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단보 (Note)

Production of Rapid-Fermented Kimchi with Starter

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Starter를 이용한 속성발효김치의 제조

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To establish the standard condition of uniformed Kimchi product, we introduced the concept of starter and studied the preparation of rapid-fermented Kimchi. Of the strains isolated from Kimchi, Kakdugi and infant's feces, M7 strain grew effectively on aseptic Chinese cabbage juice and on salted Chinese cabbage, the growth of M7 was decreased severely. Inoculated with M7 in salted Chinese cabbage, appropriate range of pH and lactic acid content were reached at 8-13 hrs and 12 hrs after addition of spices, respectively. The result of sensory evaluation was not significant at 5% level.

Kimchi, spiced and fermented vegetable food, has traditionally been one of the most important side dishes for the daily meals of the Korean people. By this time, Kimchi has been prepared by the traditional unique method of each home and spent by oneself. But, lately, it became to require the enterprise of Kimchi because various changes of dietary life pattern and residence structure by the development of state economy. Necessity of mass production of Kimchi, therefore, was accelerated to buy fresh processing Kimchi all the time by these reasons.

After the enterprising production of canned Kimchi for Army in 1967, it has been started the studies on canned Kimchi preparation and shelf-life of Kimchi (1-5). Lee *et al* (6) studied on preparation of canned Kimchi and the other several studies canned Kimchi and prolongation of storage with an antiseptics or treatment of irradiation were carried out (7-10). But fundamental studies for mass production of Kimchi were not enough up to date. Accordingly, most important problems of Kimchi product are to preserve the unique taste during the circulation and to extend the shelf-life of Kimchi.

In the present studies we introduced the concept of starter and studied on the preparation of rapid-fermented Kimchi for the purpose of establishing the uniformed Kimchi product.

Materials

Chinese cabbage and spices were purchased from a local market in Suweon. Polyethylene film (thickness 0.06 mm, width 27 cm) as a packaging material was used. Analytical reagents and media were used the special grade and Difco special grade, respectively.

Isolation of fermentative bacteria in Kimchi

Strains to be presume lactic acid bacteria were isolated from winter Kimchi, Kakdugi and infant's feces. After cultivated in LBS agar, strains were isolated from the colony produced in LBS agar and cultured purely in MRS agar slant.

Key words: Kimchi, Chinese cabbage juice, starter
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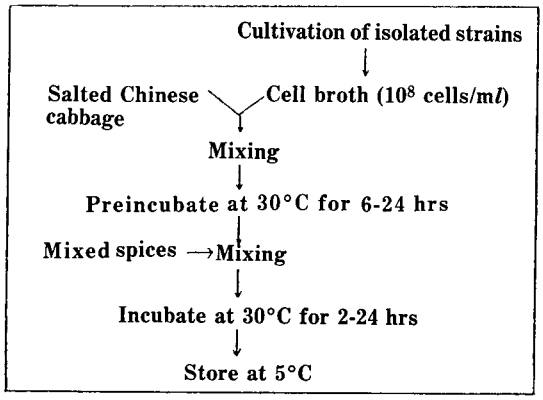

Fig. 1. Flow diagram for Kimchi preparation.

Preparation of Kimchi

Kimchi was prepared with salted Chinese cabbage, mixed spices and cell broth of starter according to Fig. 1. Kimchi contains raw Chinese cabbage 1 kg, NaCl 70g, red pepper powder 25g, garlic 20g, ginger 8g, stone-leek 45g and sugar 10g. Final salt concentration was adjusted by adding required amount of salt. For analysis, each samples of Kimchi packed consisted of 300g of material filled in PE film bags of 16×24 cm size and was sealed. For sensory evaluation, Kimchi prepared consisted of 2 kg of material filled in plastic basket. Fermentation of Kimchi was carried out at 30°C.

Analysis

The smaples from each bag were blended and filtered by sterilized gauge, and the analysis for microbial and chemical changes of Kimchi during fermentation were carried out. pH of filtrate was measured using Beckman pH meter (ss-2 type). After decolorization of filtrate by addition of activated carbon (10 w/v%), acidity was determined by titration with 0.1 N NaOH solution using phenolphtalein as indicator and calculated on the basis of lactic acid. Sodium chloride was determined by the method of Mohr (11).

