

# Korean Functional Foods

Composition, Processing  
and Health Benefits

Edited by  
Kun-Young Park  
Dae Young Kwon  
Ki Won Lee  
Sunmin Park



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# 1

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## *Korean Foods—History, Culture, and Characteristics*

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Cherl-Ho Lee

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### 1.1 History of Korean Dietary Culture

The Northeast Asian culture, generally known as a part of Chinese culture to Western society, comprises many segments of ethnic groups, which have each developed their own identity and distinctive culture over time. In the present day, they are referred to in large groups with the names of their countries: China, Mongolia, Korea, Japan, and parts of Russia (Siberia). But until a millennium ago, the ethnic group (or tribe) was more important than the nation in distinguishing the way of life of a people. The early classics of Chinese literature are the products of a long history of the thought, religion, culture, and wisdom of the many tribes in this region. The early historians in China described the existence and the lives of neighboring countries, including the Dong-yi (Eastern Archers). The Eastern Archers have inhabited a wide range of Northeast Asia, from the Shandong Peninsula to the Bohai Corridor, the Manchurian Basin, the Liadong Peninsula, and the Korean

Peninsula, which was mostly ruled by Goguryeo until the fifth century AD (Nahm, 1988; Lee and Kim, 2016).

### 1.1.1 Paleolithic Age

The early existence of human beings in this region is evidenced by early Paleolithic remains (1,800,000–300,000 years ago, BP [before present]) of the early/middle Pleistocene Age in Northern China and the Korean Peninsula. Evidence of the existence of *Homo erectus* (1,800,000–650,000 BP) was found in the Xihoudu, Lantian, and Zhoukoudian sites on the Northern Chinese Mainland, Jinniushan in the Manchurian Basin, and the Sokchangni and Chungbuk Keumkul sites on the Korean Peninsula. Zhoukoudian cave locality I, near Beijing, has yielded the largest number of *Homo erectus* fossils in the world: 40-odd individuals, together with thousands of animal bones, some of which were burnt by roasting (Barnes, 1993). Fossils of early man, *Homo sapiens*, were found in Yokpo Cave (500,000 BP) and Sangwon Cave (400,000 BP) near Pyongyang on the Korean Peninsula (Sohn, 1983).

Recently, several middle Paleolithic (350,000–40,000 BP) remains were found on the Korean Peninsula. The stone tools and animal fauna of the Seungrisan, Jommal Yonggul, Durubong, and Chongongni sites were similar to those of the Dingcun site of China. The fauna and stone tools of the Sokchangni seventh and eighth layers, Chongchongam Cave, Gulpori I, and Sangmu Yongni were comparable to those of the Xujiayao site in Northern China. The earliest Paleolithic remains found in Siberia, at the Irkutsk site near the Angara River and the Ushiki site on the Kamchaka Peninsula, were those of 70,000–130,000 years ago, similar to those found at the Gulpori site (Choi, 1983).

Numerous late Paleolithic (40,000–10,000 BP) sites were found on the Korean Peninsula, in South Manchuria, and on Japanese islands as well as the Chinese mainland. This points to the increase in population and spreading out of people in this region in the late Paleolithic Age (Lee, 1998a). During the glacial periods (Günz, Mindel, Riss, and Würm) of the Pleistocene age, the Yellow and Seto Plains were exposed by lower sea levels, and the East Sea became merely a large lake, which drained through the present Korea Strait. These increased land areas facilitated the movement of humans and animals among and between parts of East Asia (Lee, 1998a). It has also been assumed that the Asian Mongoloids moved to the American continent over the Bering Strait during these periods (Barnes, 1993). However, during the warm interglacial period, the sea levels rose to the present level, and the Korean Peninsula became a land bridge connecting the Japanese islands to Manchuria and the Maritime Province of Siberia. The mobile hunter life of Paleolithic men, who chased after large animals moving periodically with seasonal climate change, continued until the invention of earthenware. Figure 1.1 shows the sites of Paleolithic remains excavated in Northeast Asia, and the migratory route of the mobile hunters from southern Kyushu to northern Manchuria and Siberia through the Korean Peninsula, connected

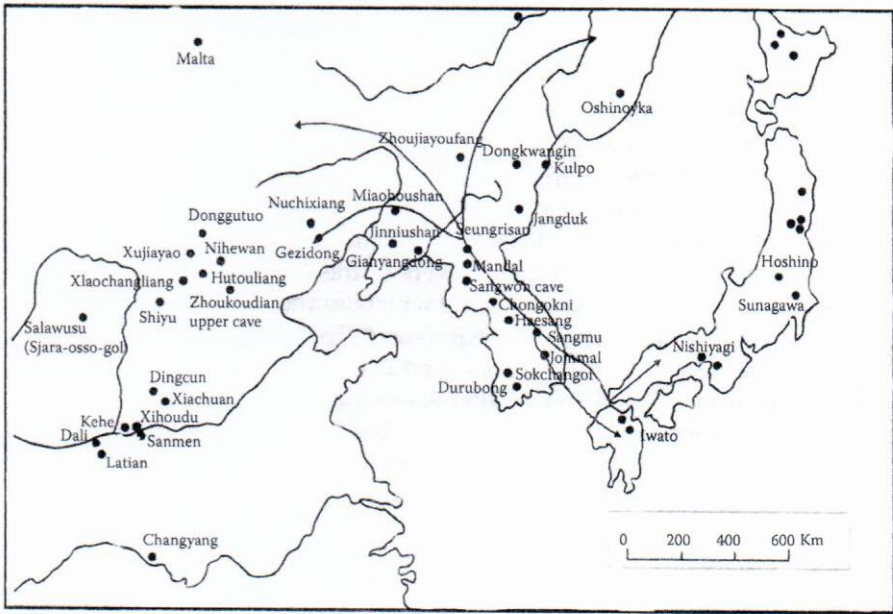


FIGURE 1.1

Paleolithic remains found in Northeast Asia. (From Lee, C. H. 2001. *Fermentation Technology in Korea*. Seoul: Korea University Press.)

by mountain ranges (Lee, 2001). Animal meat, intestines, and blood were the main foodstuffs for these people, and the use of vegetable supplements, such as grass seeds, tree nuts, and wild fruits and roots, increased in the later stages of the Paleolithic era. The people lived in caves in the mountains and gradually moved to the lower plains and river banks in the later part of that era (Lee, 1998a).

