the growth of black mold (*A. niger*), it produced acid and heat preventing the growth of acid- and heat-sensitive microorganisms; however, the acid- and temperature-tolerant molds such as *Monascus* thrived. This molded rice, perhaps, was the origin of wu-yi-chu. In alcoholic beverage fermentations, wu-yi-chu was soaked in water. As the concentration of alcohol increased, the low alcohol-tolerant *A. niger* died off, but *Monascus* must have survived. The lovely red color of the spirit undoubtedly encouraged further experimentation.

The method of making hong-chu was established before the twelfth century and was described in detail by Lee (**1916**) and Sung (**1976**). Rice was soaked until it became sour. After being thoroughly rinsed, the soaked rice was steamed. While the cooked rice was still hot, it was quickly mixed with red spirit sediment dispersed in alum solution, and mixing was continued to cool the rice. The inoculated rice was then gathered into big piles to let the mold grow. The temperature was controlled by the size of the pile and also by spreading the pile out occasionally to dissipate the heat resulting from active growth. After 3 days, the rice was dipped in water for a very short period and piled up again. The dipping process was repeated the fourth day or, if necessary, daily until the rice floated. At that time, the hong-chu could be harvested and sun dried.

From this account, one can see the Chinese already had accumulated enough experience from early work to know that acid substrate and high temperature favored growth of this mold and adequate moisture content of the rice was extremely important for successfully making hong-chu. When rice gets too dry, mold growth does not penetrate to the center of the rice, resulting in hong-chu with a white center. On the other hand, if the center of the rice has too much water, saccharification and fermentation result in hong-chu with a hollow center. The dipping process, still used in today's hong-chu industry, evidently keeps the moisture content of the rice at a proper level.

Hong-chu has been used for alcoholic beverage fermentations and as a coloring agent, as well as for medicinal uses. In recent years, hong-chu has been used to produce glucoamylase for the production of glucose.

Chiang

Chiang (salted sauce) has been the most common flavoring agent in China since ancient times. According to the *Book of Rites*, 20 jars of chiang were seen in the kitchen when the victory feast was being prepared for the first ruler of the Chou dynasty. Confucius (551-479 B.C.) was quoted as saying not to eat the food that is not seasoned with the proper type of chiang. These records suggested that chiang had more than 3,000 years of history.

Although four types of chiang made from meat, fish, and beans were mentioned in a second century book, the method of preparing chiang was not discussed until Chia (**1930**) wrote the book on sixth century Chinese technology, detailing the method of making chiang from beans. In the same book, 13 more types of chiang made from other sources are also described: nine from fish, two from meat, one from wheat, and one from elm seeds. It appears that chiang, made from animal materials, was more common than that made from plant materials at that time. Perhaps they had found that the process could keep the meats from spoilage.

The following is an account for making tou-chiang from black beans, a variety of soybeans: Black beans are steamed, sun dried, and dehulled. The dehulled beans are soaked in water, steamed again, and spread to cool. After cooling, the beans are mixed with huang-tcheng (described under "Chu") and salt at a ratio of 6:2:1 (bean:Huang-tcheng:salt). The mixture is tightly packed into jars and sealed with mud until the mold growth penetrates through the whole mass. This usually requires 4 months (from January through April). The fermented mass is cracked into small pieces, placed in jars, and mixed with salt and water. The jars are left under the sun and the contents are stirred several times daily for the first 10 days and then once every day. After about 100 days, tou-chiang is ready for consumption.

Similar methods were used in making chiang from animal flesh and fish tissues, except flesh and tissues were not cooked but minced and mixed with huang-tcheng or huang-yi, salt, and water and the mixture was kept for fermentation only about 2 weaks. When wheat was used for chiang, it was first made into huang-yi, as described under "Chu", and mixed with salt and water to become chiang.

Many more types of chiang can be found in the sixteenth century book (Lee, **1916**). Different kinds of beans and cereals were used to make those types of chiang, but methods of preparation were essentially the same as for tou-chiang. The earlier interest of making chiang from animal tissues seemed to have changed to plant materials.

The most popular types of chiang, at the present time, are huang-chiang made from soybeans, tian-mian-chiang made from wheat, and tou-pan-chiang made from fava beans. Not much change has been made from the early method of making chiang except that pure cultures of *A. oryzae* are used.

Shi

The first written record on shi or tou-shi (fermented beans) appeared in the Shih-chi (the historical records) written by Szuma Chien in the second century B.C., which stated that shi was sold next to salt, indicating shi was already a popular food seasoning. In the sixth century book (Chia, **1930**), the method of preparing shi is described in detail. Temperature is discussed as the most important factor in making shi successfully, and June was found to be the best time for this fermentation.

