

Effects of Various Sub-ingredients on Sensory Quality of Korean Cabbage Kimchi

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Abstract

Effects of various sub-ingredients (hot pepper, garlic, ginger, green onion, leek, salted and fermented anchovy juice, and sugar) on the sensory quality of Korean cabbage kimchi were investigated. Sixteen sensory attributes were selected and their intensities evaluated by 20 panelists. The kimchi had an unharmonized taste and unpleasant flavor when fermented with individual sub-ingredients, but had a well harmonized taste when fermented with all sub-ingredients. Hot pepper, ginger and garlic contributed to reduction of the unpleasant taste and moldy odor. The strong garlic flavor was reduced by adding green onion and leek. Salted and fermented anchovy juice gave a palatable taste, and the overall taste was improved by adding sugar. All sub-ingredients except sugar reduced the sour taste.

Key words : sub-ingredients, sensory quality, Korean cabbage kimchi.

INTRODUCTION

Korean cabbage kimchi has a unique sweet, carbonated and palatable taste and has long been a main side-dish in Korea. To develop the Korean cabbage kimchi as an international food, it is necessary to establish an index for the taste of each kind of kimchi and measurement items for the sensory quality evaluation.

To evaluate the sensory quality of kimchi, Ku et al¹⁾ measured sour, grassy, crispy and durable tastes, and moldy, grassy and fishy odors. Lee and Yang²⁾ evaluated appearance, odor, taste, freshness, degree of fermentation and overall taste. Yoon and Rhee³⁾ reported degree of fermentation, salty taste, texture and off-flavor. Cha et al⁴⁾ measured flavor, texture and preference. As can be seen from these measurement items, no systematic method was found in expressing the sensory quality of kimchi.

This clearly indicates that there is no standardized model for the Korean cabbage kimchi.

Kimchi is a lactic acid fermented food, but various volatile and non-volatile organic acids⁵⁻¹⁴⁾ exist in the kimchi due to propagation of various microorganisms in addition to lactic acid bacteria. Kimchi can have different sour tastes according to the degree of fermentation. It is important to achieve a balance by harmonizing the salty taste achieve and the spicy-hot taste of hot peppers with the palatable and sweet tastes produced by fermentation. In sufficiently fermented kimchi such has a grassy odor derived from the main ingredient and a number of unpleasant tastes from subingredients such as garlic, ginger, and salted and fermented fish products (jeotgal). If the kimchi is over fermented, however, the crispy texture decreases, and an acidic and moldy odor is produced. Therefore, in order for the intense sour, salty and hot tastes of kimchi to be balanced by fermentation, it is necessary to establish the optimum salt concentration

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and fermentation temperature. The kinds of sub-ingredients used and their quantitative balance are also important. In addition, specific measurement items to evaluate sensory quality should be considered.

The objectives of this study were to make a desirable evaluation table for sensory quality evaluation of Korean cabbage kimchi and to investigate the effects of sub-ingredients on the sensory quality of kimchi fermented with all sub-ingredients except one or with individual sub-ingredients.

MATERIALS AND METHODS

Materials

Cabbage (Jang-Su, mean weight of 2 kg) used in this study for kimchi-making was purchased from a local market. As sub-ingredients, hot pepper was washed, dried and ground to 100 mesh size before use. Garlic, ginger, green onion and leek were packed in polyethylene film and stored at 4 °C until use. Salted and fermented anchovy juice (20% salt and 70% anchovy), a product of Ha Sun Jung Food Co., Ltd., was used as well as white sugar of Jeil Jeidang.

