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Ethnic Fermented Foods and Alcoholic Beverages of Asia

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History of Fermented Foods in Northeast Asia

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Cherl-Ho Lee and Moonsil Lee Kim

1.1 Introduction: Where and Who?

Northeast Asian culture has been generally considered as part of Chinese civilization because currently a large portion of this region is occupied by the People's Republic of China (PRC), and the relatively small nations around the PRC have been simply understood as strongly influenced by Chinese civilization in terms of politics, economy, and culture. However, Northeast Asian culture is composed of many different ethnic groups that have developed their own identities and distinctive cultures throughout history. Therefore, before starting a discussion on the fermented food in Northeast Asia, it should be clarified where and about whom we are talking in this chapter.

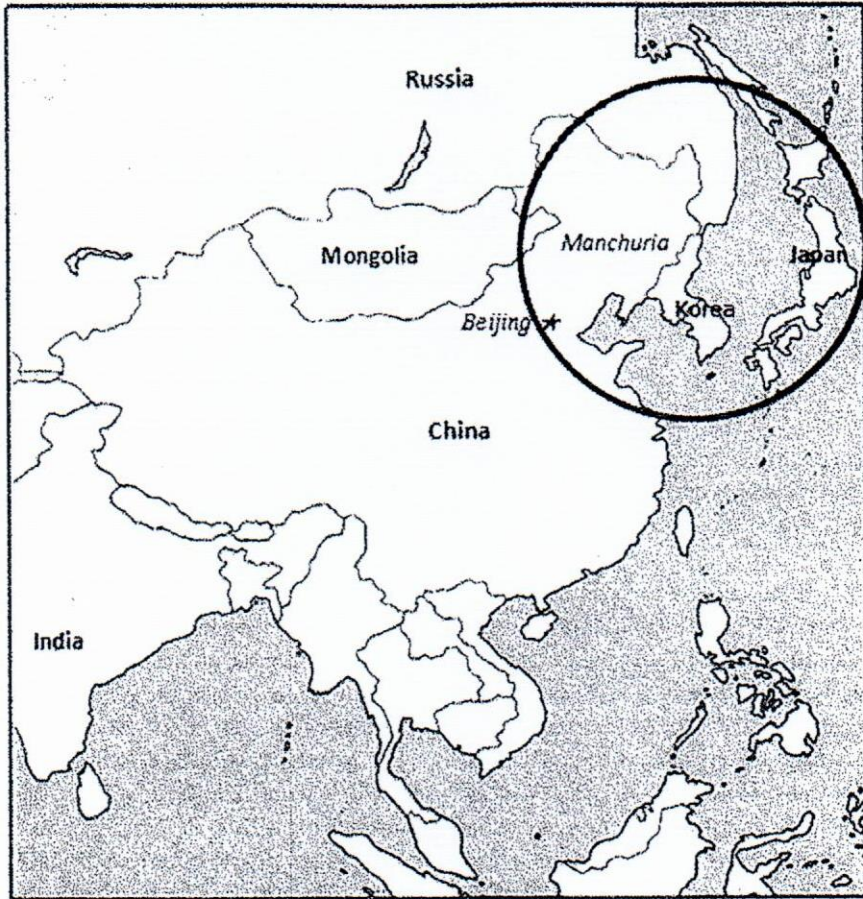
The definition of Northeast Asia varies according to the context in which it is discussed. From an economic view, it indicates China, South Korea, and Japan, as these nations are dominating current economic growth in the region. In terms of the regional security of Northeast Asia,

North Korea is at the center of this issue in relation to the surrounding countries of South Korea, China, Japan, and Russia. Sometimes people use the term "Northeast Asia" to indicate much broader territories including Mongolia, Taiwan, and eastern regions of the Russian Federation and Siberia. In this chapter on the fermented foods of Northeast Asia, we define Northeast Asia as the northeastern subregion of Asia that includes the Korean Peninsula, the Japanese archipelago, Manchuria, the Russian Far East, and the Chinese northeast coast, along with the Bohai Sea and the Yellow Sea (Map 1.1). In particular, the fermented food culture and technologies developed in the Korean Peninsula and the surrounding area of the Korea Strait will be the focus of discussion in this chapter.

The people who occupied Northeast Asia were first introduced in the Chinese history book, *Hou Hanshu (History of the Later Han Dynasty)* in the fifth century AD, as "eastern archers (*dongyi* 東夷)," collectively referring to several ethnic groups and tribes in Northeast Asia (Ban, fifth century). This Chinese word "*dongyi*" has been traditionally translated as "eastern barbarians" from the Sino-centric perspective, but here we suggest interpreting this word as "eastern archers" since the character "yi 夷" was originally composed of a combination of two words, "big (大)" and "bow (弓)." The mural painting of the Koguryŏ (ca. 37 BC–668 AD) tomb of Muyongchong in Manchuria that depicted horse

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Map 1.1 Northeast Asia

riders with big bows supports the possibility that the Dongyi were people who had good archery skills, as the name indicates. The *History of the Later Han Dynasty* describes Dongyi people who were good at horse riding and archery and who established several proto-states in Manchuria, the Korean Peninsula, and the Japanese archipelago, such as Puyō, Dongye, Okchō, Koguryō, Samhan, and Wa. This indicates that as early as the third century BC, the Dongyi had already formed a unique culture that differed from the well-known Chinese civilization that had thrived in Central and Southern China. However, it was much earlier that Chinese people recognized these archers (*yi*) as non-Chinese, as we can see from the oracle bone inscription of the Shang period (1600–1046 BC) in China, dating to around 1200–1046 BC, that reads "...the king orders to campaign against the Yi" (Ebrey 1993).

This historical evidence implies that several ethnic groups called Dongyi who had occupied Northeast Asia and competed with Chinese people since around 1000 BC or earlier must have had stable food resources that sustained the people and their communities during famines. Historical and archaeological remains tell us that the fermented foods they enjoyed, such as fermented fish, fermented vegetables, and fermented soybean products, were the most reliable and stable sources for obtaining protein throughout the year. The dietary culture of the Dongyi people, based on various fermented foods, was the result of the early use of fermentation technology, which originated in this region. In this chapter, before an in-depth scientific analysis of traditional fermented foods in Northeast Asia, the birth and the development of the fermentation technology of the Dongyi will be discussed. In

particular, the geographical and environmental background and the primitive pottery culture will be examined as prerequisites of the birth of fermentation technology in Northeast Asia.