Soybeans (yellow or black) were cooked, cooled, and placed in a pile on a straw mat, and covered with straw. The pile was turned frequently to dissipate the heat resulting from active microbial growth so proper temperature could be maintained. When the beans were covered with white mold growth, the size of the pile was reduced to increase the aeration and lower the temperature, thus providing the conditions for the growth of yellow mold. At the time the beans were completely covered with yellow mycelia, they were washed to remove the yellow growth, transferred to a pit, and tightly covered with straw. After 10-15 days, the beans turned black and became shi, which was then sun dried. To completely remove the mycelia and spores was essential; otherwise, shi had a bitter taste.

In the sixteenth century's *Ben-Chao-Gong-Mu* (Lee, **1916**), many types of shi made at different localities were mentioned together with their medicinal uses. In more recent times, shi can be classified into three general types.

Aspergillus oryzae type. This is the traditional type of shi, also known as tou-shi, and is the most common one. The method of preparation is essentially the same as just described except pure cultures of *A. oryzae* are used and the fermentation is carried out at 25 °C in wooden barrels. In some areas, the washed, molded beans are mixed with 16-18% salt and fermented at 35 °C for 30 days.

Mucor type. This type of shi is usually made in Szechwan. Soybeans are soaked for 10 hours, steamed for 5 hours, and then cooled to 15 °C. The cooked beans are packed in trays about 2-3 cm in depth and

incubated at 10-15 °C for 1-2 weeks. At the time the white growth of *Mucor racemosus* Fresenius has changed to gray, the molded beans can then be mixed with salt and distilled liquor, tightly packed into earthern jars, and sealed. After aging for 6 months in a shady place, shi is ready for sun drying.

Bacillus type. Shui-tou-shi probably is the same product as natto in Japan. Soaked and cooked soybeans are placed in a cloth bag and covered with straw. After 1-2 days at 25-30 °C, the beans are covered with viscous substances and the quality of the product is ascertained by the stickiness of the beans. The sticky beans are mixed with minced ginger and salt and then tightly packed into jars. After aging for 1 week, they are ready for consumption. The organism responsible for this fermentation has been identified as a *Bacillus* sp.

Chiang-yu and Shi-tche

Chiang-you (soy sauce), or tou-yu, probably was derived from chiang. In the sixth century book on Chinese technology (Chia, 1930), the product chiang-ching was mentioned. From the meaning of the name chiang-ching, this product was related to chiang and was probably the origin of chiang-yu.

The method of preparing chiang-yu was not described until the sixteenth century when the botanical encyclopedia (Lee, 1916) was compiled. Cooked soybeans were mixed with wheat flour, pressed into cakes, and left in the room until the cakes were covered with yellow mold growth. The molded cakes, or chu, were mixed with salt and water and aged in the sun. After pressing, the liquid was known as chiang-yu.

In more recent times, chiang-yu has been made with pure cultures of *A. oryzae*. Wheat flour is replaced with roasted cracked wheat, and the chu is made in a temperature-controlled room.

Shi-tche literally means the juice of shi, fermented beans as described under "Shi". It is a very dark but clear liquid and was the most popular seasoning in the sixth century. As stated by Chia (1930), shi-tche was obtained by boiling shi. In comparison with the products of the present, shi-tche seems to be the type of soy sauce that is made from soybeans only.

Tou-fu-ru

Tou-fu-ru, or sufu, was made from tou-fu by a mold. Tou-fu was invented by Liu An (179-122 B.C.) of the Han Dynasty (Lee, **1916**), and it had a great impact on the nutritional status of the Chinese people. Tou-fu, a cheese-like product composed principally of protein and oil isolated from soybeans, was easy to digest, to incorporate with other foodstuffs, and to use in nearly every culinary context. Tou-fu technology, perhaps, could be considered as the beginning of meat-like vegetable products.

To make tou-fu, more commonly known in the West as tofu, soybeans were soaked, ground with water, and filtered through a coarse cloth to separate a milk-like product known as soybean milk from the insoluble residue known as tou-tcha. The soybean milk was boiled for a few min and then cooled slightly. Soured soybean milk was added to the hot milk to curdle the proteins and then transferred to a cloth bag and pressed to remove the excess whey to form a soft whitish cake or tou-fu.

Other than soured soybean milk, calcium sulfate was also mentioned as a coagulant by Chia (**1930**). Today, tou-fu is prepared essentially the same way it was more than 2,000 years ago. Bittern (the liquor that remains after salt is crystallized from seawater), calcium and magnesium salts, and citric acid generally used as coagulants.

How, or when, tou-fu-ru was started is not known, but the process of making it was considered a natural phenomena. Tou-fu was cut into small cubes, steamed, placed in bamboo trays, and then covered with straw. It usually was made in spring or fall when the temperature is about 10 to 15 °C. After 3 to 4 days, the cubes were covered with white mold mycelia and packed in a jar with salt and water to age. Additives, either to add color or flavor, such as rice wine, red rice, and hot pepper, were frequently incorporated into the brine.

Species of *Actinomucor* and *Mucor* have been identified as the organisms responsible for this fermentation. Straws are the origins of these molds.

Sometimes tou-fu-ru is made with both bacteria and mold, resulting in a product with a strong, offensive odor. The preparation of this type of tou-fu-ru is a top secret in the industry and is slowly becoming a lost art.