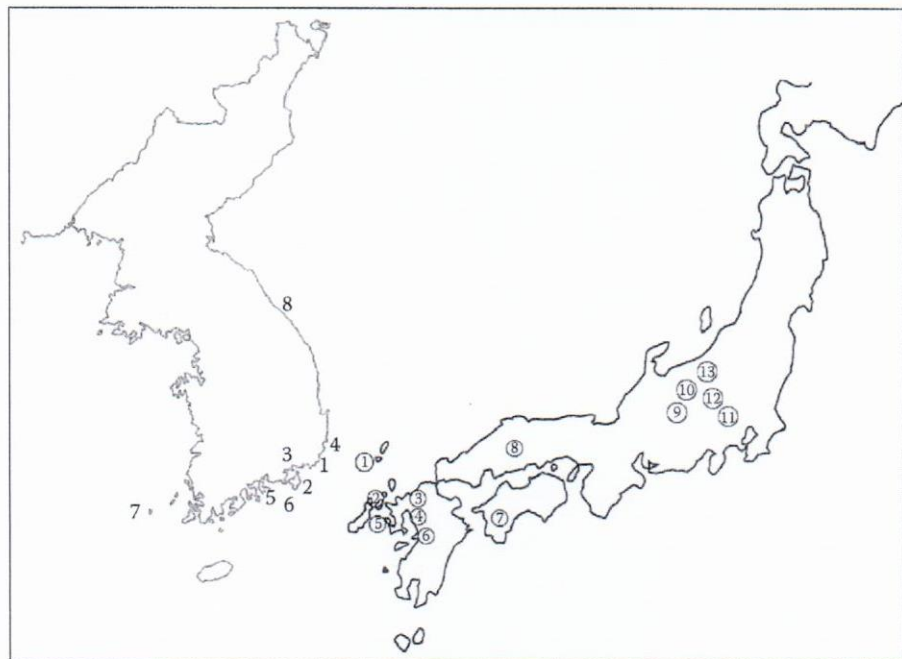
The animal meat-eating habit of the early men in Northeast Asia and on the Korean Peninsula gradually appears to have changed to an omnivorous culture by the end of the Paleolithic Age. The utilization of tree nuts and acorns, wild fruits, berries and grapes, grass seeds, roots, and young buds of trees and ferns increased gradually as the inhabitants noticed that abundant plant materials were growing around the previously inhabited caves and dwellings. Traces of pollen of grass, rice (Gramineae), and beans (Leguminosae, Papilionoidiae) have been found to have increased among late Paleolithic remains (Lee, 1998a). With the increase of plant food in the diet, the dwelling sites gradually moved from the mountains to the plains near rivers.

### 1.1.2 Primitive Pottery Age

Earthenware was likely invented by the people in the coastal area of the Korea Strait comprising the southeast of the Korean Peninsula and the north of

Kyushu in the Japanese Islands during 12,000–8,000 BP (Han, 1983). The use of Chulmun (Korean) or Jomon (Japanese) pottery spread over the whole region of Northeast Asia by the year 6000 BC, and this gradually changed the population's migratory Paleolithic life into a littoral forager life along the coastal line (Figure 1.2). The typical Northeast Asian lifestyle that existed between 10,000 and 4000 BC, before the beginning of Neolithic agricultural settlements, has been called the "Primitive Pottery Age" in order to distinguish it from the European Mesolithic culture (Lee, 1999). The numerous shell mounds excavated along the coastline and major rivers of the Korean Peninsula indicate that the people were engaged in hunting with bow and arrow and fishing with carved bone tools and other fishing equipment. Tree nuts, acorns, wild grains, fruits, vegetables, and roots were also used as foodstuff.

The use of marine products as food was expanded with the use of earthenware at the beginning of the Holocene. The food life of Northeast Asian people in the Primitive Pottery Age (6000–3000 BC) can be characterized by the abundant use of shellfish and marine products together with animal



**FIGURE 1.2**

Primitive Pottery Age remains excavated in the Korea Strait region. (From Han, Y. H. 1983. Regional comparison. In *Korean History 12: Archeology of Korea I*. National History Editorial Committee, 479–521 (in Korean).) Korean Peninsula: 1. Dongsamdong, 2. Dadaepo, 3. Chugok, 4. Sinamri, 5. Sangnodaedo, 6. Yokjido, 7. Sohuksando, 8. Osanri. Japanese Archipelago: ① Kosijima, ② Fukui, ③ Nisikaratsu, ④ Iwasita, ⑤ Senpukuji, ⑥ Todoroki, ⑦ Kamikuroiwa, ⑧ Mawatari, ⑨ Yangimata, ⑩ Isigoya, ⑪ Hasitate, ⑫ Tazawa, ⑬ Ozawa.

foods from hunting, as evidenced by the numerous shell mounds along the coastline of the Korean Peninsula and Japanese islands. The cooking of fish and vegetables in sea water in earthenware bowls, called *chigae* today, must have emerged from this period (Lee, 1999). Since the use of earthenware for the storage of cereals, vegetables, meats, and marine products could have naturally resulted in fermentation, fermented foods such as cereal alcoholic beverages, vegetable pickles, and fermented fish and meats were probably developed prior to the beginning of agriculture in this region (Lee and Kim, 2016).