1.2 Pottery and Dietary Culture of Northeast Asia

The trace of earlier people in this region can be found in archaeological discoveries. Archaeological remains suggest that this region was occupied by Early Paleolithic people who immigrated through Mainland China, Siberia, or South Asia as early as the Early Pleistocene period (~1,600,000 BP, Bae 2010). The early existence of human beings in this region is evidenced by some Early Paleolithic remains (1,800,000–300,000 BP) of the Early/Middle Pleistocene period on the northeast Chinese mainland and Korean Peninsula. Several Early Paleolithic sites, such as the Zhoukoudian (of Peking man, dated 680,000–780,000 years old) and Jinniushan sites, have been excavated in Northeast China and Manchuria. The earliest hominin fossils in the Korean Peninsula excavated from central South Korea (Chŏngokni) and in Pyŏngyang (Daehyŏndong) have been dated to the early Middle Paleolithic sites (350,000–40,000 BP), but lithic assemblage was discovered in Komunmoru, Jangsanni, and Jangdongni that seem older than Chŏngokni (Bae 2010). In addition, Middle Paleolithic remains were found on the Korean Peninsula and in South Manchuria, and numerous Late Paleolithic (40,000–10,000 BP) sites were also found on the Korean Peninsula, South Manchuria, and Japanese archipelago. These sites indicate an increase in population and a dispersal of people in this region of Northeast Asia during the Paleolithic period.

Paleolithic hominin survived by mobile hunting and mountain foraging. They preyed on deer, wild pig, bison, and roe. These animals provided people with meat, gut, and blood. Animal meat, intestine, and blood were probably the main foodstuff for these people, with the use of vegetable supplements, such as grass seeds, tree nuts,

and wild fruits and roots. Those who reached the Korean Peninsula gradually adapted themselves to their new environment as they changed dwelling site and diet habits. The meat-centered diet culture of the early hominin in Northeast Asia gradually changed to an omnivorous culture by the end of the Paleolithic Age. According to archaeological remains from the Korean Peninsula, peoples there increasingly consumed tree nuts and acorns, wild fruits, berries and grapes, grass seeds, roots, and young buds of trees and ferns. The appearance of the pollen of grass, rice (Gramineae), and beans (Leguminosae, Papilionoideae) also increased in Late Paleolithic remains (Lee 1998).

Paleolithic hominin of Northeast Asia who lived in mountain caves at the beginning gradually moved to the lower plains and riverbanks by the Late Paleolithic Age (Lee 1998). As they could now obtain abundant food around their dwelling sites, they could stay longer in these areas. Beginning to inhabit one single place, they reduced their mobile hunting practices and instead obtained more food by collecting seeds of grass and barnyard grass, millet, and wild beans. Gradually they developed skills in storing food resources by drying. Step by step, they became accustomed to collecting mollusks like frogs and snails in damp ground and clams and shellfish in rivers and beaches.

As they transferred dwelling site from the hill and cave to the coastline and riverside, ancient Northeast Asians experienced yet another significant change in their dietary culture. They began increasingly to consume marine products while also still enjoying tree nuts, acorns, wild grains, fruits, vegetables, and roots. Archaeological evidence such as numerous shell mounds along the coastal line of the Korean Peninsula and the Japanese archipelago clearly proves that the dietary habit of the people changed at the beginning of the Holocene period (ca. 10,000 BC) as their dwelling sites moved to the coastline (Lee 2001).

Interestingly, the increased consumption of marine products coincided with the invention of primitive pottery. Around the Late Paleolithic Age, by 6000 BC, the use of *Jeulmun* (Korean) or

Jomon (Japanese) pottery had spread over the region of the Korean Peninsula and the Japanese archipelago. Archaeologists call this period the *Jeulmun* period in the Korean Peninsula and the *Jomon* period in the Japanese archipelago (from ca. 8000 BC). This period is comparable to the western Neolithic period, although people in Northeast Asia had not started agriculture yet at this point. Western archaeology distinguishes the Neolithic Age from the Paleolithic by the use of polished stone tools and the start of agriculture, since these two events appear to have taken place at the same period around 8000 BC in Europe. However, this chronicle is unsuitable to that of Northeast Asia, where there are indications of the use of ground stone tools some 30,000 years old, and primitive earthenware of 12,000 years old has been discovered, while the oldest evidence of agriculture is only ca. 5000 years old (Barnes 1993). Therefore, we suggest referring to this period from the birth of earthenware to the beginning of agriculture in Northeast Asia as the "Primitive Pottery Age" in order to distinguish it from the European Mesolithic culture (Lee 1999).

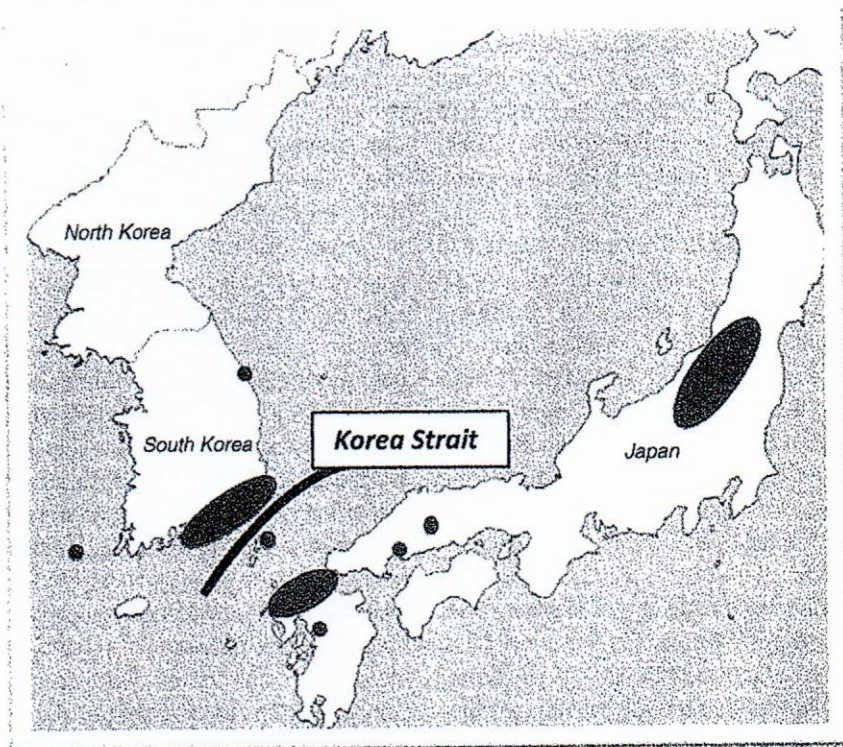
The Korean Peninsula functioned as a land bridge connecting the seasonal movements of Paleolithic hunters from the north of Manchuria to the south of the Japanese archipelago, with the Korea Strait as an obstacle obstructing their journey. Consequently, people gathered around the coastal region of the Korea Strait, making it the cultural center for the creation of the Primitive Pottery Age (Lee 1999). It is supported by the fact that the early Primitive Pottery Age remains are located in the Korean Peninsula (Dongsamdong, Dadaepo, Chilgok, Sangnodaedo, Yokjido, Sohuksando, Osanri) and the Japanese archipelago (Kosijima, Nishikaratsu, Iwasita, Senpukuji, Todoroki, Kamikuroiwa, Mawatari, Yagimata, Isigoya, Hasitate, Tazawa, Ozawa) (Han 1983). In particular, many remains have been found around Korea Strait coastal areas including the southeast portion of the Korean Peninsula and northwest of Kyushu Island (Map 1.2).

