

## Evaluation of Sensory on *Gochujang* with *Zanthoxylum piperitum* and *Chrysanthemum indicum* Essential Oils

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**ABSTRACT** *Gochujang* samples with essential oils were evaluated for sensory including taste and, smell during various storage periods with the aim of developing improved high value-added products. The sensory testing was performed on *Gochujang* with 0.005% *Zanthoxylum piperitum* and *Chrysanthemum indicum* essential oils, extracted through steam distillation. During storage at 4 and 20°C for 8 weeks, sensory testing was performed at 0, 1, 2, 4 and 8 weeks by trained panelists. Overall quality decreased in *Gochujang* samples containing *Z.piperitum* essential oil and increased in samples containing *C.indicum* essential oil, at 4 and 20°C. Samples stored at 4°C were quality more than those stored at 20°C. Sensory evaluation was highest for *Gochujang* with *C.indicum* essential oil stored at 4°C. It is concluded that functional *Gochujang* can be developed by adding small quantities of essential oils. Increasing the amount of essential oil added is likely to affect the innate taste and flavor of *Gochujang*.

**KEYWORDS:** Sensory evaluation, *Zanthoxylum piperitum*, *Chrysanthemum indicum*, *Gochujang*, Essential oil

### INTRODUCTION

Along with *Doenjang* (bean paste) and *Ganjang* (soy sauce), *Gochujang* (red pepper paste) has long been a favorite and important fermented condiment used for cooking among Koreans. (Cho et al 1981; Park et al 2007). To broaden the global commercial appeal of various *Gochujang* products, research is needed to make the taste more widely acceptable, increase the functional uses of the products, and to improve the stability and quality of the products during the increased transport distances (Choo and Shin 2000). Furthermore, consumers now consider not only taste, color and flavor of a food but also its functional aspects (Ham et al 2008). To meet these consumer expectations and increase the value-added properties of *Gochujang*, a number of studies have attempted to improve the flavor, quality and functional aspect of *Gochujang* by adding red ginseng, various plant extracts, medicinal herbs, apple, persimmon and Maesil (Jeong et al 2000; Park et al 2005; Park et al 2007; Shin et al 1999; Young and Choi 2005).

*C. indicum* is a perennial herb belonging to the Asteraceae

family (Yuk 1990). It has been used widely as a perfume, medicine, in wine, and as a food ingredient. The extracted oil from this plant has long been a valued aromatic ingredient in tea (Park 2004). Essential oil may also have anti-bacterial, anti-viral and anti-oxidant activities (Hwang et al 2007; Ren et al 1999; Woo et al 2008).

*Z. piperitum* is a broadleaf shrub that grows in Northeast Asia including Korea, Japan and China and which belongs to the *Rutaceae* family (Chung et al 1999). *Z. piperitum* bark, roots and fruit pericarp impart a hot taste and contain an essential oil, fats and fatty oil. The plant has been extensively used for a long time in Northeast Asia as a herb and medicine. Historically ancient Korean texts including *Yorok*, *Unshikjimibang*, *Jubangmoon*, and *Sanrimkyungje* contain descriptions of the use of *Z. piperitum* in *Kimchi* prior to the introduction of red pepper to Korea and the use of *Z.piperitum* to make *Gochujang* (Kim et al 2001). It also has potential in the development of natural preservatives because of its excellent anti-bacterial property (Chung et al 1999).

Essential oils have been used widely in Asia and the Western world as perfumes and food additives. In recent years, research on essential oils has included developing food additives and uses in aromatherapy (Jang 2002). However, the potential of essential oils in the functional improvement of *Gochujang* products has not been explored. The present study examined the influence of added essential oils of *Z. piperitum* and *C. indicum* on *Gochujang* on

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sensory qualities under varied conditions of storage.

