

REVIEW

Function of Traditional Foods and Food Culture in China

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Abstract

Chinese people have exploited traditional foods through their long history, and developed an abundant food culture. Especially, preserving health by dieting has been an important part of the traditional food culture in China, which is based on the theory of Chinese medicine. Some of the traditional foods are on the verge of being lost, but improvements in traditional foods will benefit agricultural industries, especially those in poor regions. The theories of traditional Chinese healthy food need more systematic study based on modern science and technology. Some of the fermented soybean foods such as *sufu* and *douchi* were reported to contain functional materials. We found that isoflavones composition in the fermented food changed during fermentation, which was closely related to β -glucosidase activity. Through these researches, we can use the wisdom of healthy eating habits accumulated over the centuries as beneficial knowledge for the health of people.

Discipline: Food

Additional key words: human health, fermented food

Introduction

Through the long history of Chinese civilization, traditional Chinese foods and cooking have developed into a fine art or a sub-culture, which nowadays is often referred to as Chinese food culture. More and more Chinese foods have become popular all over the world, because of their appealing taste and health benefits. Utilization of functional food in a diet has been the main theme of Chinese food culture throughout its long history, because Chinese people have believed that food is not just an energy source but a kind of medicine to be taken to cure diseases.

In recent years, traditional foods in China are facing an increasing challenge of the incursion of Western foods, especially fast foods. In addition, people put forward more requirements for food quality with the change of life styles, and they are more concerned about food sanitation as well. Improving the traditional foods in China using modern knowledge and technology is beneficial to preserve this precious culture. Furthermore, it is

important to meet the consumer's needs which are derived from improving living standards, because traditional foods play an important role in keeping people's health in good condition. Traditional foods also contribute to increase the value of agricultural products, and as a result, they vitalize the rural economy in China.

In this paper, we introduced Chinese food culture and some of the functions in Chinese traditional foods. The current statuses of the studies on functional properties in Chinese traditional food as well as some of the prospects of research on traditional foods in China were also presented.

Chinese philosophy of diet and food function

An old Chinese medical and herb book introduced some functional foods. Chinese people had already started to explore the relationships between food and human health some 6,000 years ago¹². A Chinese royal document written 2,800 years ago described the cooking staff of the emperor in the Zhou Dynasty (1050 B.C.–256 B.C.). It stated that nutritionists were responsible for rec-

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ipes of daily meals, which should contain proper nutrition and healthy ingredients²³. There had been many ancient works on healthy foods in China, although many of them have been lost at present. A few works survived and now they demonstrate their scientific and historical values.

Traditional Chinese foods are mostly based on rice, wheat and other grains. In addition to those materials, Chinese people incorporated as diverse food materials as possible, and combined them properly to make their meals healthy and tasty. A medical book entitled “The Yellow Emperor’s Internal Classic”, which was written about 2,500 years ago, provided a healthy food guideline, such as different kinds of food which must be taken in order to nourish the internal organs and enhance body energy²⁵. Another old Chinese book entitled “Important Technology of Qi Dynasty,” which was written about 1,500 years ago, classified the common food materials into more than 200 types of cereals, 100 types of vegetables and about 100 kinds of animal meat products^{8,24}. This book introduced the Chinese dietary structure at that time. Taking diverse foods is now recognized as a principle of healthy diet. It is quite remarkable that they already realized the benefit of taking diverse foods at that ancient time.