The use of earthenware itself may have been enough to create a revolutionary impact that dramatically changed the production and processing

of food in the Korea Strait region between 6000 and 3000 BC, prior to the period of Neolithic agricultural settlements. The marine foods obtained from the coastal regions and riversides were difficult to dry, easily decomposed by autolysis, and rapidly spoiled by microbial growth, so people needed to consume them instantly, and therefore they were not likely to rely much on marine food. However, the invention of earthenware enabled them to cook perishable foods easily and store them longer for eating. This cultural trend of seafood consumption preceding farm products still remains today: Koreans and Japanese are the only people in the world who consume seaweed and laver as daily food and eat more fish and shellfish than meat.

Moreover, earthenware was used for cooking fish and vegetables in seawater (Lee 1999). Before man knew the salty taste from marine foods, people used to take minerals (salt) from either animal blood or intestine. People alive during the *Jeulmun* and *Jomon* periods possibly enjoyed cooking seafood with vegetables, roots, and grains with seawater in an earthen vessel as they came to understand that the salty taste enabled them to eat more vegetables and plants, which enabled them to survive on plants when game was scant. Using pottery and seawater to cook marine food resources and vegetables can be related to the origin of "hot pot culture," the so-called *chigae* culture in Korea and *nabe* culture in Japan, which are the most characteristic Northeast Asian foods today. This culture is similar to that of the primitive people living in the coastal region of Papua New Guinea today who still use seawater as a salty ingredient for cooking (Ishige 1976).

In about 3000–2000 BC, which is referred to as the Late Neolithic Age by Korean archaeologists, polished stone tools were replaced by chopped stone tools, and in using these new tools, farming agriculture began. This period is actually a Neolithic Age according to the European standard since it marks the start of agricultural farming. Tribes based around agriculture and fishery settlements emerged in Northeast Asia during this period. This Neolithic period was followed by the Bronze Age in the Korean Peninsula



Map. 1.2 Locations of the early Primitive Pottery Age remain in the coastal region of Korea Strait

around 1200 BC when the megalithic culture represented by dolmens and menhirs developed.

Earthenware played another significant role in the birth of a new dietary culture in Northeast Asia during the Bronze Age: that of using soybeans in this region. When the horse-riding people of the north, the *Yemaek* tribe of Northeastern Dongyi, came to the south of the Korean Peninsula and became agricultural farming settlers, they began to use wild soybeans as a stable protein source to replace meat from their animal herds. It has been proposed that the *Maek* tribes, who settled broadly in Manchuria and the Korean Peninsula, are the first users of soybeans for food in history (Lee 1984). Chinese history books and literature also indicate that soybean cultivation was concentrated in the region of Northeast Asia, in particular, Manchuria and the Korean Peninsula, since the Bronze Age (Choi 2009). As they began relying on soybeans, the people of Northeast Asia invented and developed the process of making soybeans into food by soaking

them in water and cooking them in earthen vessels to eliminate the anti-nutritional factors in the bean. An earthen vessel excavated from Paldang in Korea, which has traces of soybeans on the surface, supports the theory that these peoples used pottery for cooking soybeans in Central Korea beginning in the Bronze Age.

Most of all, the invention of pottery brought with it the birth of fermentation technology since storing wet cereals, meats, fish, and vegetables in earthen pots naturally produces fermented foods. The invention of fermentation technology could provide relatively abundant nutrients to people compared to previous periods, so it must be related to the sudden increase in population during this period (Lee 2001). For example, cooked soybeans, saltwater, and pottery could have resulted in the birth of fermented soybean products which played an important role not only as a supplementary source of protein but also as palatable sauces enjoyed with cereals, vegetables, and meat. It seems that the *Maek* tribe of the Dongyi,

who were originally meat-eating nomads, enjoyed or invented the soy sauce that has been used for *Maek-chök* or *Bulgoki*, roasted meat marinated with soybean sauce, which is one of the favorite foods of Korean people to this day.

The use of soybean product and fermentation technology had continued and developed during the Iron Age that began in Northeast Asia around 500 BC (Nahm 1988). During this period, several proto-states and early states such as Puyö, Dongye, Okchö, Koguryö, and Samhan were established in Manchuria and the Korean Peninsula by the Dongyi people. According to ancient Chinese historical records, such as the *History of the Later Han (Hou Hanshu)* and *Records of the Three Kingdoms (Sanguo Zhi, 3rd c. AD)*, people in these states, the Dongyi, enjoyed drinking wine made of grain. Also, it is written that Chinese people acquired a new kind of soybeans (*rongshu*) from the region of the Dongyi and spread it into China. In *Qiminyaoshu*, the term of *Gaolidou*, literally meaning "soybeans of Koguryö," was used for indicating a good quality of soybeans (Choi 2009). This evidence indicates that the Dongyi largely cultivated high-quality soybeans as their staple food. With fermentation technology, they must have been able to acquire stable and nutritious food sources, which contributed to the creation of proto-states and fully developed state-level society during the Iron Age in Northeast Asia.

Fermented food products such as rice wine, soy sauce, soybean paste, and fish sauce seem to have become the most important food in the dietary culture in and around the Korean Peninsula by the seventh century AD. According to the earliest Korean history, *Samguk Saki* (1145 AD), rice, rice wine, oil, honey, soy sauce, soybean paste, dried meat, and fish sauce were the most important food items prepared for a wedding in the royal family in Silla in the year 683 AD. It seems that the introduction of Buddhism to the Northeast Asian region from the third to fourth centuries AD contributed to the development of fermented food, thus accelerating the decrease of meat consumption and encouraging the spread of vegetarian food habits. During the 1000-year period following the introduction of

Buddhism, nomadic meat-eating culture gradually disappeared. In its place, the extensive use of salted vegetables and soybean products thrived as the major food source of the Northeast Asian diet. This process also coincided with the invention and development of *Onggi*, glazed earthenware which have been used as containers for fermented products for well over a 1000 years and continue to be used to this day.

People reaching all the way to the northeast end of the continent adapted themselves to their new geographical, ecological, and cultural environments by developing their own dietary cultures and technologies. The dietary culture of Northeast Asia and the birth of fermentation technology in this region in particular have been examined in the context of the use of earthenware beginning in the prehistoric period. The invention of pottery was a significant prerequisite for the long history of fermented food, which dominates the dietary culture of Northeast Asia today. Considering the early appearance of earthenware for food cooking and storing in Northeast Asia, cereal alcoholic beverages, vegetable pickles, and fermented fish and meats were possibly made prior to the beginning of agriculture in this region. The next section of this chapter will be dedicated to a detailed analysis of the history and development of the technology of cereal alcoholic fermentation, vegetable fermentation, fish and meat fermentation, and soybean fermentation in Northeast Asia.