Starter culture

Four microorganisms (*Lactobacillus mesenteroides*, *Pediococcus cerevisiae*, *Lactobacillus brevis* and *Lactobacillus plantarum*), separated and cultured from 20 different kinds of Korean cabbage kimchi in previous studies^{22, 40}, were used as a starter for kimchi fermentation by mixing each microorganism at a ratio of 25%

Fermentation

Cabbage was first cut into 4 parts, soaked in 15% brine solution of 20 °C for 5 h, and then left in water for 10 min to reach a final salt concentration of around 3%. After draining excess water, the salted cabbage was well mixed with the sub-ingredients and starter according to the ratio shown in Table 1 (designated as standard kimchi). The ingredient ratios are the means calculated from 33 references on the Korean cabbage kimchi^{1-5, 7, 10, 12-37}. To evaluate the effects of sub-ingredients on the sensory quality of kimchi, the kimchi was prepared by adding all sub-ingredients except one or by adding individual sub-ingredients to the salted cabbage.

Table 1. Ingredient ratio of Korean cabbage kimchi

Ingredient	Ratio(%) ¹
Salted cabbage	100.00
Hot pepper powder	2.24
Ginger	0.92
Garlic	1.70
Green onion	2.98
Leek	4.00
Salted and fermented anchovy juice	4.69
Sugar	1.16
Starter ²	2.00

¹ The ingredients ratios are the means calculated from 33 references on the Korean cabbage kimchi.

² Lactic acid bacteria used as a starter of the Korean cabbage kimchi were *Lactobacillus mesenteroides*, *Pediococcus cerevisiae*, *Lactobacillus brevis* and *Lactobacillus plantarum*.

The sub-ingredients and starter were ground together in a plastic mortar, mixed with the salted cabbage (500g) and fermented at 20 °C in a sealed 2L bioceramic kimchi bottle.

Sensory evaluation

The sensory quality of kimchi fermented for 30h at 20 °C was evaluated by 20 well trained panelists. The kimchi was placed at 4 °C for 3h before evaluation. Palatable taste, grassy odor, color and overall taste were classified into very bad, bad, desirable, fine and very fine, and scored on a scale of 1 to 5 points. Unpleasant taste and flavor (sour, salty, hot, sweet, fishy and garlic) were classified as follows : *none*, *a little*, *medium*, *strong* and *very strong*, and scored from 1 to 5 points.

Statistical analysis

Data obtained from the sensory evaluation were subjected to analysis of variance. Mean separation was accomplished by use of the Duncan's multiple-range test.

RESULTS AND DISCUSSION

Measurement items for sensory quality evaluation

Several methods are used to evaluate the quality of kimchi during fermentation; (1) analysis of nutritional components produced or lost during fermentation, (2) measurement of microbial growth, and (3) sensory evaluation such as taste, odor, color

Table 2. Measurement items used in 10 references for the sensory quality evaluation of Korean cabbage kimchi

Item	Reference
Taste	2, 14, 17, 19
Sour taste	1
Bitter taste	2, 8, 14, 17
Salty taste	3
Grassy taste	1
Palatable taste	3, 10, 12, 14
Hot taste	17
Crispy taste	1
Durable taste	1
Carbonated taste	8, 12, 14
Juiciness	3
Overall taste	12, 17
Flavor	2, 4, 17
Acidic odor	1
Grassy odor	1
Moldy odor	1
Fishy odor	1
Off-flavor	8, 10, 12, 14
Texture or hardness	3, 4, 10
Freshness	2
Ripeness	2, 3, 10, 12
Color	10, 17

and texture. Kimchi is a lactic acid fermented food and lactic acid together with various organic acids are produced during fermentation by lactic acid bacteria and other microorganisms, thus resulting in an increase of acidity and a decrease of pH. Therefore, it is possible to evaluate the degree of fermentation and the storage condition of kimchi by measuring these parameters. However, fewer studies have been done on the sensory quality as on nutrients. Most of the sensory tests so far have been done in conjunction with components analyses.