Microbial changes

MRS agar was used for the counting of lactic acid bacteria and counted by using Quebac colony counter. Microbial growth was estimated by the absorbance at O.D. 600 nm.

Sensory evaluation

The sensory panel consisted of 25 persons of the Korea Food Research Institute. Panel was trained with a representative Kimchi so that they could remember the quality characteristics of Kimchi as reference. The sensory parameters, taste, flavour, texture and overall acceptability, which were recognized as the commercial value of Kimchi, were evaluated by using 1-5 scale in which the scores for the commercial product were refered to 3. And sensory evaluation was determined the significance at 5%.

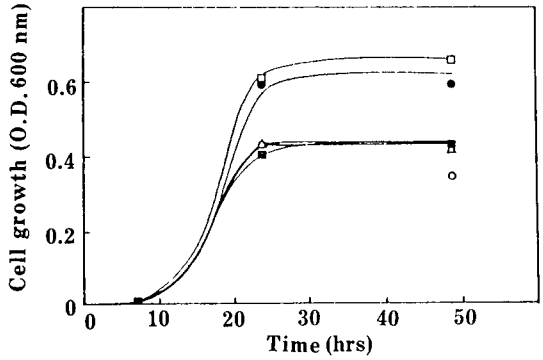

Fig. 2. Growth curve of selected strains on aseptic Chinese cabbage juice. Strains were cultured at 30°C, and the growth were measured at 600 nm.
○: K-BA-8, ●: K-GA-2, □: M7, ■: K-GA-6, △: K-BA-1

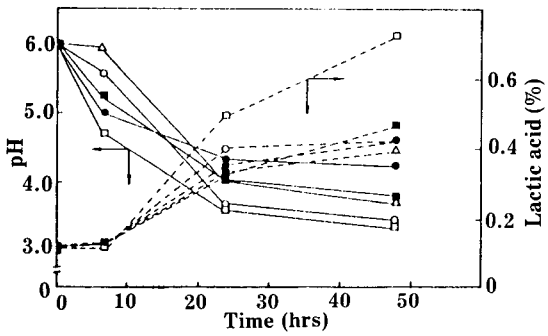

Fig. 3. Changes of pH and lactic acid content in aseptic Chinese cabbage juice.
○: K-BA-8, ●: K-GA-2, □: M7, ■: K-GA-6, △: K-BA-1

Isolation and selection of strains

Total number of isolated strains from winter Kimchi, Kakdugi and infant's fece were 34. Of isolated strains, 5 strains, K-GA-2, K-GA-6, K-BA-1, K-BA-8 and M7, which grew on LBS agar vigorously were collected again and examined for microbial cell growth, changes of pH and lactic acid content on aseptic Chinese cabbage juice. Fig. 2 shows the results of cell growth on aseptic Chinese cabbage juice. As

Table 1. Changes of bacterial cell number during Kimchi fermentation.

Time (hrs)	Kimchi[1]	Kimchi[2]	Kimchi[3]
0	5.5×10^{8}		
3	6.5×10^{8}		
6	2.9×10^{9}	4.0×10^{8}	
8	5.0×10^{9}	4.5×10^{8}	9.0×10^{8}
10	4.7×10^{10}	4.2×10^{8}	1.2×10^{9}
12	3.5×10^{10}	5.0×10^{8}	8.0×10^{8}
24	3.2×10^{9}	7.5×10^{8}	8.0×10^{8}

Kimchi inoculated with M7 strain were cultured at 30°C
1: Kimchi, only salted Chinese cabbage
2: Kimchi, added spices after 6 hr
3: Kimchi, added spices after 8 hr

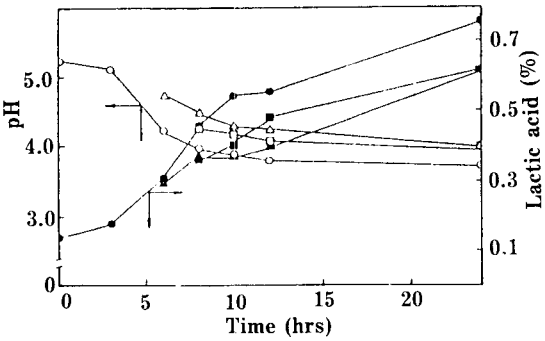

Fig. 4. Changes of pH and lactic acid content during Kimchi fermentation with M7 strain.
○,●: Kimchi, only salted Chinese cabbage
△,▲: Kimchi, added spices after 6 hrs
□,■: Kimchi, added spices after 8 hrs