1.3 Origin and Development of Fermentation Technology in Northeast Asia

1.3.1 Cereal Alcoholic Fermentation

Alcohol fermentation is considered one of the oldest food-processing technologies human beings have ever had. The production of an alcoholic drink from a cereal is a much more sophisticated affair than making fruit wine, but the process of invention of fermented beer in Northeast Asian culture is nevertheless a mystery. Since the oldest archaeological evidence of

the rice-wine crock was found in the remains of the Shang period around 2000 BC in Central China, it is believed that Northeast Asian people have also possibly prepared an alcoholic beverage from grains using fermentation technology since prehistoric times (Lee 1984).

The process of making an alcoholic drink from a cereal requires two separate biochemical steps: saccharification and fermentation. Saccharification is to hydrolyze the starch in the cereal to fermentable sugars, and fermentation is the process of converting sugars to ethyl alcohol and carbon dioxide by yeast (Lee 2001). In areas with high temperature and high humidity, mold growth is a natural process in a container storing wet starchy materials, for example, plant seeds, millet, barnyard millet, nuts, beans, and tubers. Some molds like the *Rhizopus* species produce enzymes which can hydrolyze raw starch and convert it into sugars. When a sufficient amount of moisture is provided, the sugar is transformed into alcohol by the yeast existing in nature. The resulting alcoholic food or beverage with an attractive aroma is produced in several days in summer after adding a small amount of water to starchy material in a crock. This is a natural process which can be observed even among primitive people. It is likely that the history of cereal alcoholic fermentation began with uncooked starchy ingredients; thus, the use of pottery may mean the start of cereal alcoholic fermentation (Lee 2001).

According to the book of *The Generational Origins* (Shi Ben 世本), Yi Di first prepared alcoholic drinks at the command of the daughter of Emperor Yu, the legendary Yu the Great who established the Xia Dynasty of China (ca.2070–ca.1600 BC). It is likely that the people of this period invented a new method, probably using ferment, to make beer with grains as the same book proclaims that a man named Shao Kang later prepared an alcoholic beverage from millet (Huang 2001).

The earliest written record of alcohol drinking culture in Northeast Asia appears in one of the Chinese histories, *Records of the Three Kingdoms* (*Sanguo Zhi*). According to this book, Dongyi people enjoyed alcoholic beverages during their

statewide festivals called *muchön* (in Dongye, ca. third century BC to third century AD), *yönggo* (in Puyö, ca. second century BC–494 AD), and *dongmaeng* (in Koguryö, 37 BC–668 AD) (Nahm 1988).

As people recognized the process of making alcoholic beverages by fermentation, people also invented two different methods for saccharification in ancient civilizations: using the amylases in sprouted grains, and making ferments, or useful microorganisms, grown dominantly on wet seeds and grains. In Northeast Asia, ferments of various kinds were invented for the process of the saccharification of grain alcoholic beverage, so as in Central and Southeast Asia (Table 1.1). For example, in Korea, when ferment, called *nuruk*, is mixed with cooked rice and water in about a 1:1:4 ratio, alcoholic fermentation takes place and is normally completed within 1 week in summer days. When it is strained with a sieve into turbid liquid, it is called rice beer, *makkolli* or *takju*, and when filtered with fine cloth into clear liquid, it becomes fine rice wine, *chöngju* (Lee 2001, 2009).

1.3.2 Origin of Kimchi Fermentation

Kimchi is a unique fermented vegetable product with a long tradition in Korea. It remains today a main side dish served alongside cooked rice and other dishes. The kinds of *kimchi* add up to more than 50 depending on the use of raw materials and processing methods and also on the season and locality of preparation. As there still remains a local tradition of using seawater for making salted cabbage on the southern coast and islands of Korea today, it can be assumed that the origin of *kimchi* is related to the prehistoric dietary culture of storing vegetables using seawater and pottery.

Vegetable pickles and fermented vegetables are a widespread dietary tradition not only in Asia but also in Europe. These incorporate a heterofermentative bacterium, *Leuconostoc mesenteroides*, that produces both lactic acid and acetic acid from sugars in vegetables and grows actively until the pH goes down to 4.8. When *Leuconostoc*

Table 1.1 Names of fermentation starters in different countries and their major ingredients

| Country | Name | Ingredients commonly used | Shape | Microorganism |
|-------------|-----------------|--|------------------|------------------------------|
| China | <i>Qu</i> | Wheat, barley, millet, rice (whole grain, grits, or flour) | Granular or cake | <i>Rhizopus, Amylomyces</i> |
| Korea | <i>Nuruk</i> | Wheat, rice, barley (whole grain, grits, or flour) | Large cake | <i>Aspergillus, Rhizopus</i> |
| | <i>Meju</i> | Soybean (whole seed) | Large ball | <i>Aspergillus, Bacillus</i> |
| Japan | <i>Koji</i> | Wheat, rice | Granular | <i>Aspergillus</i> |
| Indonesia | <i>Ragi</i> | Rice (flour) | Small cake | <i>Amylomyces</i> |
| Malaysia | <i>Ragi</i> | Rice (flour) | Small cake | <i>Amylomyces</i> |
| Philippines | <i>Budbod</i> | Rice, glutinous rice (flour) | Small cake | <i>Muor, Rhizopus</i> |
| Thailand | <i>Loogpang</i> | Bran | Powder | <i>Amylomyces</i> |
| India | <i>Marchaa</i> | Rice | Flat cake | <i>Hansenular, Mucor</i> |

Lee (2001, 2009)

mesenteroides stop growing at the lower pH, other homofermentative bacteria like *Lactobacillus plantarum*, which produce mainly lactic acid only, start to grow, and the vegetable becomes very sour like the sauerkraut of Germany (Lee 2001). Many of the lactic-acid-fermented vegetables are made in anaerobic conditions by packing vegetables in sealed containers like ensilage, making the resulting products very sour. The vegetable pickles described as *zhe* in Chinese classical literature appear to be this type of product (Nout et al. 2014).

On the other hand, the vegetable pickles traditionally made in Northeast Asia including the Korean Peninsula are made by salting and subsequent lactic-acid fermentation and are not so strong in a sour taste. In the process of *kimchi* fermentation, the lactic-acid fermentation of vegetables yields a sour taste by keeping cabbage or turnip slices immersed in 3% brine for 3–4 days. In such conditions, *Leuconostoc mesenteroides* are the suitable candidates dominating the system at the initial stage of fermentation (Lee 1994). This condition resembles that of primitive men putting foraged vegetables into a jar holding seawater, and with almost no exception, the result would be lactic-acid fermentation. It indicates that the Korean-style pickle, *kimchi*, originates from the natural fermentation of withered vegeta-

bles stored in seawater made in the Primitive Pottery Age (Lee 2001).

