

## The Present Status of *Kochujang* (fermented hot pepper-soybean paste) in Korea and Its Future

Dong-Hwa Shin<sup>1\*</sup> and Do-Youn Jeong<sup>2</sup>

<sup>1</sup>Division of Biotechnology, Chonbuk National University, Jeonbuk 561-756, Korea

<sup>2</sup>Sunchang County, Jeonbuk, Korea

E-mail: dhshin@chonbuk.ac.kr

### Fermented Soybean Products and Red Pepper

#### Historical review

It has been considered that the native place of soybean was Manchuria, which was a former territory of Goguryeo. In addition, there is a historical investigation for the cultivation of the bean more than 4,000 years ago in Korea (1). The originator of our *meju* (Korean style soybean *koji*) has been known as “*Si*”, which was also introduced from a foreign country as shown from Chinese literature. The *Si* is clearly notified in the *Sikhwaji* of *Sagi* as a foreign product in which Goguryeo is suggested as the originator of the *Si*. In those days, the Chinese produced a *nuruk* (Korean style wheat bran *koji*) by inoculating molds to foxtail millet or Chinese millet. However, our ancestors created technology that uses mold with beans.

During the *Si* that was developed and transferred by the Goguryeo was largely used in China, there is a kind of *meju* in our country that is almost the same as the one presented by changing *Sankuk* (grain form) like the *Si* to *Byungkuk* (mashed form) (1).

The spices used in human food have a history from time immemorial to the present day. We know that people who suffered through war used them in order to get a good flavor since ancient times. The characteristics of foods so-called flavor or taste have been given through the spices. In addition, the spices are also used as a medium of enjoying various flavors.

In recent years, the importance of spices are recognized as a new point of view for its original purpose according to the fact that it has various biologically activated functions beyond the ranges of its own flavor and taste. In addition, a study on the spices has been actively carried out throughout the world.

Red pepper (*Capcicum annam*) is named from a kind of medicinal herb with a long pedigree going back to the Ming dynasty and has different names such as *Dangcho* and *Buncho*. It is an annual herb in Korea but is a perennial plant in the tropics (1). The native place of red pepper is the tropical South America. In addition, it was originally spread to European countries by the Spanish. Then, it had spread throughout the world. It is known that red pepper was cultivated in Peru 2,000 years ago. Red pepper was introduced from Japan when the Japanese invasion of Korea occurred in 1592 and was called *Waegyveja* (2). There is a theory that the incursion route of red pepper is the north and south, but the theory of the south that is based on the period before and after the Japanese invasion of Korea (AD 1592) is more reasonable than the other theories (3).

A proof of this theory is recorded in the *Jibongyuseol* written in 1613 in which it was introduced as “Red pepper is called as *Waegyveja* because it came from Japan and was cultivated sometimes”. By following the History of the Civilization of Korea, in addition, it was introduced to kill Korean people with its poison. However, it did not work as a poison, but was good for the constitution of Korean people. Hence, it is reasonable that the red pepper was introduced about the time when war was happening (4). On the other hand,

the name of 'Kochu' as written by the *Hunmongjawhae* (AD 1527) where *Ko* means a bitter taste, but the real meaning is burning in a flame. Therefore, it is written as *Kochu* by adding *Ko* to *Cho* (5).

#### **Basis of the literature for *kochujang* (fermented hot pepper-soybean paste)**

*Kochujang* (fermented red pepper soybean-paste) is a spice and tasted food that has been used in our home for a long time. It is a unique and particular traditional fermented food that is never ever found in world history. It uses bean and red pepper powder as the main raw material and is mixed with malt-digested rice, barley and sweet potatoes. Historically, the beginning of *kochujang* for table use is estimated by the end of the 16 century or the early 17 century. If we assume that the birth of red pepper soybean paste is at the end of 16 century, it will nearly coincide with the estimated arrival time of *kochujang* (King *Sunjo*, before the Japanese invasion of Korea) proposed by Dr. Chang Ji-Hyun (6).