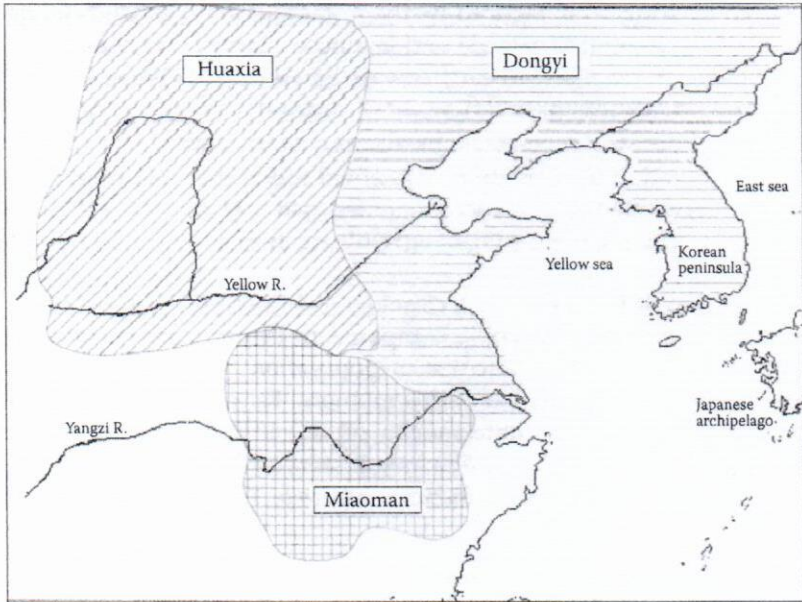
The invention of fermentation technology, which could provide relatively abundant nutrients to the people compared to in previous periods, might have resulted in a sudden increase in population. Human civilization in Northeast Asia actually started at this moment. People lived in caves along the river banks or in semisubterranean pit dwellings as demonstrated by Amsadong remains near Seoul. The long history of fermented food use and *chigae* culture characterizes the dietary culture of Koreans today.

### 1.1.3 Neolithic Age and the Era of Myth

The Neolithic Age began with agricultural settlements in Northeast Asia in about 4000 BC. Tribal states, which were based on agricultural and fishery settlements, emerged in this period. The early civilization centers on the Chinese continent were the Bohai Corridor in South Manchuria, represented by Hongshan culture; Cishan in the west of the Central Plain of the Chinese mainland, represented by Yangshao culture; and the Yangzi Delta in the Shanghai area represented by Hemudu culture (Barnes, 1993).

There were three major ethnic groups competing with each other to occupy the Central Plain of China—namely, the eastern tribe, Dong-yi; the western tribe, Hwaxia; and the southern tribe, Miaoman. Figure 1.3 shows the territories of these three tribes in the prehistoric era. The stories of the formation and destiny of these tribes were handed down in the form of myth. Most Chinese and Northeastern mythologies are the stories of thousands of years of struggle between the three tribes, especially between Dong-yi and Hwaxia, to occupy the Central Plain.

According to *Handankogi*, a collection of Korean mythology written between the Silla Era and Chosun Kingdom, the first nation of Dong-yi, Hankuk, was founded near Mount Paektu and the Heilong River in the seventieth century BC by the heavenly god Hannim and was ruled by seven emperors for 3,300 years without any struggle or war (Lim, 1986). In the fortieth century BC, the heavenly God sent one of his sons, Hanung, along with 3,000 followers, including three servants controlling the wind, rain, and clouds, to found a second nation, Baedal, in Shinsi. A bear and a tiger on earth wished to be human beings, so Hanung told them to pray in a dark cave for 100 days and eat only garlic and mugwort in order to become human. The bear followed these instructions successfully and became a woman, Yong-yo, while the tiger could not tolerate the



**FIGURE 1.3**

Prehistoric ethnic grouping in the Central Plain region of China. (From Barnes, G. L. 1993. *China, Korea and Japan: The Rise of Civilization in East Asia*. London: Thames and Hudson.)

suffering. Yong-yo then prayed to have a baby, so Hanung, a son of God, married her and they had a son. This idea of the marriage between a heavenly god and a woman (goddess) of the earth who have children—the people, who are basically the descendants of the heavenly God—is called Samsin (three gods); this concept forms the basis of Asiatic shamanism and folk Taoism, which has been the traditional religion of the Dong-yi. Hanung's kingdom continued with 18 emperors for 1,565 years. The fourteenth emperor, Chiyou (2707 BC), expanded cultivation land and produced copper and iron for the war industry. He appears in the Chinese myth known as the story of "Three Emperors and Five Kings." In 2333 BC, Tangun founded the third nation, Tangun Chosun, the last legendary nation in Korean mythology, which was ended by the forty-seventh emperor, Koyolga, in 295 BC (Lim, 1986). However, historians today consider Tangun Chosun to be the first nation in Korean history (Nahm, 1988).

The legendary nations in Chinese mythology start with Yao followed by Shun, Hsia (2000–1520 BC), and Shang (Yin, 1520–1030 BC). The story of the "Three Emperors and Five Kings" illustrates the formation of the Chinese legendary kingdoms and their struggle with the different tribes. Many of the legendary figures in Korean myths appear in the Chinese myths as a challenging nature or the prime mover of a period. In fact, the Shang period was ruled by the Eastern Archers, the Dong-yi. As with most legendary stories, the Chinese myths were also fabricated intentionally by the powerful elites and kings of the Chinese mainland to justify their legitimacy throughout

history. The truths behind the myths are not always possible to prove with evidence, but may be useful in filling the gaps of human history, especially in the case of the lost history of the Dong-yi from 8000 to 2000 BC.

The main early cereal grain cultivated and utilized by the people in Northeast Asia and on the Korean Peninsula appears to be millet, which is the native plant in that region. The oldest rice remains (12,500 BP) were found in Sorori, Korea; these were older than the rice remains found in the Yangzi River region of China (Lee et al., 2015a). Carbonated rice objects have been found in late Neolithic and early Bronze Age remains (2000 BC) in Korea. Rice cultivation was a common practice in the Three Nations Period (third century) of Korea.

When the horse-riding people of the north, the Yemaek tribe of the north-eastern Dong-yi, came south to the Korean Peninsula to become agricultural farming settlers, they needed to have a stable protein source to replace their meat from the animal herds. They invented the use of wild soybeans as food by soaking them in water and cooking them properly to eliminate the antinutritional factors in the bean. The Maek tribes are considered to be the first users of soybean as food in history (Lee and Kwon, 2005). Soybeans were cultivated by the nomads who started farming settlements at around Mt. Baekdu, in southern Manchuria, and on the Korean Peninsula at the beginning of the Bronze Age. Among Bronze Age remains in Paldang, near Seoul, a smooth earthen vessel with traces of soybeans on the surface was excavated. Botanists believe that the origin of soybeans is along the line from South Manchuria to the Korean Peninsula, where the most abundant varieties of wild soybeans are found. The first record of soybeans appears in *Shyjing*, a piece of Chinese literature written in the seventh century BC. The story of soybean introduction into China says that soybeans were brought into China from Sanyung (South Manchuria) in the early seventh century BC by Hwangong of the Chhi dynasty, as he conquered Sanyung during the Chhun Chhiu Period, and it was therefore called Yungsuk (Lee, 1984).