The traditional salted-vegetable dish of Korea was transformed into today's form of *kimchi* with the introduction of red pepper. The route of the propagation of red pepper into the Korean Peninsula is still debated, but it is known that red pepper had already been utilized in Korea in the fifteenth century or earlier (Kwon 2011).

1.3.3 Origin of Fish Fermentation

If one mixes seafood, which easily putrefies, with lactic-acid-fermented vegetables and lowers the pH below 4.5, one can prevent the proliferation of harmful microorganisms, and therefore the seafood can be stored over a long period of time and later consumed (Lee 2001). In these conditions, because of the low salt concentration, fish decomposes rapidly by autolysis with its own intestinal enzymes, and a strong flavor or putrid stench is formed. The smell and taste created in this process would be unacceptable to modern men, but to the people of primitive eras, who relied on rough plant materials like acorns, plant roots, grass seeds, etc., it likely reminded them of the savory taste of stored animal meats and intestines. In fact, some fermented fish products made

in different regions of the world have too strong a flavor to be consumed by other people outside that region. Therefore, under conditions where harmful microorganisms do not prevail, the putrefaction and fermentation are distinguished only according to the subjective judgment of consumers.

Seen from such a perspective, the mixture of low-salt cured seafood with lactic-acid-fermented vegetables would be an essential condiment for people at the transitory stage between a meat diet and a vegetarian diet and can be seen as an archetype of the lactic-acid-fermented fish products, like *sikhae* in Korea, which are widely consumed in East Asia today. High-salt-fermented fish products, like *jōtkal* in Korea, must have been developed at later stages, when abundant salt production was possible. At an even later stage after having raised the salt concentration, people came to add *nuruk* in order to achieve the rapid decomposition of fish as well as to reduce the strong putrid stench by the action of the enzymes in *nuruk*. This is the origin of *jang* (醬 in Korean or *jiang* in Chinese) which has been used widely in Northeast Asia and China as the major preserved food and condiment (Lee 2001).

The first description of *jang* appears in *Zhou Li (Rites of Zhou)* of the second century BC in China. It notes that *jiang* has two types, *hai* (醢) and *xi* (醢), and records the methods of its preparation (Lee 2001). *Hai* is made from sun-dried meats of fowl, beast, and fish which are ground into powder; mixed with rice wine, salt, and ferments made from millet; packed into a jar; and sealed and aged for 100 days. *Xi* is made from the same materials as *hai*, but acidic plum juice is added to give a sour taste. It is apparent that *jiang* was originally made from meat and is a kind of meat sauce, unlike the fermented soybean products which are commonly called *jiang* or *jang* today (Lee 1984). It can be said that *jiang* is a high-class condiment developed by 1000 years of experience, which applies the same principle of fish fermentation which might have been developed by the people in the Korea Strait region during the Primitive Pottery Age (Lee 2001).

1.3.4 Origin of Soybean Fermentation

Since major Western encyclopedias, such as the *Encyclopedia Americana* and *Great Soviet Encyclopedia*, claim that the origin of soybeans is China, it is generally understood that soybeans were first cultivated and consumed by the Chinese in Mainland China. However, according to botanical and historical research, it was the region covering South Manchuria and the Korean Peninsula where soybeans originated with the most abundant wild varieties (Kwon et al. 2001). Archaeologists generally agree that the history of soybean cultivation is about 4000 years long, as the traces of soybean use are found in the Bronze Age (ca. 1500 BC) in remains in the Korean Peninsula (Lee 1984). Soybeans appear to have been first introduced to China in the Eastern Zhou Period of the seventh century BC and further transferred to Southern China, Southeast Asia, and Japan from the third century BC to the seventh century AD (Choi 2004). Soybeans were further introduced to the Eastern Himalayas in India by the Mongolian-origin races (Tamang 2015). Accordingly, people in the Korean Peninsula and South Manchuria, the so-called Dongyi, were the first to consume soybeans as a food using earthen vessels as cooking facilities. By using earthen vessels, they were able to boil seeds in water and could thus solve the problem of trypsin inhibitor in soybeans.

During the early stages of soybean utilization, the Northeastern Dongyi had probably first invented *shi* (豉), the ancient Chinese term for Korean *meju*, by keeping cooked soybeans packed in straw mats or cloth during hot summer months. The need for condiments to replace meaty flavors for the bland cereal diet would be the most probable motivation for the northern nomads settled in the Korean Peninsula to produce fermented soybean products (Lee 2001). According to Huang (2000), there are no references to *shi* in the pre-Qin (221–209 BC) literature, but there is no doubt that by late Western Han, *shi* had become a major commodity in China. Books written from the Eastern Han to the Tang periods (100–800 AD), for instance,

Bowuzhi and *Xin Tangshu*, describe the letter *shi* (豉) as a dialect coming from the northern region and a special product of Bohai, a nation founded by the refugees from defeated Koguryō (37 BC–668 AD) (Lee 1984, 2001). Therefore, we can conclude that the origin of fermented soybean products is the Bronze Age in the Korean Peninsula and South Manchuria by Northeastern Dongyi. The written record of soybean sauce and paste utilization in Korean literature appears during much later years, such as in the records on a princess marriage in King Sinmun's reign (683 AD) of Silla. According to S.W. Lee (1990), fermented soybean products were first introduced to China during the first century BC and to Japan in the sixth century AD (Fig. 1.1). Fermented soybean products were developed in China, Korea, and Japan according to local ingredients and dietary traditions, much as the typical hot soybean paste of Korea, *kochujang*, had developed with the introduction of red pepper into the Korean Peninsula (Nout et al. 2014).

1.4 Fermented Soybean Products in Northeast Asia

1.4.1 Korean *Kanjang* and *Doenjang*

Meju is prepared from cooked soybeans. Soybeans are soaked in water overnight, cooked for 2–3 h, and mashed by pounding. It is then shaped like a brick or a ball and dried in the sun and kept in a stack covered during the night for several days. During this period, mold typically grows on the surface, especially *Aspergillus oryzae*, and the inside becomes laden with bacteria, typically *Bacillus subtilis*. Enzymes from the mold and bacteria hydrolyze the soybean proteins into amino acids and turn the carbohydrates into sugars and organic acids (Lee 2001). The amino acids and sugars interact with each other to create a browning reaction, resulting in the characteristic dark brown color and meaty flavor of *meju*. Well-fermented *meju* is immersed in brine in an earthen jar and ripened for several months. The brown