In the *Domundaekjak* written by Her Kyun (AD 1569~1618) who was born in King *Sunjo* and suffered the war, there is a word of 'chosi (hot cho, malt si)' that was verified as *Kochujang* in the present day.

The *Manchojangbup* (How to make soybean pastes) is recorded in the *Sanlimkyungjae* written by Hong Man-Sun. In addition, there is a record that is the first literature of how to make red pepper soybean paste in which it was made with the addition of dried fish, *konpo* (a sea tangle), and other materials in the *JeungboSanlimkyungjae* written by Hong Man-Sun (AD 1643~1715). The history of table use of fermented red pepper soybean-paste as a particular soybean paste in Korea is not long enough compared with the history of soy sauce and soy bean paste. Red pepper was introduced by trade ships of Poland and Portugal to the southern area and was took a long time to spread. Then, it started to be cultivated in the early 17 century. Therefore, it is assumed that the spices used in our country were black pepper and mustard before the appearance of red pepper. If there were similar pastes, it may have been black pepper pastes (7). There are many traditional methods to make fermented red pepper soybean paste, such as the *Sikchibang* of the *Sumunsasul* written by Lee Pyo (King *Yungjo*, AD 1740) that introduced a production method of 'the *Soonchang Kochujang*' by adding an abalone, big shrimp, hard-shelled mussel, and ginger, the *Rukjubangmun* written in mid 1800, AD that introduced a method to make red pepper soybean paste with barley where it was seasoned by salt, and the *Kuhapchongseo* written by *Bingherkak Lee* (AD 1815) that introduced a method to make red pepper soybean paste like the current way in which red pepper soybean malt was separately produced and applied and seasoned by salt. In addition, this literature also recorded that *Chungjang* was used to season instead of salt by adding honey, jerked meat, and jujube. Moreover, the *Nonggawolyungga* (AD 1861, Samwolyung) awakened that the *kochujang* production was in March (8).

#### **Similar *kochujang* in foreign countries**

It is not easy to find a spice that is produced by using the mixtures of red pepper powder, fermented soybean mash (*meju*), and malt-digested grains and keep them for a long period for fermentation. However, there are some similar products of red pepper soybean paste in foreign countries.

**China (9)** *Lajiojang* was made from red pepper powder. It is product which red pepper was milled after salted. The product is golden red color, it contents a variety of nutritional ingredients, which included protein, sugar, phosphorus, iron, and calcium and so on, beside of abundant vitamin C and carotene. People are used to eat it with noodle, dumplings, meals and so on.

Ground red pepper, soybean paste, sugar and refined salt were mixed with water and keep them for one week to ready to eat.

**Other foreign countries** There are many types of red pepper sauces at different countries like as Caribbean sauces, Louisiana sauces, Mexican and South Western sauces and other continents.

The most of the sauces used different types of vinegar as sour sauces and keep for fermentation very seldom. None of them use soybean.

### Recent Production Figures of *Kochujang* and its Production Methods

#### Recent production status of *kochujang*

The estimated *kochujang* consumption increased from 131,317 tons in 1980 to 176,692 tons in 2003 continuously as shown in Table 1. The results of factory production in this amount increased rapidly in the 1990s and reached 136,572 tons in 2003 by the continuous increase in its production. It brings an increase of the reliability for the quality of *kochujang* by using public relations through an advertisement media like TV, radio, magazine, and various other routes. In addition, it is considered that the purchasing ratio of the products (77.3%) increased by the trend of following-up the convenience rather than producing it in the home due to the increase of a dual-income family.

The exports of *kochujang* for factory production increased rapidly from 2,417 thousand dollars in 1990 to 7,853 thousand dollars in 2003 (Table 2). The export goes mainly to Japan, USA, Canada and China. And about also 4 million dollar valued *kochujang* was imported from over than 10 countries.