The function of food resembles Chinese medicine in many aspects. Traditional Chinese physicians often explained the function of medicine and food by “the five elements theory” and “the negative (*Yin*) and the positive (*Yang*) theory”. According to the five elements theory, everything in this world is a result of interactions among metal, wood, water, fire and earth, and each of them corresponds to the tastes of food, i.e. pungent, sour, salty, bitter and sweet, respectively^{8,24}. Therefore, healthy diet should properly combine all the five elements. The negative (*Yin*) and the positive (*Yang*) theory as well has a long history. In the Song Dynasty (960 A.D–1279 A.D), a book entitled “Curing Disease through Dieting (1085 A.D.)” mentioned that: “those herbs and foods that taste sweet and pungent are usually associated with the positive, and those that taste sour and bitter are associated with the negative”²³. According to this theory, almost all foods have a property of either the positive or the negative, and therefore foods should be properly combined so that they will make the human body reach a harmony of the positive and the negative. Some of the typical symptoms of excessive negative are blood-deficiency and feeling cold. So someone with excessive negative needs food of the positive. The typical food of the positive includes animal liver, egg, red sugar, jujube, etc. The symptoms of excessive positive are normally associated with high blood pressure, inflammation, fever etc, which can be treated by food of the negative. Such foods as

wax gourd, cucumber, lotus seed, and green bean are considered as food of the negative. Not all food has the same level of the negative or the positive, so they are further classified into different categories from strong heat, mild warm to ice cold according to their property of the negative and the positive²⁹.

Now we can understand the old diet theory of the negative and the positive with the modern knowledge of medicine. Many of ‘the negative deficiency’ symptoms are actually caused by malnutrition or indigestion. Some mild foods of the positive are easily digested and nutritious, which is surely beneficial to the patients. So are the foods of the negative for the symptoms of the positive. ‘The positive excess’ may also be called ‘accumulating much more pathogenic fire’, and it is usually caused by excessive stress, lack of sleep, decreased immunity caused by eating too much, and maladjustment of internal secretion. These people should eat foods which contain low energy and much edible diet fiber¹³.

Materials and functions of traditional Chinese foods

A characteristic of Chinese food is to use vegetables as high nutritional materials. A legend said that a person named *Shen Nong* tasted many plants and classified them into edible vegetables, inedible weeds and herbs some 6,000–7,000 years ago. Confucius (552–479 B.C.) emphasized the necessity of vegetables in the food menu, and he said that eating vegetable was not only for eliminating one’s hunger but also for having an effect on health preservation³⁰. There are many old sayings about the importance of eating vegetables in China. For instance, “put green onion and garlic in every dish, then you can be as healthy as you wish” and “eat carrots for breakfast and ginger for dinner, then you will never need a doctor.” All these show the importance of vegetables²⁰.

The medicine meal, which is cooked along with medicinal herbs, is a special health diet in China. Most of the medicine meal is to nourish liver and lungs, and to strengthen physiological conditions of the people, therefore it is not used for treating a specific illness. In general, the medicine meal mainly consists of two types of ingredients: one group includes not-so-conventional but edible materials, such as terrapin, black-bone chicken, holothurians, mushroom, ginger, jujube, garlic, wolfberry, and so on; the other group includes many kinds of Chinese herbs. These materials, together with other spices, can be used as seasoning condiments to stew chicken, cook meat and make hot pot. Among the foods cooked with medicinal herbs, some are used to recuperate from weakness and keep energy, and others are used to

treat certain symptoms. For example, ginger soup is used for cold and fever. Weakness and anaemia could be cured by red jujube boiled with black auricularia, auricula judae and soup cooked with honey and pear.

Chinese people cultivate many kinds of grains depending on the variations of geographical and climate conditions. Major grains are rice, wheat, corn, and beans, and there are some minor grains such as millet, broom-corn, naked oat, buckwheat, and adlay. For holidays and special ceremonials, Chinese people prepare mixed grain foods such as “eight treasures gruel” and “eight treasures rice”. Both of them use 8 kinds of grains, and Chinese people believe that the combination of various grains can deliver good nutrition and contributes to preserving good health conditions¹¹.

Beans have been also very popular in Chinese diet from the ancient times. Mung beans, peas and sword beans are used in Chinese medicine meals. They have been a main source of healthy food and medical supplements. Many kinds of soybean foods have also been developed in various regions and contributed to the local people's health.