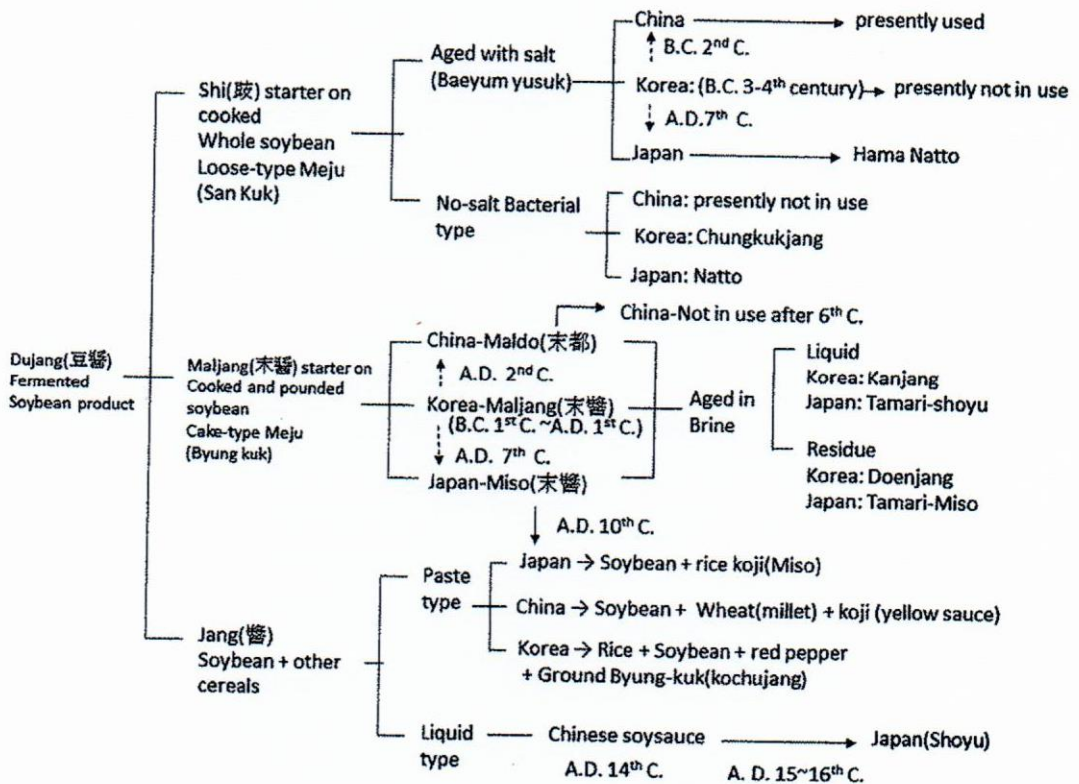


Fig. 1.1 The origin and interchange of Dujang (fermented soybean products) in East Asia (Lee 1990, 2009)

color and meaty flavor leach out into the brine. During this period, salt-tolerant yeasts grow in the mash, especially *Saccharomyces rouxii*, which produces the aroma of soybean sauce. The liquid part is soy sauce (*kanjang*) and the precipitates are soybean paste (*doenjang*). Soy sauce produced by this method is boiled once and can be stored in an earthen jar for years. The flavor of soy sauce gets richer as the storage time grows, just as the flavor of wine becomes smoother as it ages. It has been said in Korea that the taste of food in a household is dictated by the taste of their fermented soybean products.

1.4.2 Japanese *Shoyu* and *Miso*

Japanese people modified the *meju* preparation method in early 1900s by using a controlled fermentation technology incorporating a pure culture of mold isolated from the traditional starter (Shurtleff and Aoyaki 1976; Nout et al. 2014). The mold, normally *Aspergillus oryzae*, is grown on cooked rice or cooked wheat grits to make *koji*. It is mixed with cooked soybeans for further fermentation and then ripened in the brine. Soybean paste (*miso*) and soy sauce (*shoyu*) are made separately; for *shoyu*, *koji* is made with cooked defatted soybean flake and wheat grits and then mixed with brine for aging. After 4–6 months of aging, it is filtered to obtain *shoyu*, the liquid part, and the solid part is discarded. *Miso* is prepared by using *koji* made with cooked rice or other cereals which is mixed with cooked soybeans and salt and then mashed into a paste and ripened. These processes make industrialization of the products easy. The flavor of Japanese *shoyu* and *miso* is mild and sweet compared to their Korean counterparts. Korean people prefer the strong flavor of traditional soy sauce and soybean paste, just as European people distinguish Roquefort from processed Cheddar cheese.

1.4.3 Korean *Chōngkukjang*

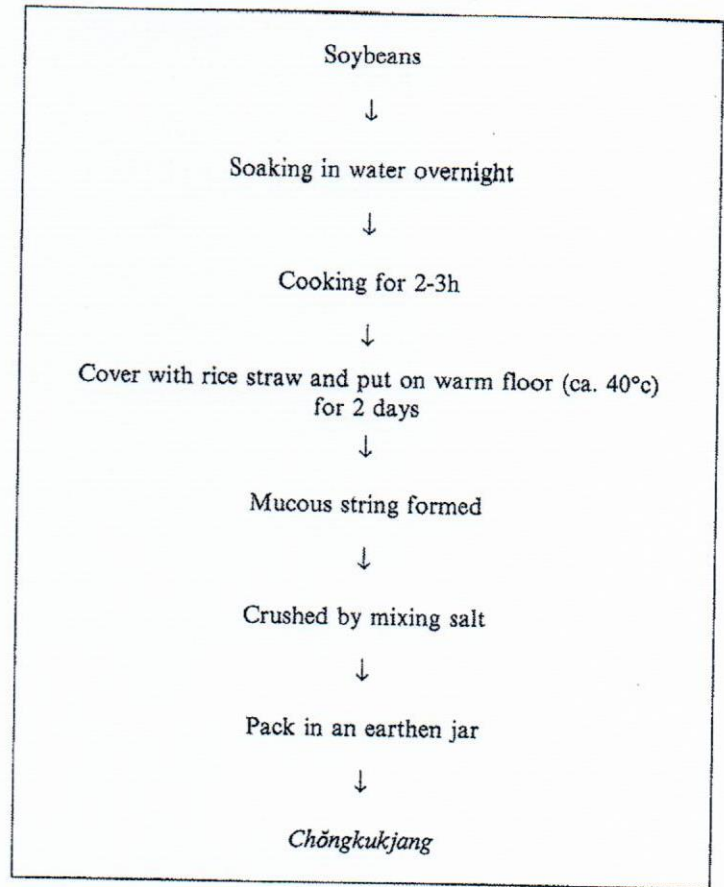
Soybeans are cooked and covered with a straw mat or cloth and then placed on the warm stone

floor, *ondol*, for 3–4 days until the mucous string is formed. This is then mixed with chopped ginger, chopped garlic, and salt and pounded slightly until the bean kernels are separated into halves and is then stored in an earthen jar (Fig. 1.2). The strong smell of fermented soybeans is partially masked by the ginger and garlic smell, which also creates the characteristic *chōngkukjang* flavor. The spicy seasoning of *chōngkukjang* is thus prepared in 3–4 days, while ordinary soybean paste, *doenjang*, which uses *meju* as a fermentation starter, takes over 6 months for complete ripening. The mucous substance in *chōngkukjang* is peptido-polysaccharides produced by *Bacillus subtilis* (Lee 2001; Nout et al. 2014).

