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Capability Analysis of Sensory Quality of *Jajang* Sauce

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Abstract Sensory quality variations of *jajang* sauce were monitored by the $\overline{X}$-chart and capability analysis based on specifications of each sensory attributes. For sensory quality control (QC) of the sauce which has a strong sweetness and sourness, the ratio of sourness/sweetness was examined as a necessary QC factor to maintain the balance of sweetness and sourness. For the sensory QC factors, all the sensory data were divided into individual sensory score of reference which was a pack of sauce manufactured a week ago. The ratio form of sensory data was useful for decreasing individual variations and for increasing normality of data measured by category scale. The overall proportion of out-spec products under normal manufacturing conditions was obtained by capability analysis of sensory data with normal distribution. Out-spec samples were monitored by the $\overline{X}$-chart of each sensory attributes.

Key words: sensory quality control, capability analysis, suppression, *jajang* sauce, $\overline{X}$-chart

Introduction

Maintaining the optimum sensory quality of a product which has mixed flavors has required balances among flavors. Flavor balance has been measured as amplitude by flavor profile analysis (1,2), which is one of descriptive analyses with trained panelists. In consumer tests, overall liking or overall acceptance might also imply the meaning of balance among flavors. Especially sweet-sour balance has been a critical factor for product optimization in beverages, and it has been reported that the sweet-sour balance was related to the suppression between sweetness and sourness although the impact amount has depended on the sweet and sour components (3-8). In sauces and dressings which have strong sourness and sweetness, the suppression between sweetness and sourness has also closely connected with the balance between sweetness and sourness of each component. In this study, we examined the advantages of the balance specification of sourness/sweetness ratio comparing to those of independent singular attributes, sweetness and sourness of *jajang* sauce. *Jajang* sauce is made of fried *chunjang* (one of soybean pastes utilized for cooking Korean Chinese dishes), diced meat and vegetables. *Jajang* sauce is usually consumed as a dish including noodles called *jajangmyeon*. The *jajangmyeon* is a very popular Korean Chinese dish, and several manufacturers have produced *jajangmyeon* as home meal replacement (HMR) products.

One of the purposes of sensory quality control is to determine whether product variations are in specification limits. It was reported that capability analysis of normal distribution data provides expected proportion of out-spec products as well as several forms of capability statistics (9). Munoz *et al*. (10) have shown that $\overline{X}$-chart provides a guide for classification of common cause variations and special cause variations. Unlike common cause variation, special cause variation is caused by known factors that result in a non-random distribution of output. In this study, we applied the capability analysis and the $\overline{X}$-chart for analyzing the overall proportion of out-spec products under normal manufacturing conditions and for monitoring the specific samples beyond the specification limits.

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Materials and Methods

Sensory evaluation The *jajang* sauce samples of HMR product named *jajangmyeon* were manufactured by Pulmuone Co., Ltd. A pack of *jajang* sauce was taken as a sample at every batch of sterilization. Sauce samples were boiled in water as packaged and distributed 30 g/panelist. Sweetness, sourness, and saltiness of the sauce were measured by 9-point intensity scale. There were 13 sessions for sauce evaluation and a blind reference was also presented at every session. The reference sample was a pack of *jajang* sauce produced a week ago at the same manufacturing line. The *jajang* sauce has the shelf-life of 2 months. In every session, presented samples were 5 to 6 packs including the reference. Total number of sauce samples through 13 sessions was 68.

Capability analysis Individual sensory data was divided into sensory data of the reference sample. Normality of data was confirmed by Anderson-Darling test (Fig. 1). Capability analysis was performed with Minitab version 14. In order to estimate the overall proportion of out-spec products in normal manufacturing conditions, the upper and the lower specification limits of each sensory quality control (QC) factor were required for statistical calculation. The specification limits which we used for the estimation is shown in Table 1.