Fermentation has been utilized to prepare tasty and healthy foods for a long time in China. Chinese people started to realize the benefit of fermented food to human health a long time ago. Some of the typical fermented foods are pickles made from some vegetables, and vinegar and alcohol made from grains. Fermentation has been widely used to prepare soybean products. Popular fermented soybean foods in China are *sufu* (fermented tofu), *douchi* (fermented soybeans), soy sauce, and fermented soymilk. *Sufu* and *douchi* had become parts of the Chinese meal at least 2,000 years ago^{2,26}. *Douchi* was found in the artifacts from the Tomb of West Han Dynasty of Mawangdui, Hunan province³³.

Research on traditional fermented soybean foods in China

Typical processing and images of *sufu* are shown in Fig. 1 and Fig. 2, respectively^{6,31}. Four steps are usually involved in making *sufu*. Those steps are: (1) preparing tofu by salt precipitation from boiled soymilk, (2) preparing the molded tofu (*pehtze*) by spraying pure culture fermentation starter, *Actinomucor elegans* onto the surface of diced tofu, and then inoculating for 48 h at controlled temperature (28°C) and relative humidity (around 90%) with air circulation to ensure adequate aeration, (3) preparing salted *pehtze* by salting 5 days until salt content of *pehtze* reaches about 16%, and (4) fermenting and aging for 2 months in a closed bottle with dressing mixture consisting of red rice koji, alcohol (generally added as rice

wine or distilled liquor) beverage, sugar, *chiang* (Chinese wheat-based miso) and spices.

The procedure and images for making *douchi* are shown in Fig. 3 and Fig. 4, respectively¹⁰. Soybeans were washed, and soaked for 3–4 h at room temperature. After draining, the soybeans were steamed for 4 h to allow 52% water content of soybean, and then cooled to 28°C. The soybeans mixed with 5% inoculum of fungus were incubated for 4 days under controlled temperature (28–30°C) to make koji. After mixing the dressing, *douchi* was fermented and aged by storing in a closed bottle or sunning for more than half a year.

Many old medical books described the effects of *sufu* on prevention of some kinds of diseases^{12,13}. The contents of some components in the *sufu* products were increased greatly under the action of microorganisms during fermentation. Water-soluble protein was increased from 3.607 g/100 g in tofu to 54.338 g/100 g in *sufu*, and the content of riboflavin in *sufu* was about 250 µg/100 g, which was 6–7 times of that in tofu^{14,27}. Meanwhile, many physiologically active compositions, such as soybean peptides, vitamin B₁, nucleic glycoside, and aromatic compounds, which do not exist in unfermented soybeans, were produced. The content of vitamin B₁ and nucleic glycoside were 0.04–0.09 mg/100 g and 0.5–1.1 mg/100 g in the *sufu* product, respectively^{4,27}. Therefore, *sufu* is not only a delicious food, but also an easily digestible and functional food. Amino acid content of *sufu* is presented in Table 1^{4,5,26}. The lower sulfur amino acid content of soy protein may help to reduce calcium excretion in comparison to consuming animal proteins, so it lowers the risk of osteoporosis. Intake of soy protein can decrease cholesterol level of serum, so the soy protein can help to reduce the risk of kidney disease and heart disease in high risk individuals¹⁵.

The contents of vitamin B₁₂, which is essential for the nervous system, in *Chou sufu* (strong smell *sufu*) and red *sufu* produced in Beijing were determined. Vitamin B₁₂ contents were 9.8–18.8 mg/100 g in *Chou sufu* and 0.42–0.78 mg/100 g in red *sufu*²⁷. Therefore, it was shown that the *Chou sufu* had not only a strong smell but a high amount of vitamin B₁₂, possibly because of high activity of microorganisms during fermentation.