Soybeans played an important role not only in supplying protein but also in providing palatability to the bland diet of cereals and vegetables in the form of fermented soybean products. *Weyjyh*, Dong-yi joen, and Kokuryo cho of *Sanguojyh*, a history book written in the sixth century in China, describe the people of Kokuryo as good at preparing fermented soybean products. The smell of soy sauce starter, shi, was described in Chinese as gaolixiu, meaning “the smell of the Korean people.” Bowuzhi of Jin (AD 265–420) records that Shi originated from a foreign country and the character is part of a dialect. *Xintangshu* of the Tang period (AD 618–907) names Shi as a special product of Bohai (AD 699–926), a nation founded by refugees from the defeated Koguryo. The production of soy sauce by the Maek tribe, who were originally meat-eating nomads, created a typical Korean dish, bulgoki or Maek-chok—roasted meat marinated with soybean sauce. This dish is considered to be a marriage of meat-eating habits with soy sauce culture, which happened in the crop-farming settlements of the nomads on the Korean Peninsula. In the

Chin dynasty China, marinated roast meat was called Maek-chok, which meant Korean roast meat. The meat diet of the nomads gradually changed because of their changing settlement patterns, as they adapted to the cereal-based food diet of the natives in the southern plains.

#### 1.1.4 The Historic Age

The classics of Korean history, *Samguksaki* (Kim Busik, 1145) and *Samkukyusa* (Ilyon, 1281), describe the founding of Dangun-chosun (2333 BC) and the Three Nations: Silla (57 BC), Koguryo (37 BC), and Paekche (18 BC). The introduction of Buddhism, in AD 372 in Koguryo and in AD 528 in Silla, accelerated the reduction of animal food consumption and encouraged the spread of vegetarian food habits. According to *Samguksaki*, rice, grain-wine, oil, honey, soy sauce, soybean paste, dried meat, and fish sauce were the important food items that were prepared for a wedding in the royal family in Silla in the seventh century. The people of Unified Silla and the succeeding Koryo dynasties were strong Buddhists. During this thousand-year period, nomadic habits centering around animal food mostly disappeared. The extensive use of salted vegetables and soybean products as the major source of protein resulted from this change. The technologies of soy sauce fermentation and rice-wine making were well developed and transferred to neighboring countries. Soybean fermentation technology was transferred from Koguryo to Japan in this period. The document of *Shoso-in* (AD 752) of Japan describes miso, the Japanese name for soybean paste, as a word from a dialect of Koryo (Korea), often called koryojang, which means Korean sauce (Lee, 1984). The ancient Japanese history book *Kojiki* says that a man from Paekche taught them rice-wine making. The memorial tablet of a man called Chin of Silla is kept in a shrine—the Matsuo Taisha in Kyoto—as a god of rice-wine. The rice-wine producers in Japan attend an annual worship ceremony for him, in order to pray for success in their own wine fermenting (Lee, 1995a).

The Chinese Yuan (Mongol) invasion of Koryo in the thirteenth century (1259–1356) brought about the suppression of Buddhism and an increased respect for Confucianism in the Chosun kingdom; it also restored the animal food diet in Korea. Another important thing in the Korean diet is representative fermented foods, such as kimchi and kochujang—typical Korean fermented vegetables and hot soybean paste—which were influenced by red pepper. Recent genetic studies of red peppers showed that the Korean type of red pepper has grown wild for a half a million years in the Korean peninsula (Kwon et al., 2017). The Korean people have known how to make kimchi and kochujang traditionally for more than a thousand years. Kimchi and kochujang can be made only with Korean red pepper—not with central American or tropical Asian red pepper.

During the Chosun kingdom (AD 1382–1910), a well-balanced variety of foods, of both animal and vegetable origins, was utilized. *Imwon Sibyukchi*, an

encyclopedia written in 1827 by Seo Yu-Gu, describes the food materials that were used in nineteenth century Korea, including 11 kinds of water, 36 kinds of cereal, 72 kinds of vegetables, 13 kinds of poultry, 34 kinds of fish, and eight kinds of spices. The ideal diet for Koreans was standardized between the fifteenth and nineteenth centuries. *Shieui Jeonseo*, written in the nineteenth century, as well as other books written between the seventeenth and nineteenth centuries, outlines the standard meal of Koreans, consisting more or less of a bowl of cooked rice, a bowl of soup, and a bowl of kimchi as a basic meal. To this basic menu, side dishes are added, forming a three-dish meal (samchop-bansang), five-dish meal (ochop-bansang), seven-dish meal (chilchop-bansang), and so on (Yoon, 1993). A 12-dish meal was served only for the king.

### 1.1.5 Dietary Changes during the Last Century

Korea opened its gates to western countries in the 1870s, much later than Japan and China. European diplomats, Russians, and missionaries from America introduced cakes and coffee. However, this was soon overshadowed by the Japanese invasion of Korea, and Korea was annexed to Japan for 36 years starting in 1910. One of the statistical records of the colonial regime shows that Japan extorted one-third of the rice produced in Korea every year during this period (Lee, 1995b). The Korean people suffered greatly from the shortage of food, and even defatted soybean flakes were rationed as a rice substitute. Soon after the rehabilitation in 1945, hundreds of thousands of people moved from Communist North Korea to South Korea in order to escape the terror regime of Kim Il-Sung, who was enforcing one-man worship. The total number of refugees from the north to the south during the Korean War (1950–1953) was estimated at two million. The starvation of the people was barely overcome thanks to wheat flour and nonfat dry milk donated by the US aid program. Milk porridges were rationed to the starving people, who had been non-milk-eating people. After experiencing severe lactose intolerance symptoms, people gradually adapted to being able to eat milk porridge. This triggered the explosive consumption of milk products during the economic growth of the 1970s and 1980s, and the rapid Westernization of Korean food habits afterward (Lee, 1995b).

