S7-3

Preparation of Starter Powders for Kimchi

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Preparation of kimchi starter is needed to get consistent product qualities, safety and storage of commercial kimchi, To determine critical factors influencing kimchi taste, kimchi samples were collected in Jeonju and analysed to find correlation between sensory scores and microbial properties, such as microbial numbers, dominant strain number, subdominant strain number, yeast strain numbers, and floral diversity and also between sensory scores and physicochemical properties, such as pH, acidity, salinity, reducing sugar, and a few kinds of nonvolatile acids. But non of the examined property showed any significant correlation to sensory scores.

The most common microbial compositions of the kimchi samples were *Leuconostoc mesenteroides* as dominant strain, and *Lactobacillus sakei* as subdominant strain, which pattern was observed in all the three kimchi samples with highest sensory scores, but not in all the three kimchi samples with the lowest sensory scores. This results mean the major microbial composition is critical to determine the taste of fermented kimchi (Fig. 1).

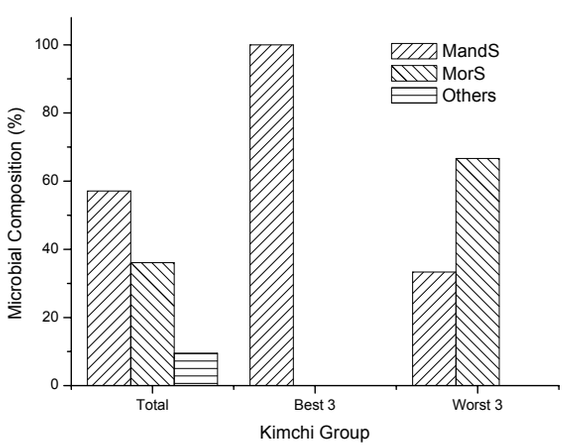

Fig. 1. Microbial composition of kimchi group
MandS: *L. mesenteroides and L. sakei* as dominant and subdominant strain
MorS: *L. mesenterois or L. sakei* alone as dominant and subdominant strain
Others: Other combination of microbial strains
Total: all samples, Best 3: 3 samles with highest sensory scores, Worst 3: 3 samples with lowest sensory scores

Selected strain of *Leuconostoc mesenteroides* was combined with each of 7 strains of *Lactobacillus sakei* and 2 strains of *Saccharomyces servazzii* and tried on fermenting kimchi. Kimchi fermented only with *Leuconostoc mesenteroides* or with combination of *Leuconostoc mesenteroides* and *Lactobacillus sakei* tasted good, but kimchi fermented only with *Lactobacillus sakei* or combination with *Saccharomyces servazzii* did not. By sensory evaluation one strain of *Leuconostoc mesenteroides,* K8P4 and one strain of *Lactobacillus sakei,* K5M3 were finally selected as starters for kimchi fermentation. The two starters showed gamma hemolysis on blood agar and negative reactions in all safety checks tested (Table 1).

Table 1. Safety of selected kimchi starters

Test	*L. mesenteroides* K8P4	*L. sakei* K5M3
Hemolysis	γ	γ
Ammonia	-	-
Indole production	-	-
Phenylalanine deaminase	-	-
β-glucuronidase	-	-
β-glucosidase	-	-
Gelatin liquefaction	-	-
7α-dehydroxylase	-	-
Nitroreductase	-	-

Preference test by the public of kimchi fermented by the two starters, *Leuconostoc mesenteroides* K8P4 and *Lactobacillus sakei* K5M3, showed that twice more people liked starter kimchi rather than natural kimchi.

For large scale production of starter microorganisms, appropriate media were sought. Growth of the starters, *L. mesenteroides* K8P4, and *L. sakei* K5M3, was enhanced when 1% molasses solution was supplemented with 0.5% yeast extract, 0.01% Magnesium Sulfate, and 0.005% Manganese Sulfate. For cultivation of *L. sakei* K5M3, addition of culture filtrate of *L. mesenteroides* K8P4 to medium or mixed culture with *L. mesenteroides* K8P4 was better in growth yield.

Optimum condition for production of *L. mesenteroides* K8P4 in fermentor was aeration of 0.5 VVM, agitation of below 300 rpm, and 10 hr cultivation with pH of medium controlled to 6.0, and that for *L. sakei* K5M3, aeration of below 0.5 VVM, agitation of below 150 rpm, and 8 hr cultivation with pH of medium controlled to 6.0.

Skim millk solution of 5-10% was best among tested protecting materials for freeze-drying starters. It was also best for storage of starters.

When potato starch and $CaCO_3$ were used as diluents of starter powders. Potato starch enhanced

growth of *L. mesenteroides* K8P4 while $CaCO_3$ that of *L. sakei* K5M3.

Starter powders produced by molasses media and freeze-drying showed weak dominance in kimchi during fermentation. However supplementation with 1% sucrose and 3% NaCl to the medium increased the dominance of starters.

When starter dose effect was examined up to 100 times, fermentation rate, kimchi properties and kimchi taste are not much altered by increasing starter amount by 10 times. However 100 times increase gave fermented kimchi unpleasant odor.

Starter kimchi is better than natural kimchi in ASTA value after 8 weeks of storage, shelf life, mannitol content and reducing activity. It has antimicrobial activity against *E. coli* and *S. typhimurium*, but not against *S. aureus* and *C. perfringens*.

Table 3. Properties of kimchi

Test		Natural kimchi	Starter kimchi
ASTA value after 8 weeks		9.7	15.0
Shelf life at 15°C		12±3	25±5
Mannitol content (%)		0.72	0.85
Electron donating activity (%)		57.9	63.2
Antimicrobial activity	*E. coli*	+	+
	S. typhimurium	+	+
	S. aureus	-	-
	C. perfringens	-	-

For preparation of better starters, studies of below subjects should be followed.

1. Changes in microbial composition of kimchi during fermentation and storage
2. Changes in microbial composition of major ingredients during storage
3. Better way to dry starters for easy use and prolong shelf life of dried powders
4. Better way to dilute uniformly the starter powders without affecting kimchi fermentation
5. Better way to improve the effect of starter in controlling kimchi microbial composition
6. Effect of microbial metabolites on kimchi taste