## MATERIALS AND METHODS

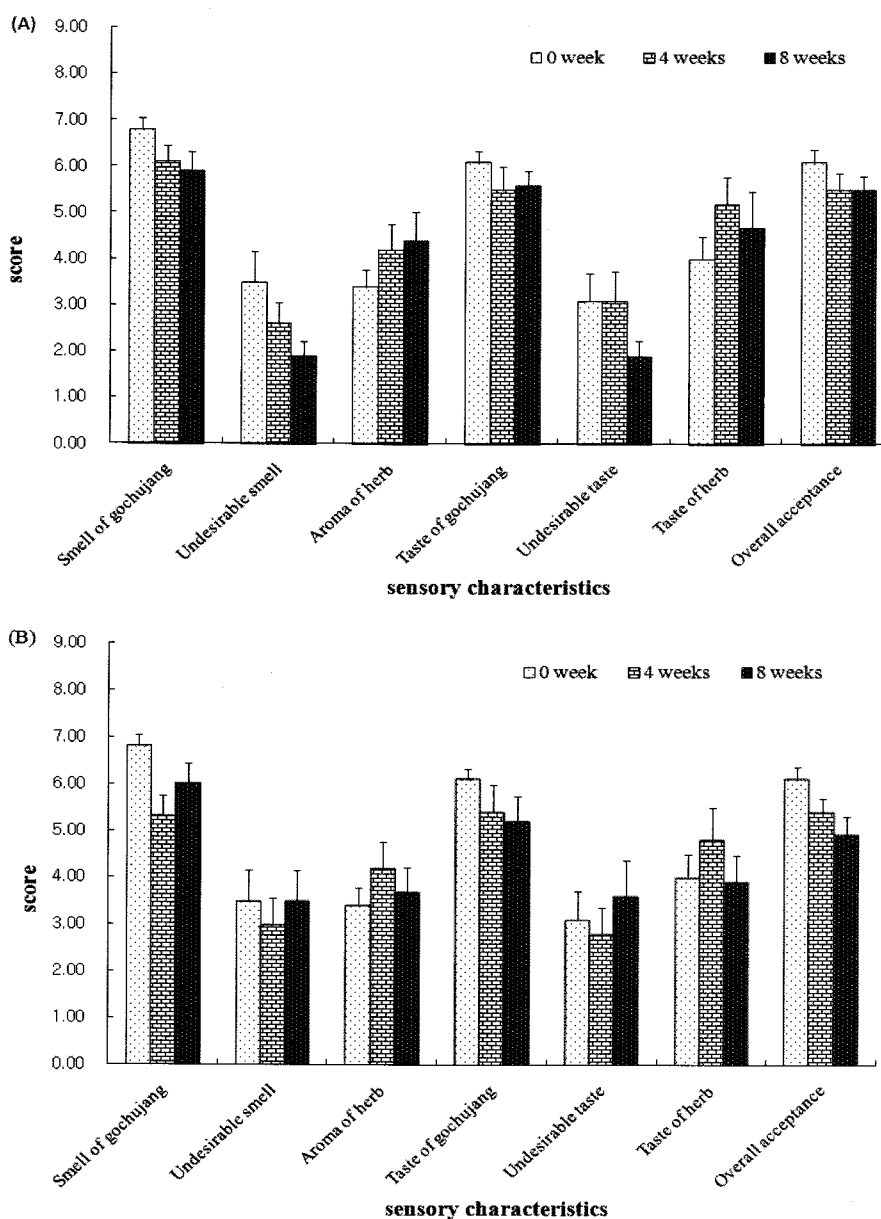
### Materials

*Gochujang* fermented for 6 months after its preparation at the Solmye agricultural cooperative was purchased from a market (Banghak-Dong, Seoul). Its ingredients were sweet rice powder (36%, organic, Korea), red pepper powder (22%, organic, Korea), salt (Korea), malt (Korea), rice malt syrup (organic, rice produced in Korea), and fermented soybean powder (organic, Korea). For the extraction of essential oils as described below, *C.indicum* and *Z.piperitum*

gathered and dried in October 2008 in the Inje region of Gangwon Province and in September 2008 in Sanchung, South Gyungsang Province, respectively, were used.

### Extraction of essential oils

Essential oils were extracted using steam distillation. After 1 kg of sample was grounded in a blender, the powder was placed in a net. The net was then placed in 4-5 L of distilled water from which volatile components had been removed. Steam distillation was done for 2 h by connecting a tube cooled by a continuous flow of 4°C water. After collecting the essential oil layer in the extraction tube, anhydrous sodium sulfate was added to the solution to



**Fig. 1.** Change in sensory score of *Gochujang* with *Z.piperitum* essential oil during storage at 4°C (A) and 20°C (B). The data represent means±SEM.

completely remove water and obtain pure essential oil.