Sufu and *douchi* also contain high amounts of peptides that are derived from soybean proteins by the effect of protease. Soybean peptides are not only digested easily, but also improve energy metabolism, and they have functions of refreshing, strengthening muscles, lowering cholesterol, anti-oxidation, angiotensin I-converting enzyme (ACE) inhibitory activity, anti-hypertention and regulating insulin⁹. The *sufu* and *douchi* extract showed high antioxidative and ACE inhibitory activity^{28,32}. SDS-

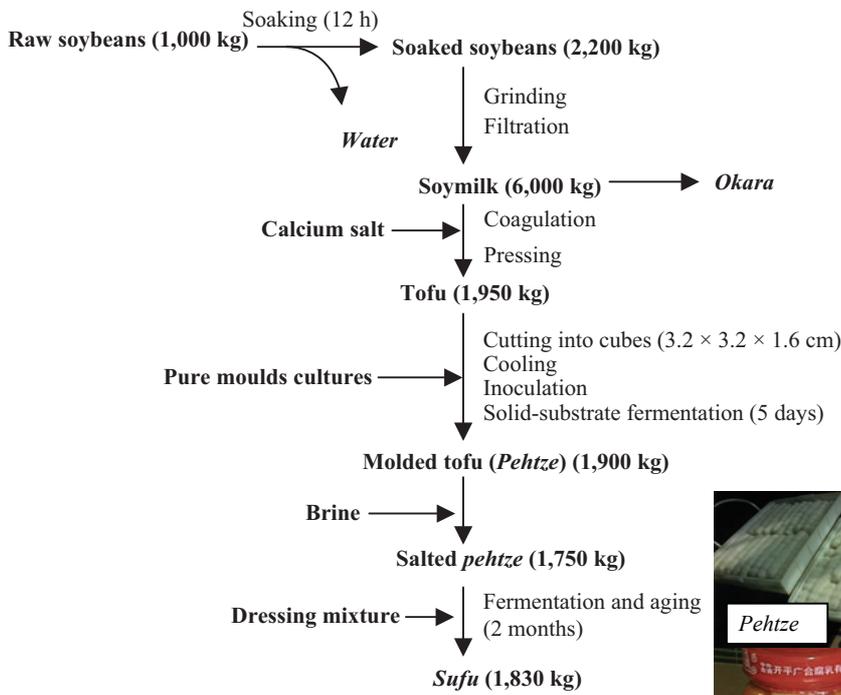


Fig. 1. Flow diagram for processing of soybeans to sufu. Pehtze (molded tofu), salted pehtze and dressing mixture are shown in Fig. 2.



Fig. 2. Sufu processing

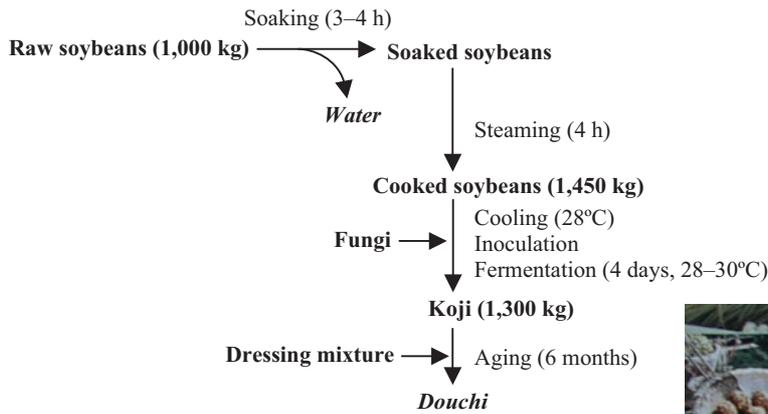


Fig. 3. Flow diagram for processing of soybeans to douchi. Fermentation, dressing, aging and drying are shown in Fig. 4.