Items of measurement used for the sensory quality evaluation of Korean cabbage kimchi by previous researchers were investigated for use as an index in the present study. Table 2 shows a variety of measurement items selected from 10 references. In the sensory quality evaluation of kimchi, measurement items were generally differentiated by the purposes of investigation such as storage evaluation, evaluation of the degree of fermentation and evaluation of the final product quality. In these investigations, items were established in detail such as taste, odor and preference^(1, 3, 8, 10, 15, 25, 35) or comprehensively such as

Table 3. Sensory quality evaluation of salted cabbage fermented without any sub-ingredients, and of Korean cabbage kimchi fermented with the specified with the specified single sub-ingredient and with all sub-ingredients (standard) for 30h at 20°C

Item	SKC	Ingredient added to the SKC							Standard kimchi
		Hot pepper	Ginger	Garlic	Green onion	Leek	SFAJ	Sugar	
Taste									
Sour***	2.62 ^{cd}	2.77 ^{cd}	1.54 ^d	1.69 ^d	4.77 ^{ab}	5.85 ^{ab}	4.15 ^{ab}	3.08 ^c	4.00 ^{ab}
Sweet***	2.00 ^b	2.15 ^b	2.54 ^b	2.15 ^b	2.23 ^b	1.69 ^b	4.15 ^a	4.46 ^a	4.00 ^a
Salty***	2.81 ^{bc}	2.62 ^{bc}	2.46 ^{bc}	3.39 ^b	3.69 ^b	3.77 ^b	6.15 ^a	3.00 ^{bc}	4.00 ^b
Bitter***	1.69 ^d	4.08 ^{ab}	2.39 ^c	3.15 ^{bc}	4.00 ^{ab}	5.00 ^a	5.15 ^a	4.31 ^{ab}	4.00 ^{ab}
Hot***	1.39 ^b	4.62 ^a	1.08 ^b	1.31 ^b	1.54 ^b	1.15 ^b	1.46 ^b	1.39 ^b	4.00 ^a
Palatable***	2.69 ^b	2.15 ^b	2.08 ^b	4.15 ^a	1.77 ^b	1.46 ^b	1.92 ^b	4.77 ^a	4.00 ^a
Grassy***	2.85 ^c	4.31 ^b	4.00 ^b	5.69 ^a	5.62 ^a	6.00 ^a	6.23 ^a	6.31 ^a	4.00 ^b
Unpleasant**	2.15 ^d	3.69 ^c	1.92 ^d	4.54 ^{bc}	5.85 ^{ab}	6.00 ^a	5.39 ^{ab}	3.46 ^b	4.00 ^{bc}
Crispy*	4.69 ^b	4.77 ^b	5.92 ^a	6.08 ^a	6.31 ^a	5.54 ^{ab}	5.39 ^{ab}	6.00 ^a	4.00 ^{bc}
Overall**	1.15 ^b	3.77 ^a	1.08 ^b	1.46 ^b	1.92 ^b	3.62 ^a	4.08 ^a	4.15 ^a	4.00 ^a
Odor									
Acidic***	2.46 ^b	2.31 ^b	2.31 ^b	3.92 ^{ab}	4.62 ^a	4.54 ^a	5.15 ^a	4.31 ^a	4.00 ^{ab}
Grassy***	5.15 ^b	4.46 ^{bc}	3.54 ^c	4.62 ^{bc}	5.31 ^b	5.62 ^{ab}	5.23 ^b	6.62 ^a	4.00 ^{bc}
Fishy	4.31 ^b	4.23	3.85	3.39	4.69	4.77	5.39	3.77	4.00
Garlic	1.69	2.54	2.85	3.54	2.62	3.76	2.39	2.23	4.00
Moldy***	4.00 ^{bc}	3.46 ^{bcd}	2.77 ^d	2.54 ^d	4.00 ^{bc}	5.23 ^a	4.77 ^{ab}	3.62 ^{bcd}	4.00 ^{bc}
Color***	2.23 ^b	4.08 ^a	1.08 ^b	1.00 ^b	1.00 ^b	1.00 ^b	1.08 ^b	1.00 ^b	4.00 ^a