**Addition of essential oil into *Gochujang***

The essential oils of *Z.piperitum* and *C.indicum* essential oil was individually added to *Gochujang* samples to a final concentration of at 0.005%. The resulting samples were placed into glass jars and stored at 4 and 20°C for 8 weeks.

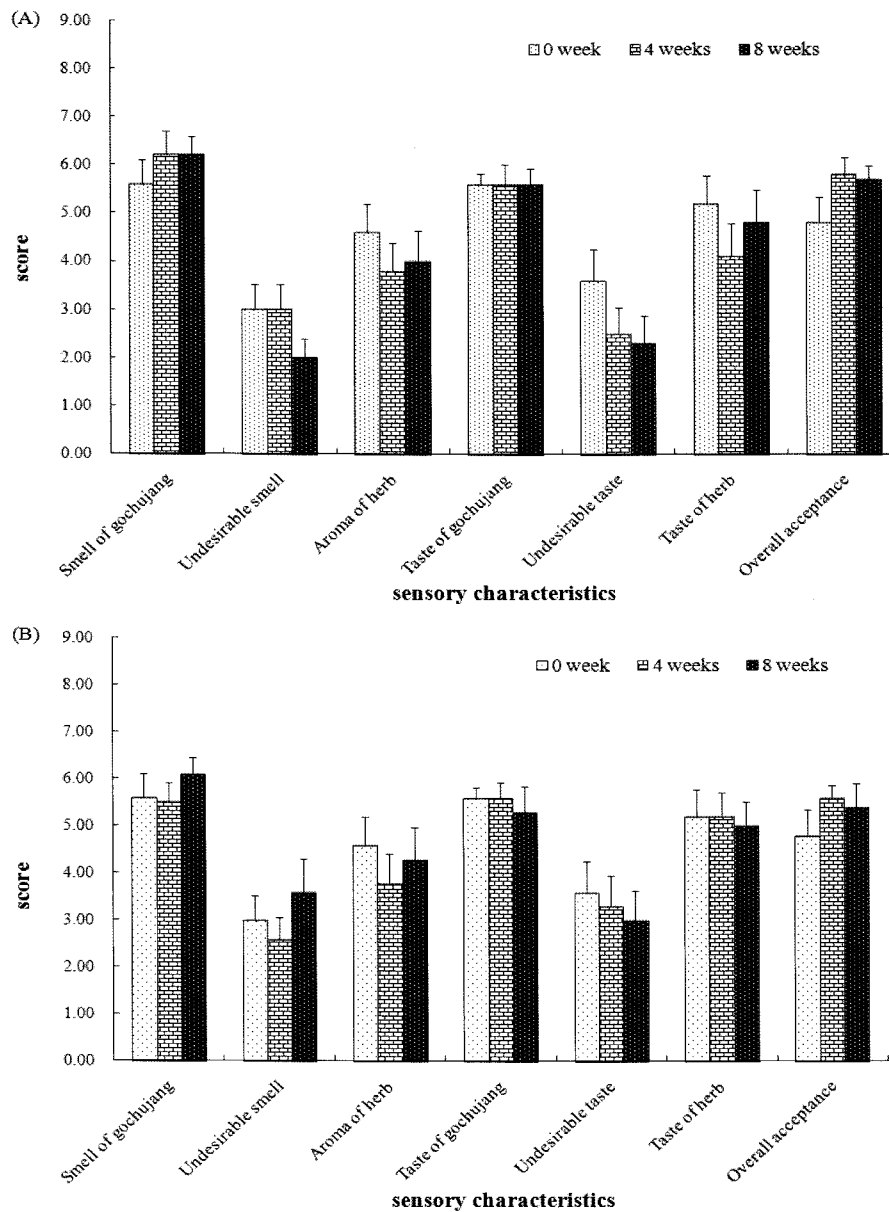
**Sensory evaluation**

A sensory test was done by 10 trained panelists in which 1 g of the *Gochujang* sample was given to each panelist. *Gochujang* samples with *Z.piperitum* and *C.indicum*

essential oils and stored at 4 and 20°C were taken at 0, 1, 2, 4, and 8 week for this sensory test. The panelists evaluated the taste, smell and overall quality. Sensory characteristics were scored on a scale of 1 (very weak) to 9 (very strong).