Japanese *natto* is a modified form of *chōngkukjang*. *Natto* is fermented soybeans grown with *Bacillus subtilis* on cooked soybeans. The fermented soybeans with mucous string are consumed directly without further processing, so it is a non-salt-fermented product. However, *natto* is not generally accepted by Korean people. It is always mixed with spices and used for the cooking of vegetable stew as a meaty-flavored condiment. The amount of *chōngkukjang* added to the stew is large enough to supplement protein to the diet significantly. The fermented bean halves floating and mixing in the vegetable stew are seen as a healthy sign.

In the urbanized lifestyle of today—the so-called apartment culture—what Korean elders miss most is the stimulating savory smell of *chōngkukjang* emanating from their kitchen. Since Korean young people are known for disliking the smell, neighbor-conscious apartment life does not allow for the preparation of *chōngkukjang* stew at home. Consequently, *chōngkukjang* stew is an important menu item for traditional Korean food restaurants, where elderly people prefer to go. *Chōngkukjang* was also called *Jeonkukjang* in the old days. “Chōngkuk” means the Chinese empire “Qing,” while “Jeonkuk” means “Warring States.” What all these names imply is that this product was made for extraordinary situations, for example, wartime or famine conditions, to meet the urgent need for nutritious savory food ingredients.

Fig. 1.2 Flowchart for *chōngkukjang* making



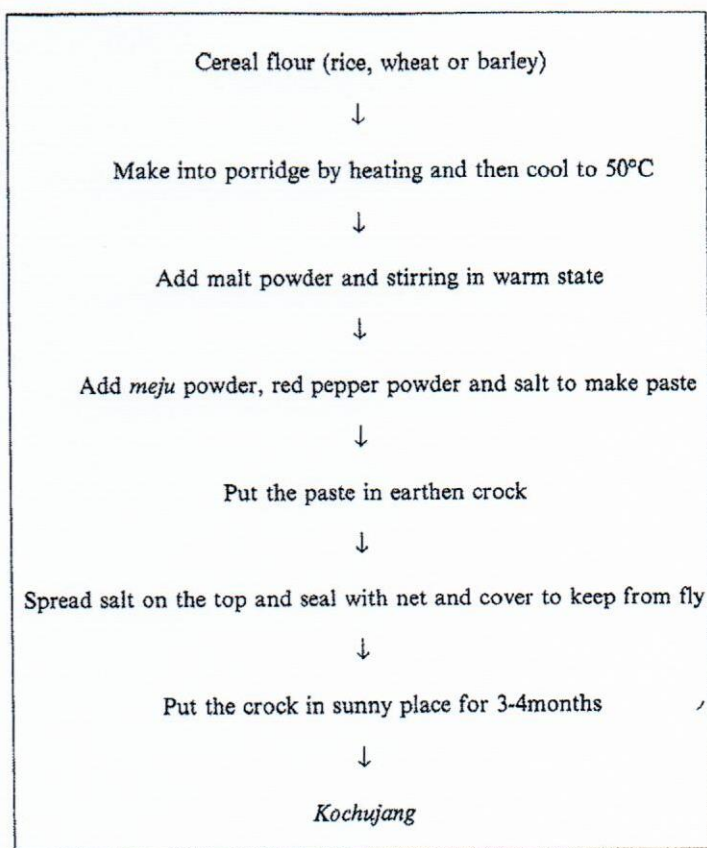
1.4.4 Korean Kochujang

The basic tastes for European cultures are sweet, sour, bitter, and salty, and Japanese people add here *umami*, the meaty taste. Korean people add another one: hot or pungent taste. The most remarkable difference between Korean food to that of neighboring Japan and China is the strong pungent taste of red pepper in most Korean dishes. *Kochujang* is a unique hot bean paste seasoning popular in Korea. It is made from fermented soybean starter, *meju*, and malt made from barley (Fig. 1.3). As seen in Fig. 1.3, malt powder is mixed with cereal porridge made from rice, glutinous rice, or barley. Enzymes in the malt hydrolyze the starch into sugars and dilute the consistency of the mixture (Lee 2001; Nout et.al. 2014). *Meju* powder, red pepper powder, and salt are added to the partly saccharified porridge with thorough mixing to make a paste

which is then put in an earthen jar. The top is covered by salt in order to prevent mold growth. The jar is then placed in a sunny place for further fermentation. The proteins in the soybeans and cereals degrade into amino acids, producing a meaty flavor. During the fermentation, a wonderful harmony of the meaty flavor from hydrolyzed proteins and the sweet taste of hydrolyzed starches with the pungent taste of red pepper and salty taste is achieved, and a new characteristic flavor stimulating the appetite of Koreans is formed (Shin et.al. 2012).

Kochujang is the queen of fermented soybean products in Korea. The shiny red color, rich and smooth consistency, and stimulating hot-sweet-meaty aroma are enough to trigger your central nerve to cry for a bowl of warm rice. One can empty a bowl of rice with *kochujang* alone as a side dish. It is a good source of protein, and it contains essential fatty acids and vitamins, espe-

Fig. 1.3 Flowchart of *kochujang* making



cially vitamin A. A bowl of cooked rice and a fresh cucumber with enough amount of *kochujang* for dressing is an excellent lunch menu in the summer for Korean people, just as a hotdog covered with tomato ketchup might be for European people.

1.5 Role of Fermented Food in Northeast Asia

Fermented food has long been at the center of the dietary culture of Northeast Asia. For example, the traditional Korean diet is composed of rice as a staple food, supplemented with soybeans, *kimchi* as a side dish, and fermented soybean products (*jang*) and fish products (*jŏtkal*) as the main condiments. Thus, fermented foods are the major condiments providing the taste and palatability to Korean meals. Historically, *kimchi* was an important vitamin and fiber source for Koreans during

winter when green vegetables were not available. Korean rice wine was an essential item for ancestor-memorial services, wedding ceremonies, and religious and communal rituals as a medium for accessing the spiritual realm. Many of the founding myths of ancient nations in Northeast Asia note the abundance of affairs incorporating grain-wine drinking, with communal and religious rituals often ending with drinking and dancing overnight.

Since the taste of foods in a household was heavily dependent on the taste of soybean sauce and paste, *jang* fermentation was considered one of the most important annual events for families of Northeast Asian culture. People believed that the taste of *jang* was related to the family's well-being. Since the grain wine for ancestral rituals and religious ceremonies was brewed at home, each district and household had their own unique method of wine brewing, and numerous kinds of grain wine were produced. For example, a num-

ber of books describing rice-wine brewing were published and sold in the seventeenth to nineteenth centuries of the Chosun Kingdom in Korea. The advanced fermentation technology developed in and around the Korean Peninsula seems to have been influenced by the dietary culture of surrounding countries and people. For example, soybean fermentation tradition and rice-wine brewing technologies were transferred to China and Japan. This can be supported by the fact that the Matsuya shrine of Kyoto, Japan, keeps the tablet of Master Jin from Silla as the god of rice wine.