SKC: Salted Korean cabbage

SFAJ: Salted and fermented anchovy juice

*p < 0.05, **p < 0.01, ***p < 0.001

Table 4. Sensory quality evaluation of Korean cabbage kimchi fermented with the rest six sub-ingredients after subtracting the specified each sub-ingredient and with all sub-ingredients (standard) for 30 h at 20°C

Item	Subtracted ingredient								Standard kimchi
	Hot Pepter	Ginger	Garlic	Green onion	Leek	SFAJ	Sugar	Garlic Green onion Leek	
Taste									
Sour***	6.54 ^a	5.39 ^b	5.54 ^b	5.46 ^b	5.08 ^b	4.85 ^b	3.54 ^c	3.77 ^c	4.00 ^c
Sweet**	3.85 ^b	4.69 ^a	4.15 ^{ab}	4.08 ^{ab}	3.39 ^b	4.15 ^{ab}	3.46 ^b	3.85 ^b	4.00 ^{ab}
Salty***	4.92 ^a	5.00 ^a	4.69 ^{ab}	4.08 ^{abc}	4.69 ^{ab}	3.08 ^c	3.69 ^{bc}	3.77 ^{bc}	4.00 ^{abc}
Bitter**	3.31 ^d	3.54 ^{cd}	4.23 ^{bcd}	5.31 ^a	4.62 ^{abc}	4.69 ^{ab}	3.77 ^{bcd}	4.00 ^{bcd}	4.00 ^{bcd}
Hot***	1.08 ^c	3.92 ^{ab}	4.69 ^a	4.92 ^a	4.39 ^{ab}	2.85 ^{cd}	2.54 ^d	3.62 ^{bc}	4.00 ^{ab}
Palatable*	3.69 ^a	2.85 ^{ab}	3.39 ^{ab}	3.92 ^a	4.00 ^a	2.54 ^b	2.92 ^{ab}	3.92 ^a	4.00 ^a
Grassy***	5.46 ^a	3.08 ^c	3.54 ^{bc}	3.77 ^{bc}	4.00 ^b	3.62 ^{bc}	5.54 ^a	3.15 ^{bc}	4.00 ^b
Unpleasant***	6.15 ^a	5.00 ^b	4.69 ^{bc}	4.46 ^{bc}	4.31 ^{bc}	4.62 ^{bc}	4.62 ^{bc}	4.00 ^c	4.00 ^c
Crispy***	4.85 ^{ab}	4.08 ^{bc}	3.23 ^c	3.92 ^{bc}	4.54 ^b	4.85 ^{ab}	5.54 ^a	4.39 ^b	4.00 ^{bc}
Overall***	2.69 ^d	3.69 ^{abc}	4.54 ^a	4.54 ^a	4.00 ^{ab}	3.46 ^{bcd}	2.62 ^d	2.85 ^{cd}	4.00 ^{ab}
Odor									
Acidic***	4.00 ^{bc}	4.54 ^{ab}	5.00 ^{ab}	5.39 ^a	4.15 ^{ab}	3.69 ^{bc}	2.23 ^d	2.85 ^{cd}	4.00 ^{bc}
Grassy*	4.00 ^{ab}	3.77 ^{abc}	2.85 ^c	3.62 ^{abc}	3.31 ^{bc}	4.23 ^{ab}	4.54 ^a	4.08 ^{ab}	4.00 ^{ab}
Fishy	3.15	3.23	4.00	3.39	3.69	4.31	4.00	4.00	4.00
Garlic***	5.08 ^a	3.92 ^b	2.39 ^c	5.15 ^a	5.69 ^a	3.39 ^b	2.54 ^c	2.54 ^c	4.00 ^b
Moldy***	3.92 ^c	3.15 ^c	5.23 ^c	3.77 ^c	3.54 ^c	4.39 ^b	4.39 ^b	4.31 ^b	4.00 ^{bc}
Color***									
	1.15 ^{bc}	3.15 ^{ab}	4.15 ^a	4.31 ^a	4.62 ^a	3.31 ^{ab}	3.39 ^{ab}	2.92 ^{ab}	4.00 ^a