Results and Discussion

$\overline{X}$-Charts of sensory QC factors The $\overline{X}$-charts of sourness, sweetness, and sourness/sweetness ratio were plotted by

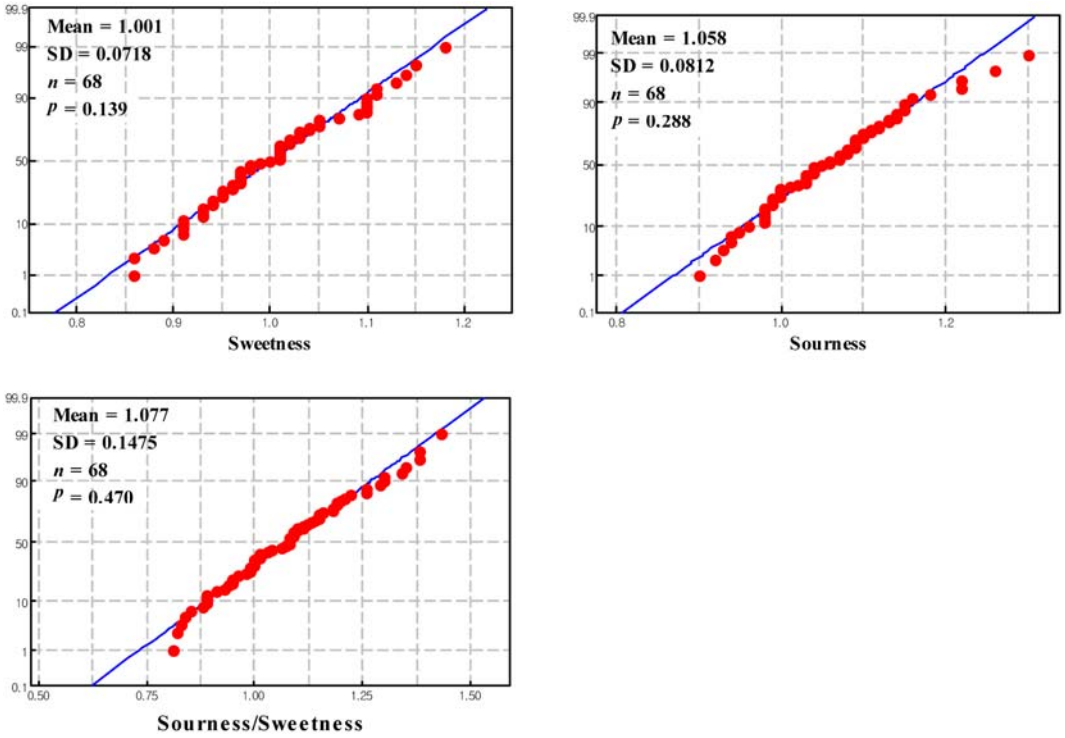

Fig. 1. Normal probability plots of sweetness, sourness, and ratio of sourness/sweetness.

Table 1. Specification limits for sensory quality control factors

Sensory attributes	Specification Limits	
	Upper limit	Lower limit
Sweetness Sourness Saltiness	1.2	0.8
Sour/Sweet Salty/Sweet	1.3	0.7

Minitab (Fig. 2). There were 4 out-spec samples in sourness and 0 in sweetness. However, the $\overline{X}$-charts of sourness/sweetness ratio (Fig. 2C) showed 7 out-spec samples although specification limit of the sourness/sweetness ratio was 20% broader (0.7 to 1.3) than those of sourness and of sweetness (0.8 to 1.2). The main issue was to determine whether the 4 samples beyond the ratio specification limits, 10, 57, 58, and 68, should be in-spec or out-spec (Fig. 2). Sourness of these 4 samples was relatively higher than that of the reference but these were still in the specification limit of sourness. Sweetness of these 4 samples was relatively lower than that of the reference but these were still in the specification limit of sweetness. Specification of balance between sourness and sweetness might be more effective when it was described as sourness/sweet ratio instead of being specified as 2 independent attributes. Sauce could be perceived by consumers as too sour even with a little bit higher sourness if it was accompanied by a little bit lower sweetness. The importance of the sweet-sour mixture suppression has been studied in beverages (3-8), but there were few studies on the mixture suppression in sauces.

Among 2 years of voice of customer (VOC) of the *jajang* sauce of Pulmuone, the highest amount of VOC was strong sourness. The increasing sourness could be due to several variations in manufacturing process or in the amount of ingredients. In sensory respects, the variations in sourness of the sauce could be detected or understood as an unbalance between sourness and sweetness. For example, sourness could be perceived much higher than optimum level when sweetness was perceived lower than expected. The sourness-sweetness suppression provided explanations of the difference in the out-spec samples from the $\overline{X}$-chart of sourness/sweetness ratio and in those from the $\overline{X}$-chart of sourness.