The per-capita GNP of South Korea in the postwar era was 72 USD in 1954 and less than 100 USD until 1962. It increased to 130 USD in 1966 when the first Five-Year Economic Development Plan ended (1962–1966), to 288 USD in 1971 at the conclusion of the second plan, and to 797 USD in 1976 at the close of the third plan. The GDP reached 1,719 USD in 1981, when the fourth plan ended and 2,296 USD in 1986 when the fifth plan concluded. During this period, the proportion of the farming population decreased from 60% of the total population to less than 20%, with a massive inflow into urban centers.

Korea achieved a Green Revolution, producing rice at the level of self-sufficiency in the 1970s, and the term “barley hump,” referring to the food shortage, disappeared as the daily rice supply per person exceeded 300 g.

With the rapid development of the food industry after 1980, Korean dietary life changed significantly: The daily intake of animal products per person almost doubled in 5 years, from 98 to 183 g. In particular, there was a significant increase in meat consumption, from 79 to 119 g, and milk consumption rose from 10 to 43 g. Along with such changes in food consumption patterns, degenerative diseases such as diabetes, hypertension, and heart disease started to become important health issues. Therefore, this period has been assessed as one in which South Korea had passed into an era of surplus over the optimal patterns of Korean food consumption. Animal food consumption continued to grow, reaching 230 g in 1995 and 279 g in 2005. The average daily food intake for South Koreans was also on the rise and was estimated to increase 30% in 25 years, from about 1 kg per person in 1980 to 1.3 kg in 2005. The growth in food intake, especially the excessive animal food intake, caused a deterioration of national health, including an increase in obesity and degenerative diseases. The ratio of obesity in Korea in 1995 was 18.8% for men and 22.2% for women, making the average obesity ratio of the population 20.5%. This increased to 26.4% in 1998 and 32.7% in 2000, at which point 38.1% of men and 25.9% of women were obese. The changes in the leading causes of death indicate that the number of people who died of cancer increased by 27% from 1989 to 2009; the number of patients who died of breast cancer doubled, and deaths from colon cancer increased by 3.3 times. During the same period, the number of those who died of diabetes increased by 2.5 times (Lee et al., 2015b).

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## 1.2 Health Concept of Korean Functional Food

The concept of health for Koreans has been formed through history, influenced by the indigenous folk Taoism and the old oriental philosophy of man and the universe, which is represented by the concept of yin/yang and the Five Phases theory. The oldest Chinese medicine book, *The Yellow Emperor's Classic of Medicine*, written in the Chin and Han periods of China (220 BC–AD 220) contains theories of man–universe unity, yin and yang, the Five Phases, the ten calendar signs (the decimal system), earth's twelve branches (the duodecimal system), and other fundamental principles of medical treatment (Ni, 1995). This book was first introduced into Korea in the period of Koguryo King Pyungwon, in year 3 (AD 561). Since then, Chinese medicinal knowledge has greatly influenced the health concepts and food habits of the Korean people.

### 1.2.1 Taoism

Taoism, the folk religion that originated from the shamanistic beliefs of Northeast Asians, forms the basis of the health concepts found in the

traditional diet and medicine of the Korean people (Lee, 1998b). Korean thought about life and health is based on the shamanistic folk philosophy, which sets as the ultimate goal a healthy eternal life. The established Taoism, as developed by early Chinese philosophers, teaches that this goal can be achieved through discipline, mainly with the control of the breath, sex, and food. The principle of this control is the harmony of yin and yang, the negative and positive aspects of the universe. Toward the end of the nineteenth century, tens of thousands of broken tortoise shells and status pieces suggesting longevity were found in the capital city of the Shang (Yin) dynasty on the southern riverbank of Anyang, China. Pictographs on the engraved tortoise shells showed that the basic principles of yin and yang were a part of the Shang dynasty, and that they originated from the legendary saint, Bok-Eui (3000 BC), the god of divination. The Chinese characters, which are used as a writing system today, were developed during the Jou dynasty (1100–220 BC). The theory of interchange developed through the Jou dynasty for 3,000 years, leading to Taoism and Confucianism.

### 1.2.2 Yin and Yang and Five Phases Theory

*The Book of Changes (Yijing)* is the basis for the yin and yang theory and the principles of the Five Phases; it contains the principles that explain changes in the universe and in nature. Examples of yin/yang that are commonly found in nature include: dark/bright, female/male, inside/outside, center/circumference, weak/strong, empty/full, cold/hot, rise/descend, plants/animals, death/life, moisture/dryness, big/small, sparse/dense, and electron/proton. The important principles applied to the yin/yang relationship are mutual suppression and repulsion, mutual dependence, mutual compensation for equilibrium, and mutual transformation. These principles imply that there is no absolute yin (negative) or yang (positive) in nature, and that everything is relative.

Wood, fire, earth, metal, and water represent the principles of the Five Phases. These imply transition, movement, or passage, rather than the stable, homogeneous chemical constituents such as earth, air, fire, and water, the four eternal elements of ancient Greek science (Magner, 1992). The Five Phases are the principles of changes linked by the relationship between generation and destruction (or suppression), as shown in Figure 1.4 (Magner, 1992; Lee, 1998b).

According to the theories of yin/yang and the Five Phases, all food materials are classified according to their properties and their different tastes. These properties are cool, classified as yin; neutral; or warm, classified as yang. For example, fruits on the tree are considered yang, while roots in the soil are considered yin. The yin property also represents material entities, such as nutrients; the yang property represents functions, like energy. Taste is divided into five groups, representing the Five Phases: sour—wood, bitter—fire, sweet—earth, pungent—metal, and salty—water. As shown in

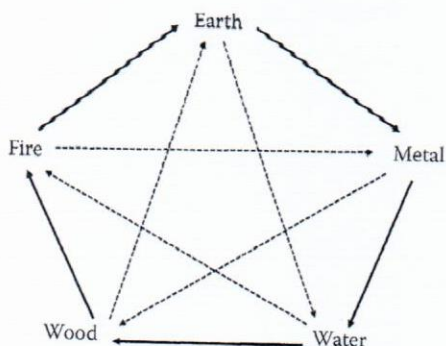


FIGURE 1.4

The five phases. As individual names or labels for the finer ramifications of yin and yang, the five phases represent aspects in the cycle of changes. The five phases are linked by the relationship between generation (—) and destruction (- - -).