**Statistical analysis**

The results from the sensory evaluation were analyzed with ANOVA using SPSS 17.0 (Statistical Package for the Social Sciences, spss Inc., Chicago, IL, USA). Significant differences among the samples were evaluated using Duncan’s multiple range test.



**Fig. 2.** Change in sensory score of *Gochujang* with *C.indicum* essential oil during storage at 4°C (A) and 20°C (B). The data represent means±SEM.

## RESULTS AND DISCUSSION

### Effect of storage period on sensory evaluation for *Gochujang* with *Z.piperitum* essential oil

Fig. 1 shows the results of sensory test done on *Gochujang* with *Z.piperitum* essential oil and during storage at 4 and 20°C for 8 weeks. Samples stored at 4°C produced a less undesirable smell but more herbal aroma from the essential oil itself. On the other hand, samples stored at 20°C produced less undesirable smell, although the objectionable smell increased with time; however, the aroma from the essential oil decreased from very pungent to weak during the storage. The results suggest that the aroma from the essential oil affected the innate smell and undesirable smell from *Gochujang*. The undesirable smell decreased significantly in samples stored at 4°C compared with samples stored at 20°C. On the other hand, the innate taste of *Gochujang* diminished in the samples stored at both temperatures, but was less evident in samples stored at 4°C. The taste imparted by the essential oil was stronger in the beginning but decreased with time; this effect was more pronounced during storage at 20°C. Overall, preferences decreased with time, especially in samples stored at 20°C, probably because increased undesirable taste but marginal or no change in undesirable smell affected overall quality.

### Effect of storage period on sensory evaluation for *Gochujang* with *C.indicum* essential oil

Figure 2 shows the results of sensory evaluation done on *Gochujang* with *C.indicum* essential oil and during storage at 4 and 20°C for 8 weeks. The innate *Gochujang* smell tended to increase at both temperatures. Undesirable smell decreased at 4°C but tended to increase at 20°C. The aroma from the essential oil was weaker in the beginning but became stronger during storage at both temperatures. However, no significant difference was discerned in the taste of *Gochujang* stored at both temperatures. Undesirable taste was decreased significantly at 4°C compared to 20°C. The

taste of the essential oil was weaker in the beginning but became stronger with time for samples stored at 4°C but no significant change was evident in samples stored at 20°C. Overall, preferences were increased significantly in samples stored at both temperatures but decreased somewhat at 8 weeks of storage. The overall increase in preferences was probably because of an increased innate smell of *Gochujang* and no change in the inherent taste combined with decreased undesirable taste.

### Sensory evaluation on *Gochujang* samples with *Z.piperitum* and *C.indicum* essential oils at 8 weeks of storage

Tables 1 and 2 show the results of sensory evaluation done on *Gochujang* samples with *Z.piperitum* and *C.indicum* essential oils and fermented for 8 weeks at 4 and 20°C. No significant differences were evident. The herbal aroma and taste from *Gochujang* became stronger with the addition of these essential oils; however, the innate smell and taste of *Gochujang* itself significantly decreased as compared with control samples. Overall quality for essential oil added *Gochujang* were significantly lower than the control and no significant difference was seen in undesirable smell and salty taste.

In conclusion, overall quality were higher in the samples stored at 4°C compared to 20°C. Although no significant difference was observed in overall quality by 8 weeks of storage between the two *Gochujang* samples with both essential oils, it would probably better to add *C. indicum* essential oil rather than *Z. piperitum* essential oil to *Gochujang* that is to be stored for a longer period of time. A previous study reported that higher concentrations of pumpkin added to *Gochujang* resulted in decreased preferences and that the aroma and taste were better with the addition of 1% pumpkin compared with the control but no significant difference with the addition of 2 and 5% pumpkin (Choo and Shin 2000). Consistent with this prior data, the presently observed decreased sensory preference of

**Table 1.** Sensory evaluation of *Gochujang* with *Z. piperitum* essential oil and *C. indicum* essential oil during storage at 4°C for 8 weeks