**Table 1.** Production of fermented soybean product in Korea (Unit: kL, M/T)

Year	Soy sauce			<i>Doenjang</i> (soybean paste)			<i>Kochujang</i>		
	Estimated needs	Factory supply	Ratio	Estimated needs	Factory supply	Ratio	Estimated needs	Factory supply	Ratio
1980	397,540	108,765	27.4%	274,375	53,995	19.7%	131,317	35,750	27.2%
1985	404,602	107,890	26.7%	275,638	46,270	16.8%	141,724	32,548	23.0%
1990	416,700	167,040	40.1%	278,450	59,300	21.3%	148,600	43,890	29.5%
1995	414,300	178,818	43.2%	280,200	94,444	33.7%	160,100	77,058	48.1%
2000	352,400	179,239	50.9%	266,300	133,476	50.1%	165,700	113,976	68.8%
2003	344,734	209,848	60.9%	283,000	149,359	52.8%	176,692	136,572	77.3%

**Table 2.** Exports of *kochujang* in 2003 (Unit: kg, \$)

Country	Soy sauce		<i>Doenjang</i>		<i>Chunjang</i>		<i>Kochujang</i>		Total
	Amount	Value	Amount	Value	Amount	Value	Amount	Value	
Total	5,399,791	5,630,250	2,541,992	4,070,904	324,880	607,063	4,485,250	7,853,337	18,161,554
USA	1,373,200	1,739,468	1,328,025	1,925,337	229,207	313,430	2,107,500	3,150,193	7,128,428
Japan	363,410	182,893	304,946	359,407	1,800	2,000	1,508,219	3,187,410	3,731,710
China	576,747	1,319,505	390,425	938,827	39,177	200,205	174,520	329,332	2,787,868
Russia	1,835,879	1,167,832	55,214	68,148	0	0	59,263	98,463	1,334,443
Canada	232,632	226,900	140,973	212,112	17,342	20,507	223,274	370,645	830,164
Others	1,017,923	993,652	322,409	567,073	37,354	70,921	412,474	717,294	2,348,941

#### Comparisons of the production methods

*Kochujang* can largely be classified by the factory made products and traditional products. The differences between the products are presented in Table 3 and Table 4.

**Table 3.** The differences between traditional *kochujang* and factory *kochujang*

Contribute	Traditional <i>kochujang</i>	Factory <i>kochujang</i>	Remark
Starch source	Waxy rice, over 20% (Domestic only)	Wheat flour (Imported one permitted)	Traditional <i>kochujang</i> : natural microbe Factory <i>kochujang</i> : starter (pure strain)
Red pepper powder	Over 20% (Domestic only)	Over 6% (Imported one permitted)	
Preservative	Not permitted	Not more than allowed dose	
Fermentation container	Clay pot	Tank	Traditional <i>kochujang</i> : natural fermentation Factory <i>kochujang</i> : forced aging
Fermentation period	At least 6 months	Not more than 15 days	
Sterilization	Non treatment	Pasteurization (Only for yeast)	
Maker		QC manager	

**Table 4.** Comparison of ingredients between traditional *kochujang* and factory *kochujang*

Contribute	Traditional <i>kochujang</i>	Factory <i>kochujang</i>	Remark
Ingredients	<ul style="list-style-type: none"> <li>○ Waxy rice: about 24% (over 20%)</li> <li>○ Red pepper powder: about 28% (over 20%)</li> <li>○ <i>Meju</i> powder: about 8% (natural fermentation) - rice : soybean (6:4)</li> <li>○ Malt: about 5%</li> <li>○ Salt: about 10% (summer: about 12%)</li> <li>○ Water: about 30%</li> </ul>	<ul style="list-style-type: none"> <li>○ Wheat flour: about 17%</li> <li>○ Red pepper powder: about 10%</li> <li>○ <i>Meju</i> for <i>kochujang</i> (starter) : defatted soybean 100%</li> <li>○ Parboiled and polished wheat</li> <li>○ Starch syrup</li> <li>○ Waxy rice (<i>waxy-kochujang</i> only)</li> <li>○ Yeast extract</li> <li>○ Condiment (MSG etc.)</li> </ul>	Some factories use not defatted soybean

### The Future Direction and Development

In order to develop the industry of *kochujang* processing and highlight as a prominent spice throughout the world, it is surely necessary to study and endeavor a lot on it in the future. It has a part to play in the improvement of the production system by cherishing the traditional methods and changing the taste for people around the world. In the sense of the meaning, we present some proposals to develop the industry of *kochujang* as follows.