In East Asia, a crude starter culture, *nuruk*, has been used for cereal fermentation. It was made by solid fermentation mold grown on a cereal substrate. Although the names of fermentation starters used in East Asia are different in each country (see Table 1.1), the microorganisms involved and

the processing methods are similar. The microflora and substrate vary with the climate and geographic conditions. Figure 1.4 compares the processing methods of Korean *nuruk*, Japanese *koji*, Indonesian *ragi*, and Filipino *budbod* (Lee 2001) (Fig. 1.4).

Japanese *koji* is made with the pure culture of *Aspergillus oryzae* and the enzyme activity is relatively high. It produces the light and bland taste of rice wine, which is preferred by women and young people. On the other hand, Korean *nuruk* is made by natural mixed culture fermentation, and the resulting rice wine has a deep and complex flavor. In the case of soybean sauce, the pure-cultured Japanese *koji* produces a mild- and sweet-tasting sauce suitable for table dipping sauces, while naturally fermented Korean *meju* produces a strong and sharp flavor which is useful for soup and in cooking other dishes.

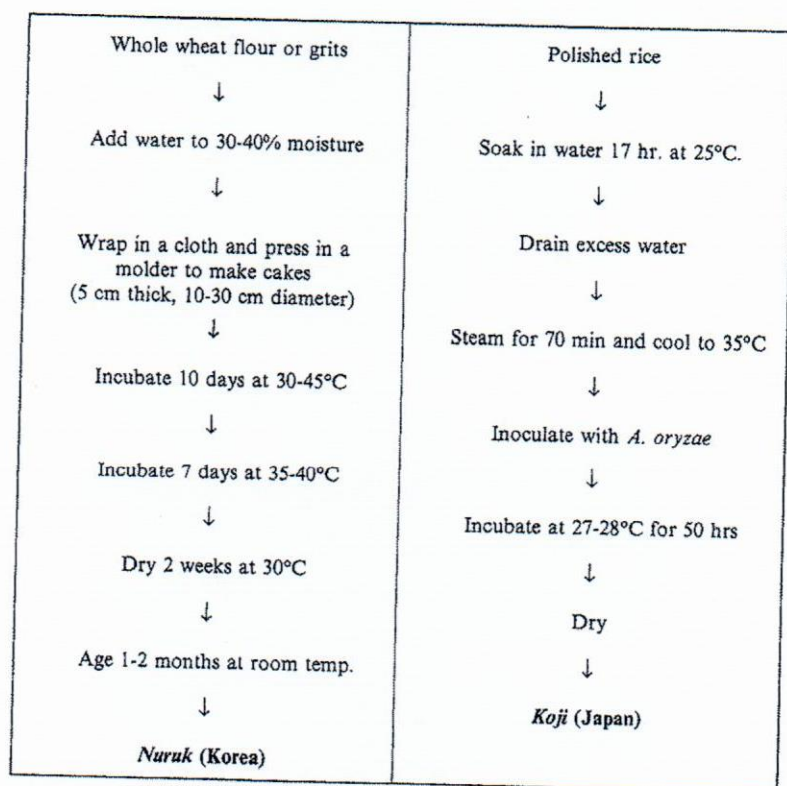


Fig. 1.4 Flowcharts for the preparation of solid-fermented starters made in different countries in the Asia-Pacific region

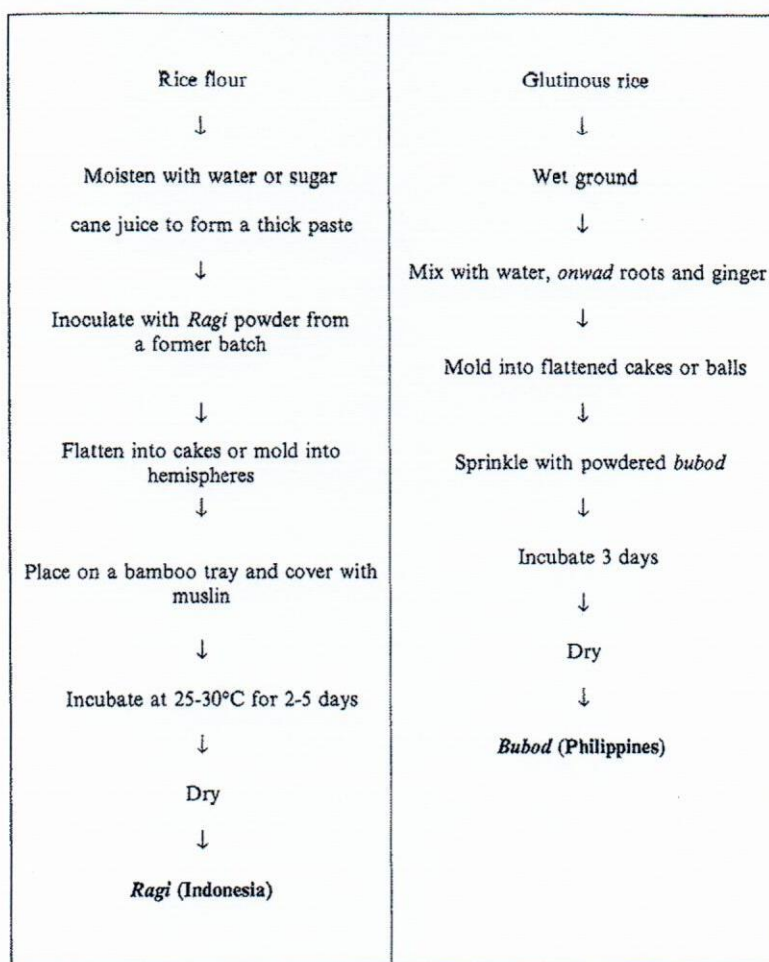


Fig. 1.4 (continued)

1.6 Conclusion

The Korea Strait region is considered one of the original sites of fermentation technology in East Asia. Archaeological findings and geographical considerations on the movement of the ancient people in the Late Paleolithic and Early Neolithic era in this region support the contention that fermentation technology began as early as 6000 BC during the Primitive Pottery Age in the Korea Strait region, comprising the southeast coast of the Korean Peninsula and the northwest coast of Kyushu in the Japanese archipelago. By using earthen vessels/jars,

which are able to hold wet organic materials for the first time in human history, microbial growth was able to occur as a spontaneous phenomenon. Alcoholic fermentation (rice wine), fish fermentation (*sikhae* and *joetkal*), vegetable fermentation (*kimchi*), and then soybean fermentation (*doenjang*) in later periods (ca. 1000 BC) have all been developed in this region. These fermented foods, which have a long storage life and abundant nutrients formed by the microbial conversion process, have contributed greatly to the food availability and nutritional status of the people in this region through history.

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