Other Fermented Soybean Foods

LA-PA-TOU.—La-pa-tou is a bean product of *Mucor* fermentation, named for the time of the year it is made, approximately December 8 of the lunar calendar. Evidently, the relatively low temperature around that time of the year in most parts of China favor the growth of this particular *Mucor*. Like most of the other fermentations in China, straw probably is the source of this mold. Cooked beans are wrapped with straw and placed in a room about 15 days. At that time, the beans should be covered with white mycelia which should penetrate into the center of the beans, binding them, and resulting in a cake. The fermented beans are sliced, sun dried, and used as a flavoring agent or they are consumed fresh.

MEI-TOU-TCHA.—In some parts of China, the residue from preparing soybean milk, known as tou-tcha or okara in Japan, is also fermented and used in a similar way as that of la-pa-tou. The product is called mei-tou-tcha or meitauza. The organism responsible for the fermentation has been described as *M. meitauza*, a synonym of *Actinomucor elegans* (Eidam) C.R. Benjamin and Hesseltine.

Tsu

Traditionally, Chinese make tsu, or vinegar, from grains such as millet, rice, and sorghum. The distinct feature of the traditional process is the solid substrate fermentation carried out by a combination of molds, yeasts, and bacteria. More than 20 methods of preparing tsu are discussed in the sixth century book *Chi-Min-Yao-Shu* (Chia, **1930**). Although the methods vary with the raw materials used, in general, they are similar. The grain is cooked and mixed with chu (molded grain). An appropriate container is then packed full with the mixture and tightly sealed. After 3 weaks under favorable conditions, the grain transforms to tsu. Chia (**1930**) pointed out that the white scum on the surface of the fermented mass was harmful; on the other hand, the thin film over the surface was beneficial. As we learned later, the harmful film was scum yeast and the beneficial film was *Acetobacter* sp. Today, people in China still favor the vinegar made from grain with the traditional processes.

Yan-tsai

Yan-tsai (salted vegetables) are vegetables salted and fermented in their own juices and now commonly known as suan-tsai (sour vegetables) or yan-tsai (salted vegetables). Yan-tsai has a long history in China. Confucius of the sixth century B.C. was quoted in the classic *The Book of the Odes* as saying "having yan-tsai, I can survive the winter", indicating slating and fermenting had already been used as a process to preserve vegetables when they were bountiful. More than 20 ways of preparing yan-tsai were described by Chia (**1930**), suggesting the importance and the popularity of yan-tsai in China. Preparation can be grouped into the following five ways:

1. Vegetables are washed with salt water, drained, packed into the container, and covered with salt. After 7 days, the vegetables are ready.
2. Vegetables, chu (molded wheat), and boiled diluted rice gruel are packed into a container in alternate layers until full. Salt water is then added from the top. The fermentation time is about 7 days.
3. Vegetables are soaked in boiling water for a few min, drained, and placed in salt water with chu (molded wheat) and diluted rice gruel. The container is then sealed. The fermentation time is about 7 days.
4. Vegetables are immersed in salt water for about 5-7 days.
5. Cucumbers and turnips are sliced, and mixed with salt and chiang, tou shih, or fermented rice mash. They are packed in a container and sealed. After 3 days, they are ready for consumption. This type of preserved vegetable is generally known as chiang-tsai.

Suan-tsai, yan-tsai, and chiang-tsai are still popular in China. The details of these procedures may have changed to some extent, but the underlying principle of making them is still based on the early discoveries.

Conclusions

In China, the use of microorganisms to convert agricultural commodities into foods and alcoholic beverages is an art which has 6,000-7,000 years of history. Because of the long history and incomplete written records, no attempt was made to search for the origin of these products.

The development of fermented products, dependent on the use of rather sophisticated mcrobiology and technology, was indeed a remark-

able achievement in the early history of China, and laid a firm foundation for today's fermentation industry. Throughout history, the Chinese seemed to follow their own ways in developing these products without foreign influences.

Mold fermentation was the distinguishing feature in the history of Chinese fermentation. Unlike the alcohol fermentation industry of the West where malt is generally used to convert the grain starch into glucose, the Chinese discovered chu (molded grain) to carry out the conversion. Most chu are contaminated with yeast, but some chu made with certain strains of *Rhizopus* or *Mucor* possess the ability to convert glucose into alcohol. The amylo-process discovered by French scientists in the late nineteenth century actually was carried out in China in the third century. Even today, the use of *Rhizopus* and *Mucor* in making alcoholic beverages is unique in China.

The Chinese also made a great contribution in developing soybean foods with mold fermentations, although the merits of these fermentations have not been appreciated in the West until recent years. Many of the traditional processes are still carried out in various parts of China. But in the last few decades, research on the traditional art to improve and to modernize the centuries-old processes has been stressed and is discussed in the chapter by J.S. Chiao (Modernization of Traditional Chinese Fermented Foods and Beverages).

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