#### Quality preservation and standardization

**Discoloration and swelling** It is necessary to manage a lot of factors in order to preserve a certain quality because *kochujang* is a kind of fermented food produced from complex materials. Especially, the changes of color in a finished product will affect to the degradation of products. Therefore, a method to solve this problem or at least delay this problem is needed. A cause of discoloration is generally related to the maillard reaction and primarily regarded as a combination of oxygen and an amino acid reaction with sugar. In order to sustain the bright color of *kochujang*, it is required that a natural coloring matter be actively considered. In addition, it is necessary to delay the maillard reaction by replacing sugar with other ingredients.

**Preservation methods** There are many methods proposed to preserve *kochujang* for a long period of time. However, it is required to introduce a new method in order to replace the existing heat treatment from now on

because *kochujang* is very sensitive to heat treatment due to the characteristics of the product although a method that adds alcohol after finishing a heat treatment is actually an easy way used in factory production. To achieve a new method, the combined use of natural preservation additives with the heat treatment is also examined. In traditional *kochujang* production process without a heat treatment, there are some problems like discoloration and swelling caused by gas production. However, we considered that these problems would be clearly solved by using natural preservation additives using the results of the study performed by other colleagues and myself.

**Fermentation management** A natural fermentation of *kochujang* is processed by the microorganisms and created enzymes in the red pepper or fermented soybean mash (*meju*). In the production process of *kochujang* in a traditional method, natural microorganisms are used. However, in the case of factory production, a *koji* that is a multiplication of *Aspergillus oryzae* is mainly used. On the other hand, some factories applied a combined use with *Bacillus*. Here, all products of *kochujang* have to be managed and standardized for the process of fermentation by managing the microorganisms. It was verified that fermentation could be performed by using a superior strain for *meju* malting based on our study. Moreover, it is possible to manage the quality of *kochujang* from the study.

It is only natural that the fermentation process of *kochujang* is to be scientifically managed and introduced in the manageable range before a new departure for the worldwide food. The standardization of *kochujang* comes true by this process and improves its quality. In addition, the selection of microorganisms related to the process, applications and fermentation temperature, and general conditions have to be included in the management of the fermentation process.

#### **Verifying and enlarging the functionality**

A study on the ingredients of capsaicin that has a hot taste of red pepper has been actively conducted throughout the world. The metabolic process of capsaicin in an organism and its application have been largely known and extended to the suppression of fat and prevention of disease by connecting the promotion of lipid metabolism and accentuation of the immunity. From the results, the functionality of *kochujang* will not be limited to red pepper only but will try to overcome this level of study. As mentioned above, it is expected that *kochujang* is not a simple mixture of red pepper but a different product that has a particular function because it goes through a complex fermentation process. Although the daily intake amount of *kochujang* is small, a biological function due to the special ingredients of it will be a good object for study.

#### **Sanitation processing of *kochujang***

A most deeply related element to the fermentation of *kochujang* is microorganisms and enzymes. Moulds, enzymes, and *Bacillus* species among the microorganisms are concerned in the fermentation and are not always considered that it plays a good role in the process. Although, there has been some management done for a part of microorganisms, it is not possible to manage the microorganisms for a large amount of red pepper mixed as a product of *kochujang*. Therefore, it is necessary to consider the problems of sanitation that may occur in the fermentation process of *kochujang* with a study on the issues and extracts a method to replace the problems. In addition, it will be applied in a production factory. Moreover, the industry of *kochujang* has to prepare with a good enough coping and preparation because the standard of a finished food will be strengthened in the future.

