

Kimchi fermentation and lactic acid bacteria (LAB) taxonomy

MHEEN, Tae Ick

Bio R and D's Co., Ltd

Kimchi is Korean traditional fermented vegetable food which is salted, blended with various spices and ingredients, and fermented for a certain period of time at ambient temperature or lower temperature. Korean cabbage and radish are the most widely used raw materials in making Kimchi, but many other vegetables are also used depending on their availability.

More than 200 kinds have been reported in Korea depending on the raw materials used, processing methods, seasons, and localities. Among them, Tongbaechu Kimchi and Bossam Kimchi based on cabbage and Kkakdugi, Dongchimi, and Chonggak Kimchi based on radish, are the most popular items extensively consumed during winter. Yeolmu Kimchi based on young radish, and Oisobaegi or Oiji based on cucumber are popular in summer.

Raw materials used for Kimchi preparation are divided into three groups, primary, secondary and optional ingredients. Korean cabbage and radish are primary vegetables, and secondary ingredients include garlic, red pepper powder, green onion, ginger, and salt. Fermented fishery products and other seasoning agents are often used as optional ingredients. A recipe for the simplest Kimchi may include cabbage, 100g; garlic, 2g; red pepper powder, 2g; green onion, 2g; ginger, 0.5g; with optimum salt content of 2-3%.

Whole or cutted cabbage is salted with 10-15% brine for 3-10 hours and then washed twice with fresh water and drained. Other secondary ingredients, chopped and combined are mixed with the salted cabbage and fermented in tightly sealed containers at 10-20°C for 3 to 7 days. The length of time to complete the fermentation depends on the salt content and temperature.

The optimum pH for the best taste of Kimchi is 4.2 and the optimum acidity is 0.6% as lactic acid. The best taste is attained after 3 days of fermentation at 20°C with 3% salt. Under similar conditions, Sauerkraut fermentation usually takes 20 days. The final pH and acidity of Sauerkraut is 3.5 and 1.5-2.0%, respectively.

Kimchi has a unique sour, sweet, carbonated taste and is usually served cold. Furthermore, Kimchi contains a lot of live LAB (more than 10^8 - 10^9 cells/ml of Kimchi). In this respect, Kimchi differs from western Sauerkraut which is only acidic in taste and served warm, while Japanese Asatsuke which is not fermented products has little live LAB.

Total amount of Kimchi production was estimated to be 1,595,285 M/T and one fourth of total consumption of Kimchi was commercially produced in 1998. According to a national nutritional survey, an adult consumes 50-100g/day of Kimchi in summer and 150-200g/day in winter.

Kimchi fermentation is carried out by many microorganisms derived from various raw vegetables and ingredients of Kimchi, but LAB which can grow in 3% brine, are major microorganisms involved in the Kimchi fermentation.

Sugars in Kimchi raw materials are converted to lactic acid, acetic acid, carbon dioxide and ethanol by heterofermentative LAB during Kimchi ripening, and these acids and carbon dioxide are responsible for the fresh, sour and carbonated taste of Kimchi. However, after a certain period of time, excessive lactic acid is formed and off-flavors are developed due to the growth of homofermentative LAB. After the ripening of Kimchi, in certain cases yeasts and molds appear and destroy the product by softening the texture and forming undesirable odours.

During the last 50 years, researchers have isolated and reported many genera and species of bacteria, yeasts and fungi from Kimchi samples, but it was confirmed that major microorganisms responsible for Kimchi fermentation were LAB and yeasts were known to play a role in softening of Kimchi texture and generating off-flavors.

In the Kimchi fermentation system, it is obvious that heterofermentative LAB producing dextrans from sugars are major species in the early stage of fermentation and homofermentative LAB producing excessive lactic acid are major species in the late stage of fermentation. Much gas is produced in the early stage of the fermentation, while homofermentative species predominate after this period and relatively little acid is formed.

It was also confirmed that low salt concentration and low temperature (e.g. 2%, 10°C) favored growth of heterofermentative LAB, while high salt concentration and

high temperature (e.g. 3.5%, 30°C) favored growth of homofermentative LAB. Therefore, salt concentration and temperature are the most important factors for controlling Kimchi fermentation.

Besides the two key factors for controlling Kimchi fermentation, many factors and microorganisms affecting Kimchi fermentation has been reported. In this lecture I would like to put emphasis on the important factors influencing Kimchi fermentation and some characteristics of Kimchi microorganisms and LAB taxonomy will be presented.