seen in Fig. 2, M7 strain from infant's fece was grew vigorously than the other strains. After incubation for 24 hrs, M7 was reached at stationary phase. In changes of pH on aseptic Chinese cabbage juice, M7 was took faster than the other strains into appropriate range of Kimchi (Fig. 3). K-BA-1 was decreased slowly and took 18 hrs appropriate range of Kimchi, pH 4.2-4.6. On the other hand, M7 was decreased rapidly and took 10hrs. M7 was also increased rapidly into proper range of T.A., 0.45-0.7% of lactic acid. But the other strains were increased slowly.

In this study, we found that M7 strain which showed vigorous cell growth, rapid changed of pH and lactic acid content was fitted as the preparation of starter.

Effect of salted Chinese cabbage as a seed

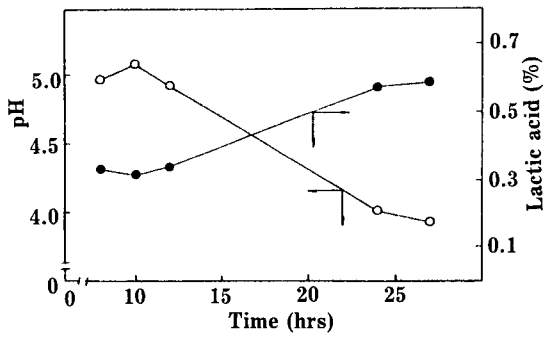

Fig. 5. Changes of pH and lactic acid content on rapid-fermented Kimchi with starter.
○: pH, ●: Lactic acid content

Table 2. Sensory evaluation of Kimchi.

Item	Fermentation period (hr)				
	8	10	12	24	27
Taste	3.00	3.07	2.98	3.29	2.74
Flavour	3.19	2.95	2.83	3.14	2.67
Texture	3.43	3.33	3.31	3.24	3.07
Overall acceptability	3.22	3.19	2.86	3.11	2.43

M7 strain grew vigorously in aseptic Chinese cabbage juice was inoculated into salted Chinese cabbage (5%, v/w). Changes of bacterial flora, pH and lactic acid content were investigated by elapsed time during fermentation at 30°C. As shown in Table 1, bacterial number on salted Chinese cabbage was maximum at 10 hrs and decreased in number of viable cell over 93% at 24 hrs incubation. Meanwhile, when spices were added into salted Chinese cabbage after 6 and 8 hrs, bacterial population was decreased to 15 and 20% of salted Chinese cabbage respectively. Thereafter, these population was increased gradually. pH on the Kimchi added condiments was higher level than on the white Kimchi prepared only salted Chinese cabbage and decreased with a same trend gradually (Fig. 4). On the other hand, lactic acid content was higher in a way of salted Chinese cabbagee. In case of adding the spices, adding after 8 hrs incubation was more effective than 6 hrs.

Rapid-fermented Kimchi with starter

White Kimchi was prepared with salted Chinese cabbage and 5% (v/w) of culture broth of M7 strain

according to Fig. 1. And it preincubated at 30°C for 8 hrs. Thereafter, preincubated Kimchi was mixed with spices and was fermented at 30°C. 8-13 hrs after addition of spices, the change of pH during fermentation was not lose favor with reasonable range. And 12 hrs after addition of spices, lactic acid content was 0.5% level (Fig. 5). As shown in Fig. 5, changes of pH and lactic acid content were not agreed with each other for appropriate range of Kimchi. It was considered that those results were due to action of spices. The results of sensory evaluation for rapid-fermented Kimchi was shown in Table 2. The sensory parameters, taste, flavour, texture and overall acceptability were evaluated by using 1-5 scale in which the scores for the commercial product were refered to 3. As shown in Table 2, texture was good without regard to fermentation time and taste, flavour and overall acceptability were generally good at 8 hrs, 10 hrs and 24 hrs respectively. But sensory evaluation for these parameters were not significant at 5% level. It was considered that these results were due to diversification of preference for Kimchi.

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