SFAJ : Salted and fermented anchovy juice

*p < 0.05, **p < 0.01, ***p < 0.001

overall taste and odor^{2, 4, 12, 14, 17, 35, 36}. The use of various measurement items is considered to be due to differences in the sensory quality caused by differences in the kinds and quantities of sub-ingredients added. This indicates that there has been no concrete standard for expressing the sensory quality of kimchi.

Tables 3 and 4 show the sensory quality results for the kimchi fermented with individual sub-ingredients and with all sub-ingredients except the specified one. The kimchi was fermented for 30 h at 20°C and evaluated by 20 panelists.

Effects of sub-ingredients on sensory quality

Hot pepper

The composition of pigments in hot pepper consists of 40 different carotenoids with capsanthin and capsorubin as a major carotenoid and carotenes as provitamin A. These pigments are lipidsoluble, but released into water and penetrated into tissues during kimchi fermentation thus making it red-colored. Capsaicinoid, a hot taste co-

mponent in hot pepper, shows not only a unique harmonized taste with other taste components but also an important role as an effective antioxidant⁽¹⁾ to prevent oxidation of vitamin C, carotenes and lipids.

The amount of hot pepper added to kimchi varied 0.3 to 8.0% by local characteristics and preferences. The average amount of hot pepper added to kimchi was found to be 2.24% from 37 cabbage kimchi related literatures, with frequency of use of 97.3%. Based on this, the effect of hot pepper (addition of 2.24%) on the sensory quality of kimchi fermented for 40 h at 20°C was investigated. This kimchi showed more bitter and hot tastes and brighter color than the salted cabbage fermented without addition of any sub-ingredients, but the overall taste was highly evaluated. In addition, the former showed higher values for grassy and unpleasant tastes than the latter. From these points of view, hot pepper is considered to be an effective sub-ingredient in producing a harmonized taste with various spices. It is also considered that the unpleasant taste is the result of an imbalance of taste caused by using hot pepper only. In spite of

the fact that hot pepper was reported to promote the fermentation of kimchi^{10, 12, 13, 18, 22, 41-43}; it did not show any significant increase in sour taste and did not affect sweet, salty, palatable and crispy tastes. Compared with the kimchi fermented with all sub-ingredients, on the other hand, the kimchi fermented with all sub-ingredients except hot pepper had stronger sour, grassy, unpleasant and garlic tastes. However, the hot taste, color and overall taste were considerably reduced. There were no significant differences in the sweet, salty, bitter and crispy tastes, or the acidic, grassy, fishy and moldy odors. Therefore, the results indicate that a single addition of hot pepper to the salted cabbage brings an undesirable sensory quality such as unpleasant taste. However, when used together with other sub-ingredients, the hot pepper enhanced the sensory quality of kimchi. The kimchi fermented without addition of hot pepper increased the sour and grassy tastes. This coincides with the previous result that hot pepper promotes the fermentation of kimchi.

The difference in the sensory quality between the salted cabbage fermented with and without hot pepper was due to an imbalance of taste caused by using a single sub-ingredient. The alternative reason is that the hot pepper was more contaminated with various microorganisms compared with the other sub-ingredients and these microorganisms promoted the fermentation of the kimchi by utilizing the nutrients in the various sub-ingredients. However, further studies are needed for this.

Ginger

Ginger contains unique components like citral and linalool, and hot taste components such as gingerone and shogaol. Ginger has a yellow-colored flesh and also contains substances to be easily browned. Therefore, it is thought that all of these would considerably affect the sensory quality of kimchi such as taste, flavor and color. However, little studies have been done on this subject.