Fig. 4. Douchi processing in Shanxi province

Table 1. Amino acid content of *sufu* samples

Amino acid	Red <i>sufu</i> ²⁶ (g/100 g <i>sufu</i>)	Chou <i>sufu</i> ²⁶ (g/100 g <i>sufu</i>)	<i>Sufu</i> ⁴ (g/100 g protein)	White <i>sufu</i> ⁵ (Molar ratio, %)
Alanine	0.32	0.70	10.0	7.0
Arginine	0.38	0.27	2.1	2.5
Aspartic acid	1.00	0.66	5.1	13.7
Cystine	0.59	0.20	0.4	
Glutamic acid	2.15	2.08	0.6	22.0
Glycine	0.54	0.42	4.4	7.0
Histidine	0.20	0.18	1.4	1.9
Isoleucine	0.88	0.58	4.8	4.5
Leucine	0.81	0.95	8.8	7.6
Lysine	0.59	0.29	7.0	7.3
Methionine	0.51	0.14	0.7	
Phenylalanine	0.59	0.59	4.6	2.6
Proline	0.38	0.29	2.4	7.7
Serine	0.34	0.27	2.3	5.2
Threonine	0.45	0.23	2.0	4.1
Tryptophan	0.09	0.05	0.6	
Tyrosine	0.54	0.25	2.2	1.0
Valine	0.16	0.58	5.3	5.2

PAGE patterns of the extracts indicated that *sufu* extracts mainly consisted of peptides whose molecular weights were less than 10 kDa and those peptides were responsible for the activities²⁸.

Some of the benefits of soybean foods are explained by the function of isoflavones¹⁶. Soybean foods can be considered as the only natural dietary sources of isoflavones, and it was reported that isoflavones have an estrogenic effect to lower the menopause symptoms of woman⁷. Genistein, which is a major component of soybean isoflavone, was effective against cancer cells, including lung, colon, rectal, breast, stomach, and prostate cancers²¹.

We showed that all isoflavones in *sufu* were forms of aglycone (Table 2), and that *douchi* contained higher amounts of aglycones and lower amounts of glycosides than those of soybean (Table 3). These results indicated that isoflavones were converted into aglycones (daidzein and genistein) from glycosides (genistin and daidzin) during the fermentation. The content of aglycones gradually increased, whereas the content of glycosides decreased during the process from raw soybean to *sufu*. The change in the isoflavone compositions was significantly related to the activity of β -glucosidase during fermentation, which was affected by the NaCl content (Fig. 5). The highest β -glucosidase activity (118 U/g dry matter) was recorded during *sufu* manufacturing. The level of the β -glucosidase activity could remain high if

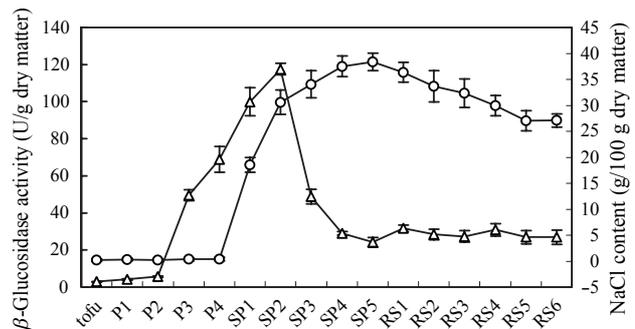


Fig. 5. Changes in the β -glucosidase activity (Δ) and NaCl content (\circ) for *sufu* processing

P1 to P4: fermented *pehtzes* for 12, 24, 36, and 48 h; SP1 to SP5: *pehtzes* subjected to salting for 1, 2, 3, 4, and 5 day; RS1 to RS6: ripening of *sufu* for 5, 10, 15, 30, 45 and 60 day, respectively.

the content of NaCl was lower than 30 g/100 g dry matter during salting. The β -glucosidase activity was only 29 U/g dry matter when the percentage of NaCl increased to 38 g/100 g dry matter³¹.

Isoflavone aglycones had different absorption from glucosides in the stomach. There is considerable evidence that hydrolysis of the isoflavone glucosides is necessary for their absorption from the gut since the glucosides have not been detected in human plasma²². Daidzein and genistein but not their glucoside forms were

Table 2. Effect of *sufu* processing on the redistribution profile of individual isoflavone

	Glucoside (mg/g)		Aglycone (mg/g)		Glucoside (%)	Aglycone (%)
	Genistin	Daidzin	Genistein	Daidzein		
Tofu	0.36	0.35	0.01	0.02	95.9	4.1
Pehtze	0.18	0.21	0.17	0.11	57.4	42.6
Salted <i>pehtze</i>	0.08	0.06	0.14	0.10	36.8	73.2
Sufu	0.0	0.95	0.0	0.15	0.0	100.0