Table 1.1, taste can be related to the human body and its organs, senses, and feelings, and even to color, the weather, and the seasons, through classification into the Five Phases. Antagonistic or affinitive relations between tastes and organs/senses are also judged or predicted by the principles of the Five Phases. For example, sour (wood) generates the heart (fire) but suppresses the spleen (earth), and salty (water) is related to the kidney and generates the liver while suppressing the heart. Though simplified unrealistically, Table 1.1 explains the basic notion of the Five Phases applied to food and health practices.

TABLE 1.1

Classification of Materials and Properties according to the Five Phases

Five Phases	Taste	Colors	Weather	Seasons	Bearing
Wood	Sour	Blue	Wind	Spring	East
Fire	Bitter	Red	Hot	Summer	South
Earth	Sweet	Yellow	Wet	Long summer	Center
Metal	Hot	White	Dry	Autumn	West
Water	Salty	Black	Cold	Winter	North
Five Phases	Organs	Intestines	Senses	Tissues	Feeling
Wood	Liver	Gall bladder	Eyes	Tendon	Anger
Fire	Heart	Small intestine	Tongue	Vein	Joy
Earth	Spleen	Stomach	Mouth	Muscle	Love
Metal	Lungs	Large intestine	Nose	Hair	Sorrow
Water	Kidney	Bladder	Ear	Bone	Fear

### 1.2.3 Traditional Chinese Medicine

Traditional societies like China and Korea have a long history of using food as medicine. Traditional Chinese medicine (TCM), for example, in Shennong's *Materia Medica*, divides types of medicine into three categories:

- 120 Upper medicines, which are nontoxic and usable in the long term as food
- 120 Middle medicines, which have a low level of toxicity and are used for chronic diseases
- 125 Lower medicines, which have a high level of toxicity and are used for acute illness

Food is considered the most important medicine to be used for the maintenance of health and prevention of illness, as well as in the first stages of treatment of an illness. The middle or lower medicines are used only when medicinal food (upper medicine) cannot cure a disease. Lists of medicines are found in many traditional Chinese works of literature. They have been developed over thousands of years of experience, mainly through human trials, and have substantiated the effectiveness of the theories of yin/yang and the Five Phases (Lee, 2004).

In TCM, food and medicine commonly have certain health functional properties, such as the four types of chi or ki (energy), the five tastes, descending/ascending, sinking/buoyant, channel tropism, and toxicity. The four types of chi are cold, cool, warm, and hot, which represent the causes of diseases in the body. Cold and cool are considered yin, while warm and hot are yang. Tastes and properties are also classified into yin and yang, as shown in Table 1.2 (Kim et al., 1995). All food materials are classified according to their different tastes and their properties: cool, classified as yin; neutral; or warm, classified as yang.

Healthy food in TCM implies balancing and harmonizing yin and yang and the Five Phases in a diet. A healthy diet must contain an even balance of food materials that have cold/cool (yin) and warm/hot (yang) properties and the five tastes. Therapeutic food (or functional food) means enforcing a certain chi for the imbalanced condition (illness) of a body, and enriching a certain taste to enhance or suppress an organ's function. The effectiveness of functional food has been explained systematically with this principle in TCM (Lee, 1998b).

**TABLE 1.2**

Classification of Chi, Taste, and Properties into Yin and Yang

	Yin	Yang
Chi	Cold, cool	Warm, hot
Taste	Sour, bitter, salty	Pungent, sweet, umami
Properties	Descending, sinking	Ascending, buoyant

The disease susceptibility and medicine response of individuals are also explained by the differences in chi and personality trait properties. The types of body constitution in TCM are focused on medicinal practice based on the theories of yin/yang and the Five Phases. In contrast, Korean Sasang constitutional typology is based on a combination of neo-Confucianism and the medical tradition of Korea, and describes nature as quaternary (Chae et al., 2003). Traditional Chinese medicine places importance on the harmony between humanity and nature, whereas Sasang typology emphasizes the harmony in social life and developing one's character.

#### 1.2.4 Eastern Medicine and Sasang Typology

Chinese traditional medicine has contributed to the development of Eastern medicine in Korea, in combination with traditional folk medicine, as recorded by Hur Jun in 1610. Eastern medicine was further developed in Korea during the eighteenth and nineteenth centuries, and grew into Sasang medicine (typology): As described by Lee Je-Ma in 1894, Sasang is a unique theory of categorizing people into four body types according to their physical constitutions: taeyang (large yang), taeum (large yin), soyang (small yang), and soeum (small yin). Figure 1.5 shows a schematic diagram of Sasang types from a biopsychological perspective (Chae et al., 2003). The yang types (taeyang and soyang) are extroverted and the eum (yin) types (taeum and soeum) are introverted. the taeyang type is very rare in Korea. The body shape of the taeum type is larger than those of the soeum and soyang types. The personality traits and physical characteristics are symbolically expressed by the organ size: taeyang—large lungs and small liver, soyang—large spleen and small kidney, taeum—large liver and small lungs, and soeum—large kidney and small spleen (Lee and Choi, 1996). Sasang typology emphasizes

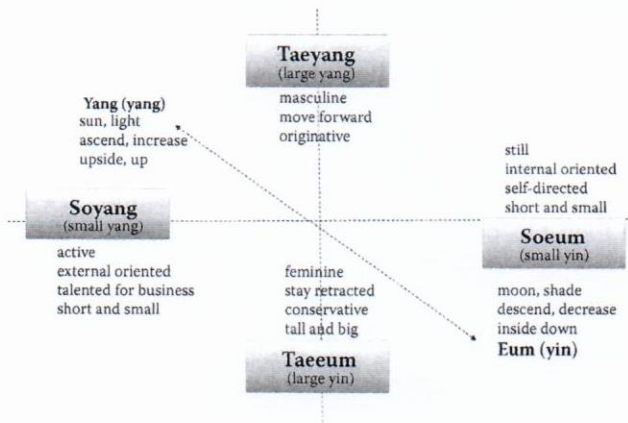


FIGURE 1.5

A schematic diagram of Sasang types from a biopsychological perspective. (From Chae, H. et al. 2003, *Journal of Alternative and Complementary Medicine*, 9(4):519–528.)

the importance of individual body types in the diagnosis and treatment of diseases and suggests prescribing different medicinal treatments and food intake for different body constitution types (Lee, 2007).