#### **Attempting to enhance diversity of the products**

**Development of a fusion food** *Kochujang* is a kind of fusion food. Red pepper that was originated from South America was introduced from Portugal via Japan or China to Korea and was created as a traditional food

so-called *kochujang* by combining it with the native food of soybean pastes.

It is time that we make the second generation of *kochujang* by producing a fusion food, which will be prepared to the taste of people around the world based on our *kochujang*. It will be a good chance to open up a new market by introducing a healthy curiosity and recognition of a healthy food if it can be reached by the hands of people with a tasted food using red pepper while the functionality of red pepper has been fortunately recognized throughout the world. In order to fulfill this purpose, we have to understand the dietary life and habit of the foreign countries and make an effort to support the scientific background. It is not possible to spread it in the case of a lack of preferential taste. It will be a form that is able to infiltrate each dietary life even though it has a basis based on the preferential taste.

Hot sauce is already well known throughout the world. Therefore, we have to draw moral from the famous products that are in circulation around the world.

**Development of a product with various quality** A product that has a different hot taste, compensates for a taste of sweet and toothsome, and changes the colors for fitting the characteristics of the country is actively considered. In addition, it will be supplied to various customers, such as the younger generation, children, and other particular ages. Especially, how the product will be sold in a fast food store to compete with a tomato catchup will be considered. Various spices and foods used by its spices have been developed according to the fact that a food becomes high-grade and attract the attention of customers. In addition, the demand will increase in a related business. It surely seems that a product of *kochujang* will be used as a basis for developing a new form of spicy sauces or condiments.

#### **Secure optimal raw materials**

The most important raw material is red pepper. The final products show a different characteristic for the taste or property of red pepper in which the quality of red pepper presents totally different characteristics according to the varieties, cultivation areas and methods, harvesting time, and weathers. As a result, maintaining the quality of red pepper rises as an important item for the management. In order to effectively manage and maintain, it is required to breed good varieties of red pepper and make standardization for the cultivation methods. It is necessary to study the selecting and breeding for varieties of red pepper in spite of spending a long period in order to launch a product of *kochujang* as a representative product throughout the world. The breeding of red pepper so far has been developed to fit disease resistance, quantities, and properties of *kimchi*. However, the breeding of red pepper will be managed and controlled by the level of government in order to arrange the business of *kochujang* because *kochujang* production is also a major consuming field of red pepper.

Moreover, the flour used in factory produced *kochujang* as a kind of major raw material is also carefully studied to examine the optimal quality and characteristics. In addition, a kind of *koji* will be studied.

#### **Preparation of a base for the internationalization**

**Joint venture with a foreign special enterprise** A joint venture with the existing local spice production company that has a large market share in the world market or construction of a factory in the domestic will be actively considered. An addition of a new product that has a marketability becomes not a burden for the celebrated Production Company all over the world because they already have a strong distribution network and brand. A hot sauce production company may contribute largely to the development of a related technology for red pepper and strategy for the marketing. It is true that if we will lose the competition with the dominated companies in the world, we will be lost the market and insulted by depriving the main room of the domestic market.

**Strengthening public relations for foreign dining out groups and joint sponsorship for an event** Because the selection of spicery is finally decided by the dining out consumers, it is necessary to seek a method to announce *kochujang* and use it for their foods by forming a connection chain with the consumers and exercise in public relations. In the case of the consumers who are engaged in the dining out business, they can point exactly the methods to use *kochujang* in their dishes and present items and opinions. It is a better way to contact them by the level of association or group than an individual enterprise.

**Active participation for international meetings** A number of foods related fairs and exhibitions are holding around the world and giving a chance to announce their foods, manufacturing machinery, raw and subsidiary materials throughout the world. It is still not popular the participation such a fair or exhibitions even though some manufacturing companies were participated to the fairs or exhibitions held in America or Japan. Participating the international fairs and exhibitions may give a chance for the producers even consumers not only presenting our products and introducing other related foods. Actually, there are many cases to succeed a commercial transaction through these fairs or exhibitions. It is good for us to host these kinds of fairs or exhibitions in an active manner.