In the present study, the kimchi fermented with addition of ginger only to the salted cabbage had stronger bitter, grassy and crispy tastes than the salted cabbage fermented without addition of ginger. This result supports the previous reports^{22, 23, 40} that ginger causes a delay in fermentation. It is recognized that ginger also reduces the unpleasant orders such as grassy, fishy and moldy odor. There

were no significant differences in the sour, sweet, salty, hot, palatable, unpleasant and overall tastes, acidic odor and color between the kimchi fermented with and without ginger. When the kimchi was fermented with all sub-ingredients except ginger, the sour and unpleasant tastes increased and the grassy taste decreased. This result coincides with the previous findings that ginger has an effect of reducing undesirable tastes of kimchi and of delaying its fermentation. As in the case of hot pepper, however, the bitter taste strongly appeared when ginger only was added, but was not reduced when the ginger was subtracted. This phenomenon may be the result of an imbalance in taste caused by adding all sub-ingredients. In other words, the reduction of the unpleasant taste by adding ginger only is probably due to a mixed effect of a variety of sub-ingredients. In both case, the spicy-hot taste and color of ginger did not significantly affect the sensory quality of kimchi.

Garlic

Garlic together with hot pepper is used most frequently as a sub-ingredient in kimchi. The unique flavor of ginger comes from the hot taste components allyl sulfide and allicin. Alliin present in the tissue of garlic is tasteless but changed to allicin by the enzyme allinase isolated when the tissue is destroyed. Allicin shows a strong sterilization power. Since in kimchi-making ground garlic is used, alliin is changed to allicin with an intensive taste. This allicin takes part in the desirable fermentation of kimchi by inhibiting the growth of various unnecessary microorganisms derived from sub-ingredients in the initial fermentation period. This can be seen from many reports superscript 1,^{10, 13, 22, 27, 36, 40} indicating that although allyl sulfides like allicin have 15 times as stronger germicidal power as carbonic acids, they promote the fermentation of kimchi. With fermentation of the kimchi, the intensive hot taste of garlic was slowly changed to the harmonized taste and flavor. The existence of various volatile components derived from garlic such as ethyl sulfide, dimethyl disulfide, trisulfide, dimethyl diallyl disulfide in the kimchi indicates the occurrence of mutual harmony of taste or flavor components. As shown with other sub-ingredients such as hot pepper and ginger, the effects of garlic on the sensory quality of kimchi were slightly

different between the kimchi fermented with garlic only and the one fermented with all sub-ingredients except garlic. When garlic only was added to the salted cabbage, the bitter, grassy and unpleasant tastes derived from the imbalance of sub-ingredients increased. However, garlic, like the ordinary spices, gave a palatable taste and reduced moldy odor. When garlic was not used, the kimchi showed stronger sour and unpleasant tastes and moldy odor than the kimchi fermented with all sub-ingredients, but the grassy and garlic odor decreased greatly. The increase in the sour taste of the kimchi fermented without hot pepper, ginger, garlic, and salted and fermented fish products (jeotgal) which is due to inhibitors in the sub-ingredients which prevent the fermentation of kimchi as well as various effects such as the buffering action of sub-ingredients. In the case of sub-ingredients like hot pepper and garlic, which were proved scientifically to promote the fermentation, the inside fermentation was promoted but it was shown as a comparison effect of sour taste caused by which have no unique taste or flavor from sub-ingredients.