Table 3. Effect of *douchi* processing on the redistribution profile of individual isoflavone

	Glucoside (mg/g)		Aglycone (mg/g)		Glucoside (%)	Aglycone (%)
	Genistin	Daidzin	Genistein	Daidzein		
Black soybean	0.70	0.64	0.11	0.10	86.7	13.3
TianMashan koji ^{a)}	0.19	0.21	0.37	0.32	37.0	63.0
TianMashan <i>douchi</i> ^{a)}	0.14	0.09	0.48	0.39	21.1	78.9
Yipinxiang <i>douchi</i> ^{b)}	0.13	0.06	0.82	0.72	11.1	88.9
Yongchuan <i>douchi</i> ^{c)}	0.32	0.33	0.26	0.20	58.3	41.7

a): produced in Liuyang TianMashan *douchi* manufacturer, Hunan province.

b): produced in Liuyang yipinxiang *douchi* manufacturer, Hunan province.

c): produced in Yongchuan seasoning company, Sichuan province.

absorbed from the stomach, and genistein was better absorbed than daidzein^{1,19,22}. Genistein had been reported to have a higher antiproliferative effect on the growth of human breast carcinoma and prostate cancer cells compared to genistin^{17,18}. All those reports indicated that the function of isoflavones increased during the fermentation, and fermented soybean foods with high contents of aglycones had the advantage of functional foods.

Current situation and prospect of Chinese traditional food

More and more people are realizing the importance of the concept of "food and medicine serves the same purpose", which had originated in ancient Chinese philosophy. When the problem of hunger was settled in the industrialized world, people began to try getting better nutrition from their food and keeping their health in good condition using food functionalities. Western culture tends to rely on medicine pills that contain kinds of physically active compounds extracted from natural materials to cure diseases caused by nutritional deficiency. Chinese physicians, pharmacists as well as food and agriculture experts, however, keep trying to develop various types of new healthy food products to meet the vast market demand.

Over the past 6,000 years, Chinese culture has accumulated a host of knowledge about traditional health

foods, however, due to change in life style of people and the ongoing modernization process, many Chinese traditional cultures are disappearing. The theories of traditional Chinese healthy food need more systematic study based on modern science and technology. Collection and documentation of these theories are also important, because many of the ancient, legendary works are vanishing as time goes by. Some of the legendary tenets of traditional Chinese foods are yet to be proved scientifically. There are many suspicious beliefs and myths, however, we believe many people tried to practice traditional theories and found some truth in them. All of these platitudes need to be studied scientifically. The chances are that some of these old theories would be proved false, while others may provide important clues to discovery.

Among Chinese new generations, there is not enough attention and respect for traditional healthy foods. Traditional foods are considered to be old-fashioned. Actually, some of the food processing is out-of-date with low hygiene and quality standards. Some of them have poor appearance and lack convenience. As a result, many valuable and effective Chinese traditional healthy foods are threatened with extinction. If food processing could be modernized by using the advanced technology and high quality standards used in many developed countries, those foods will become more popular, which will provide benefits by increasing the market value of agricultural products.

We need greater appreciation of the health benefits of traditional Chinese food. We also need more effort to explore and preserve the traditional Chinese food culture which has never been reported to the industrial society before. It is also a great opportunity to achieve commercial success. To do this, we need to cooperate among different scientific fields and different institutions, which will enable us to carry out comprehensive and systematic studies about healthy food. Developments in life science, medical science and neurology provided many up-to-date techniques and much knowledge for studying and understanding traditional Chinese food. We need joint work among historians, archaeologists, food experts, pharmacists and medical researchers. We should also encourage business to get involved in industrializing and modernizing the processing of healthy food.

As a conclusion, development of traditional Chinese food will benefit agricultural industries, especially those in poor regions, and be more profitable to local enterprises and farmers. A more important consideration is that such a development will also improve the nutritional conditions of modern people and will benefit their health.

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