Many attempts to establish a reproducible and objective method of assessing the Sasang constitution types have been reported after the writing of Lee Je-Ma, but none of the methods has provided reproducible and satisfactory results. A questionnaire developed by KyungHee University (QSCC II) was widely studied for the assessment of Sasang types, and distinctive personality traits associated with Sasang types were demonstrated using psychometric and anthropometric instruments (Chae et al., 2003). Numerous food therapy schemes suggesting beneficial and harmful food items for different Sasang types have been reported and used by TCM doctors and dietitians in Korea (Lee, 2007). Table 1.3 shows an example of a Sasang food list, with foods that are beneficial for different body constitution types (Kim et al., 1995).

Although the assessment of individuals' constitution types is not conclusive, many people in Korea follow Sasang theory in selecting their food and herbal treatments, especially when their health is not satisfactory.

Considering food to be medicine, practitioners of TCM and Eastern medicine have studied each food ingredient for its yin/yang properties and its applicability in diet therapy. Their knowledge has been compiled in numerous classical medicine books in both China and Korea for hundreds of years, and has been practiced in everyday life at the household level as dietary customs. The term *boyak*, which means supplements to replenish weak points in a body, has been used widely in Korea, and the terms *functional food* and *therapeutic food* are, in fact, the scientific terms for *boyak*.

Many reports have suggested that the low-fat intake and high proportion of plant food in the Korean diet might be part of the reason for the lower prevalence of obesity, the lower death rates due to coronary heart disease or high blood pressure, and the lower rates of breast, prostate, and colon cancers than in many other Asian and Western countries (Lee et al., 2002). Koreans believe in the old traditional concept that "food is medicine." Therefore, herbs or fruit ingredients such as ginger, cinnamon, Job's tears, mugwort, pomegranate, citron, mushroom, ginseng, etc., are used in cooking, as well as for therapeutic foods. Food preparation has been likened to prescribing medicine for the individuals in a household. The word *yaknyum*, the general term for seasoning, means "thought of medicine." The enormous size of the health food market in Korea today reflects the country's tradition of food as medicine.

A survey on consumers' attitudes toward health food and their perceptions of health and food habits in Korea revealed that people considered food habits to be the most important factor in the maintenance of health, followed by physical exercise. More than 90% of people believed that food habits were the most important factor determining the health of human beings and that diseases could be cured by adjusting food habits (Lee et al., 1996a). Half of the subjects had made use of health foods (or "functional" foods), and 68% of them believed in their effectiveness (Lee et al., 1996b).

TABLE 1.3

Example of a Sasang Food List

	TaeYang	SoYang	TaeEum	SoEum
Cereals	Buckwheat	Barley, red beans, mung beans, barnyard millet, sesame	Soybeans, Job's tears, sugar, wheat, wheat flour, great millet, perilla, sweet potato, common millet, peanut	Sticky rice, hulled millet, glutinous millet, potato
Fruit	Kiwifruit, grapes, persimmon, cherries, Chinese quince	Watermelon, Korean melon, strawberries, banana, pineapple	Chestnuts, pear, walnuts, ginkgo nuts, pine nuts, apricot, mum, plum	Apple, mandarin orange, peach, jujube
Vegetables	Water shield, pine needles	Cucumber, Chinese cabbage, pumpkin, lettuce, eggplant, sow thistle, edible burdock bamboo shoot, Asian plantain	Radish, bellflower root, Indian lotus, taro, hemp, bracken, lanceolate root, shiitake mushroom, ear mushroom, matsutake mushroom, <i>Umbilicariaesculenta</i>	Water dropwort, Welsh onion, garlic, black pepper, ginger, spinach, carrot, red pepper, crown daisy, onion, mustard
Fishes	Oysters, abalone, conch, shrimp, crucian carp, crab, sea slug, mussels	Flatfish, puffer, turtle, crawfish, carp, snapping, snakehead fish	Freshwater snail, codfish, yellow corvina, small octopus, brown croaker, herring, squid, brown seaweed, laver, kelp	Alaska pollack, loach, eel, snake, catfish
Meats		Pork, eggs, duck	Beef, milk	Chicken, lamb, dog meat, pheasant, goat, sparrow meat

Source: Kim, J. Y. et al. 1995. *Journal of Constitutional Medicine*, 7:263-279.

### 1.3 Future of Korean Functional Food

Recently, molecular biologists have started to recognize that variations in the genetic makeup of individuals may cause variations in their responses to nutrient intake (Milner, 2004). It is often observed that, even with similar food consumption patterns in a family, one person suffers from obesity while another does not. Food allergies and celiac disease, for example,

provide other evidence of genetic variation as it relates to food components (Murray, 2005). With the completion of the Human Genome Project and the powerful tools of molecular biology, it is now possible to elucidate the effects of nutrients or bioactive food ingredients on the regulation of gene expression (i.e., nutrigenomics) or on the impact of variations in gene structure on one's response to food components (i.e., nutrigenetics). Genetic components responsible for differences in dietary response have been proposed for many years by molecular biologists, and research to examine these nutrient–gene interactions has recently begun. Individual genetic variation may possibly be explained by single nucleotide polymorphisms (SNPs).