Green onion and leek

Green onion and leek together with garlic are perennial roots belonging to Liliaceae. They contain various allyl sulfides (which were also contained in garlic), carotenes and vitamin C. They have the green color of chlorophyll, show blue and red colors and produce a harmonized taste when added to the kimchi with hot pepper. The frequency of use in the general cabbage kimchi was 72.8% for green onion and 32.4% for leek, which both are much lower compared with that of 97.3% for hot pepper and 100% for garlic. However, in the literature dealing with green onion and leek as sub-ingredients, the amounts used were comparatively high, i.e., 0.6-0.9% for green onion and 2.0-6.0% for leek. The kimchi fermented with the respective green onion and leek had stronger unpleasant, sour, bitter and grassy tastes and acidic odor than the fermented salted cabbage. This phenomenon was more severe for leek and the moldy odor was strong. However, the kimchi fermented without green onion and leek showed stronger sour taste and garlic odor respectively than the one fermented with all sub-ingredients. In case of green onion, bitter taste and acidic odor were

higher. Also, when kimchi was fermented after subtracting either garlic, green onion or leek, there were no significant effects on the overall taste. However, when garlic, green onion or leek were subtracted, the garlic odor was greatly reduced and the overall taste was also reduced. Therefore, these green onions are considered to maintain a mutual additive relation and particularly green onion and leek showed an effect of harmonizing the garlic odor. Thus, even though one or two sub-ingredients are used in kimchi-making, similar sensory quality can be maintained. However, the nutritional balance should be considered here.

Salted and fermented anchovy

Various salted and fermented fish products (jeotgal) including salted and fermented anchovy contain sufficient proteins and amino acids, and have their own unique taste and flavor. Therefore, these sub-ingredients would affect not only the nutritional balance but also the improvement of the sensory quality of kimchi. When salted and fermented anchovy juice only was added to the salted cabbage, the fermented kimchi had a stronger unpleasant taste and fishy odor than the fermented salted cabbage without their addition. The former had stronger salty and grassy tastes, but the overall taste was better than the latter. When the salted and fermented anchovy juice only was subtracted, the sour taste increased and the hot and palatable tastes decreased. The decrease in hot taste may be due to a comparison effect between salty and hot tastes. The palatable taste, which was not shown when the salted and fermented anchovy juice only was added to the salted cabbage, was detected when all sub-ingredients were added.

Sugar

Frequency of use of sugar in kimchi-making was 27% with a concentration of 0.4-3.0% and sugar was used for sweet and harmonized tastes. However, since sugar is utilized as a nutrient by various microorganisms present in kimchi, it is expected to affect the kimchi fermentation and sensory quality. When sugar only was added to the salted cabbage, the kimchi had stronger sweet, bitter, palatable, grassy, unpleasant and crispy tastes, acidic and grassy odors, and overall taste than when the salted cabbage only was fermented.

Thus, sugar had the most variety of effects as a single sub-ingredient. By adding sugar, unpleasant taste like as grassy and fishy odors were also perceived. This was because a low concentration of sugar did not play a role as a refresh sweetener. On the other hand, when kimchi was fermented without sugar, the grassy and crispy tastes were emphasized. Thus, it is considered that sugar promotes the fermentation of kimchi and contributes greatly to harmony of tastes by reducing the hot and overall tastes, and acidic and garlic odors.

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배추김치의 관능적 품질에 미치는 부재료의 영향

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요 약

배추김치의 부재료로서 고추, 마늘, 생강, 파, 부추, 멸치젓, 설탕 등이 starter 로 숙성시킨 김치의 산 맛, 단맛, 쓴맛, 매운맛, 감칠맛, 덜 익은 맛, 불쾌한 맛, 사각사각한 맛, 종합적인 맛, 새콤한 내, 풋내, 비린내, 마늘내, 군덕내, 색상 등 관능적 품질에 미치는 영향을 조사하였다. 그 결과 부재료 개별적으로는 균형된 조화미가 나타나지 않았으나 상호혼합처리함으로써 맛의 상호보완이 되었다. 파와 부추는 강한 마늘내를 조화시켰으며 멸치젓은 감칠맛을 부여하였고 설탕은 종합적인 맛을 향상시켰다. 또 설탕을 제외한 고추, 생강, 마늘, 파, 멸치젓 등은 다같이 산미를 감소시키는 효과를 나타내었다.