<i>Gochujang</i> <sup>1)</sup>	Color	Smell				Taste			Texture	Overall quality
		Smell of <i>Gochujang</i>	Undesirable smell	Aroma of herb	Salty taste	Taste of <i>Gochujang</i>	Undesirable taste	Taste of herb		
Control	6.40± 1.08 <sup>2)a3)</sup>	7.20± 1.14 <sup>b</sup>	2.20± 1.55 <sup>a</sup>	2.00± 1.33 <sup>a</sup>	6.60± 1.27 <sup>a</sup>	7.10± 1.29 <sup>b</sup>	1.90± 1.37 <sup>a</sup>	1.90± 1.37 <sup>a</sup>	5.90± 0.99 <sup>a</sup>	6.80± 0.92 <sup>b</sup>
C	5.90± 0.99 <sup>a</sup>	5.90± 1.29 <sup>a</sup>	1.90± 0.99 <sup>a</sup>	4.40± 2.01 <sup>b</sup>	6.20± 1.14 <sup>a</sup>	5.60± 0.97 <sup>a</sup>	1.90± 1.10 <sup>a</sup>	4.70± 2.41 <sup>b</sup>	5.60± 0.97 <sup>a</sup>	5.50± 0.97 <sup>a</sup>
K	5.90± 0.99 <sup>a</sup>	6.20± 1.23 <sup>ab</sup>	2.00± 1.25 <sup>a</sup>	4.00± 2.00 <sup>b</sup>	6.10± 0.99 <sup>a</sup>	5.60± 1.08 <sup>a</sup>	2.30± 1.83 <sup>a</sup>	4.80± 2.20 <sup>b</sup>	5.60± 0.97 <sup>a</sup>	5.70± 0.95 <sup>a</sup>

<sup>1)</sup>C:*Gochujang* with *Z.piperitum* essential oil, K:*Gochujang* with *C.indicum* essential oil

<sup>2)</sup>Mean±standard deviation

<sup>3)</sup>Means with same letters in column are not significantly different at the level of significance ( $p < 0.05$ ) as determined by Duncan's multiple range test.

**Table 2.** Sensory evaluation of *Gochujang* with *Z. piperitum* essential oil and *C. indicum* essential oil during storage at 20°C for 8 weeks

<i>Gochujang</i> <sup>1)</sup>	Color	Smell				Taste			Texture	Overall quality
		Smell of <i>Gochujang</i>	Undesirable smell	Aroma of herb	Salty taste	Taste of <i>Gochujang</i>	Undesirable taste	Taste of herb		
Control	6.60± 0.97 <sup>2)3)</sup>	6.60± 1.43 <sup>a</sup>	2.70± 1.77 <sup>a</sup>	2.20± 1.48 <sup>a</sup>	6.90± 0.99 <sup>a</sup>	7.40± 1.51 <sup>b</sup>	2.50± 1.58 <sup>a</sup>	2.00± 1.16 <sup>a</sup>	6.10± 1.20 <sup>a</sup>	6.90± 1.20 <sup>a</sup>
C	5.40± 1.27 <sup>a</sup>	6.00± 1.41 <sup>a</sup>	3.50± 2.07 <sup>a</sup>	3.70± 1.64 <sup>ab</sup>	6.40± 1.43 <sup>a</sup>	5.20± 1.69 <sup>a</sup>	3.60± 2.41 <sup>a</sup>	3.90± 1.79 <sup>b</sup>	5.50± 1.35 <sup>a</sup>	4.90± 1.29 <sup>b</sup>
K	6.00± 1.05 <sup>ab</sup>	6.10± 1.10 <sup>a</sup>	3.60± 2.22 <sup>a</sup>	4.30± 2.16 <sup>b</sup>	6.20± 1.23 <sup>a</sup>	5.30± 1.70 <sup>a</sup>	3.00± 2.00 <sup>a</sup>	5.00± 1.63 <sup>b</sup>	5.80± 1.40 <sup>a</sup>	5.40± 1.58 <sup>b</sup>

<sup>1)</sup>C:*Gochujang* with *Z.piperitum* essential oil, K:*Gochujang* with *C.indicum* essential oil

<sup>2)</sup>Mean±standard deviation

<sup>3)</sup>Means with same letters in column are not significantly different at the level of significance ( $p<0.05$ ) as determined by Duncan's multiple range test.

*Gochujang* with *Z. piperitum* and *C.indicum* essential oils in this study was probably because of the high concentrations of oils added. As a result, the innate smell and taste of *Gochujang* became weaker. It is expected that overall quality will increase by decreasing the concentrations of essential oils added into *Gochujang*.

## ACKNOWLEDGMENTS

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