The health effects of food components are related to specific interactions on a molecular level, SNP in gene regulation, translational control of ribonucleic acid, enzyme regulation (proteomics), and metabolite modulation (metabolomics), which occur as genotypes (Ommen, 2004). On the other hand, in traditional Eastern medicine, numerous phenotypic data on diet response to health have been accumulated and systematically classified by the Sasang body constitution theory. Body constitution is a genomic trait of individuals, which is mainly determined by SNPs. Therefore, it is possible to relate the molecular level genomic studies to the body constitution typology for the scientific substantiation of traditional functional foods (Lee, 2007).

As body constitution types are genomic traits of individuals, it will be possible to determine Sasang types with molecular level genomic studies when sufficient data are accumulated. It is important to identify the genes or SNPs responsible for the phenotypic body constitution types, specifically taeyang, taeum, soyang, and soeum. Once they have been found, we will be able to classify Sasang constitution types objectively and reliably and be ready to utilize the old wisdom of diet therapy, which has been developed for thousands of years through human trials, as illustrated in Figure 1.6.

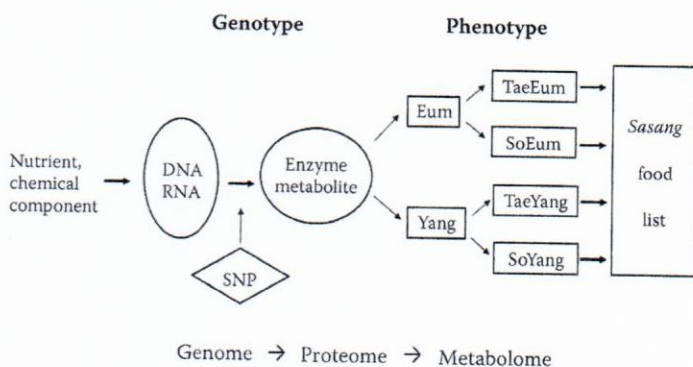


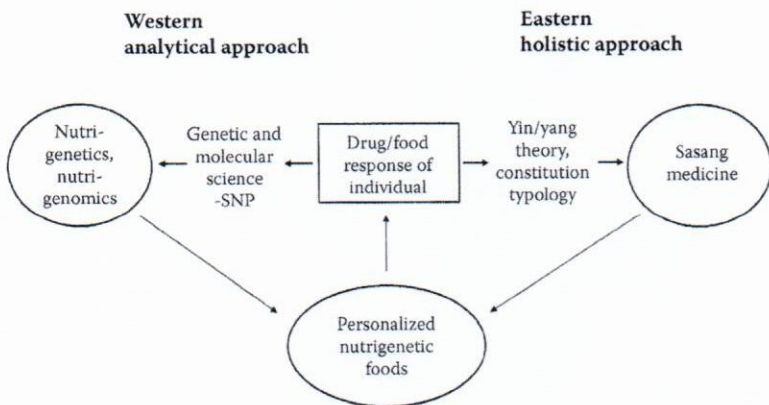
FIGURE 1.6

The relationship between nutrigenetic studies and Sasang body constitution typology. (From Lee, C. H. 2007, *Food Science and Technology Research*, 13(2):89–95.)

An attempt was made to develop marker genes for the classification of Sasang body constitutions (Park, 2006). TCM school students in Korea, who were classified identically by QSCC and by three TCM doctors, were selected; their blood samples were assayed with microarray analysis; and the Sasang-specific genes were identified. About 145 genes were differentially expressed in a microarray, and they were clustered into three groups, respectively: ta-eum, so yang, and so eum. Genes expressed differentially depending on the Sasang constitution types were related to signal transduction, transport, and immune response in their function. Although this study was not conclusive in its classification of the constitution types, it provides the possibility of using microarray analysis and SNP analysis of specific genes for the objective determination of body constitution types (Lee, 2007).

Figure 1.7 illustrates the relationship between nutrigenetic studies and Sasang typology, which have developed toward opposite directions in the East and the West. If we are able to find a channel to relate the Western analytical approach to the Eastern holistic approach, we will achieve great advancement in human nutrition and biomedical research. It will allow us to use all of the data accumulated in Eastern medicine for predicting the health effectiveness of foods. Recent research on nutrigenomic/epigenetic studies may provide a possible way of communicating genomic studies with Sasang typology.

If we are able to identify the genetic markers that are responsible for Sasang typology, we can select food materials useful for an individual with specific markers from the Sasang food list. This will allow Western analytical researchers to communicate with Eastern medical doctors, and to discuss the scientific substantiation of traditional functional foods in the East (Lee and Lee, 2003). It will open a new era of nutrigenomics, and we will be able to



**FIGURE 1.7**

Collaboration of Western analytical approach and Eastern holistic approach in the field of functional food. (From Lee, C. H. 2007, *Food Science and Technology Research*, 13(2):89–95.)

scientifically substantiate the health benefits of traditional functional foods more easily. It will reduce the variation in experimental results, minimize the cost of finding scientific evidence for functional foods, and consequently prevent the adverse effects of functional food, which often occur in some segments of a population. Personalized or tailor-made functional food that is effective for groups of people with specific body constitutions will be created to enhance their vitality and to treat their health problems.

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## 1.4 Conclusion

Considering food to be medicine, practitioners of traditional medicine in Korea have studied each food ingredient for its properties, taste, and medicinal effects. Their knowledge has been compiled in numerous medicinal books for thousands of years, and has been practiced in everyday life at the household level as part of Korean dietary customs.

Present food law requires scientific substantiation to claim the health effects of a functional food. However, it is not an easy task to verify the physiological and psychological effects of foods made of multiple ingredients. In addition, an individual's response to the intake of a food component varies, as mentioned in the Sasang typology. Consequently, present food regulations restrict the marketing of traditional functional food. There is a strong need to relate the traditional functional food concept to modern scientific methodologies, such as nutrigenomics, in order to be able to use the enormous amount of data compiled in the jewelry box of Eastern medicine, accumulated through a thousand years of human trials.

After the long journey of the food industry through the survival-food age, the convenience-food age, and the functional-food age, we are expecting to usher in a "personalized functional food" era through the collaborative efforts of molecular biologists and Eastern medicine researchers. The new era of personalized functional food will lend great opportunities to future food industries and will contribute greatly to the betterment of the quality of human life.

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