In addition, it is necessary to contribute continuously to an international academic magazine or conference to attract an expert eye for the worldwide scientists for announcing the scientific technologies of *kochujang* to the world. The 'Tempeh' from Indonesia is a good example of that.

**Plan for the connection with a dining out business** The growing of the dining out industry has been highlighted in both advanced countries and under developed countries. In addition, it largely affects the growth of the business. The dining out industry has been formed as an internationalized model instead of a domestic market only and existed as a situation that the raw and subsidiary materials are decided by the quality and its prices regardless of a place of production. The materials of dining out industry may be classified by the main and subsidiary materials in which spices and flavors occupy a large part of the subsidiary materials. In order to achieve the internationalization of *kochujang*, it is necessary to make an effort to connect a multinational foreign company in the field of dining out industry. Although our *kochujang* industry is not ready to invest in the foreign dining out industries, it seems that there will be a chance for the business of *kochujang* if we decide how to participate in the business according to the necessity.

## CONCLUSIONS

The scale of the industry of *kochujang* in Korea is about 200 billion won and 7.8 million dollars by 4,500 tons for the exports. Although it is still not a large part of the food industry in Korea, the scale of soy products will increase because it is a major subsidiary food in our dietary life and has been moved from a home made product to a factory made product.

*Kochujang* is the largest part in the scale of the sales and has merit because it has a domestic basis and is able to grow to an internationalized for the next product of *kimchi* due to the originality of a spice, which has a unique fermented taste. In order to make *kochujang* an internationalized food, it is necessary to devise a study on the scientific development of *kochujang* itself and a diversity of products that is fitted to the taste of people around the world. In addition, the participations of various exhibitions and food fairs are supported by the level of the government in order to promote the advertisement of *kochujang* throughout the world. In addition, these will be actively greeted by the relative businesses.

Red pepper used as a major raw material of *kochujang* has been widely studied throughout the world and

mentioned that it has an effect on the protection of fat, strengthening a function of the immune system, and as an biological active function. A fermented spice like our *kochujang* is expected that it has a beneficial function in our body owing to the products of fermentation differed from red pepper itself.

If we prove the various biological functions of *kochujang* with a particular taste and flavor, it will energize a new market whatever we want. It is necessary to support a continuous effort by the businesses, supporting by the scientific world and consideration by the policy in order to announce a traditional food to the world.

In the present day, the industry of *kochujang* is now on a firm basis and has been activated in the field of its study. Then, it is possible to succeed a birth of the secondary internationalized food by concentrating on these efforts.

## REFERENCES

1. Lee SW. 1998. Historical review. Present status of Korean traditional fermented foods and future prospects. *Korean Society of Food Sci and Tech. Proceeding.* p 1.
2. Yoo TJ. 1980. *Sikpum Dongeuybogam.* Academy press. p 63-65.
3. Lee SW. 1990. History of spices and condiments. The Korean Society of Food Culture, Proceeding. p 3-12.
4. Shin DH. 1995. Quality improvement, automation for production and functional reinforcement of traditional *kochujang*. Report, Chonbuk National University, Ministry of Science & Technology.
5. Shin HH, Lee SR. 1991. Quality attributes of Korean red pepper according to cultivars and growing area. *Korean J Food Sci Tech* 23: 296-300.
6. Lee CY. 1989. Culture of Korean fermented soybean products. Proceeding, Society of Korean Food Science and Technology. p 1-5.
7. Hwang HG. 1988. Studies on the malted red pepper catchup and ginger of Chonlla province. *Korean J Dietary Culture* 3: 351-357.
8. Kim SZ. 1999. Anticancer activity of traditional *kochujang*. *PhD Theses.* Dongduk Women's University.
9. Fang JG. 1995. Jiang lei zhi pin sheng chan ji shu. Chinese Light Industry Press. p 7-8, 232.