Capability analysis of sensory attributes In order to estimate proportion of out-spec products under normal manufacturing process, we specified upper limit as 1.2 and lower limit as 0.8 for single attributes, sweetness, sourness, and saltiness. In the case of sensory balance ratio, such as sourness/sweetness ratio, the upper limit was 1.3 and the lower limit was 0.7. Table 2 shows the proportions of out-spec products described in %. Sourness/sweetness balance ratio showed higher proportion of out-spec products than that of single attribute, sourness.

Monitoring proportions of out-spec sensory attributes provides critical quality factors of certain product. Undoubtedly, understanding of causes for out-spec products is important to minimize out spec products. In general a food company has lots of manufacturing lines which produce similar or same products. Production yield is obviously important for analyzing the manufacturing capacity of individual production line, but sensory quality capability should be

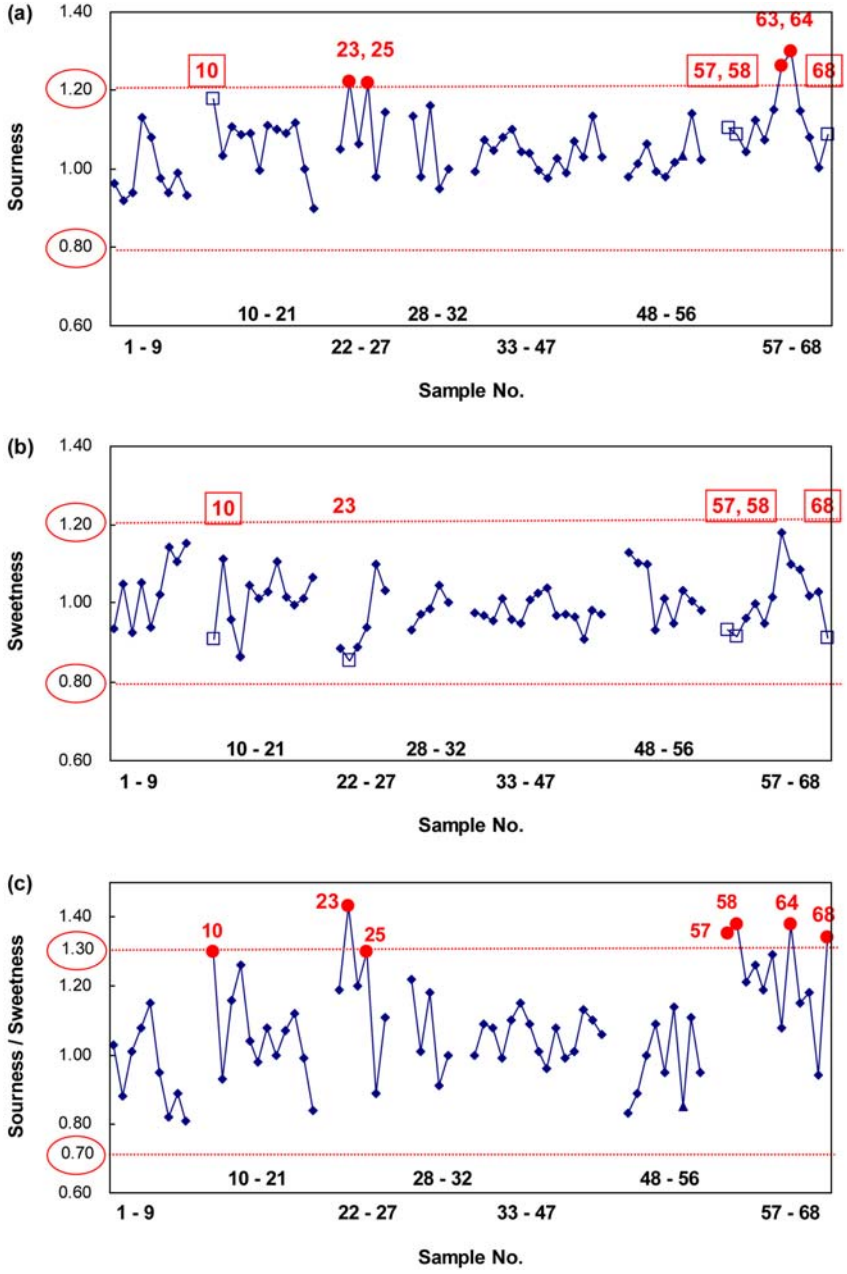

Fig. 2. $\overline{X}$-charts: (a) sourness, (b) sweetness, and (c) sourness/sweetness.

Table 2. Proportions of out-spec products

Sensory attribute	Out-spec product (%)
Sweetness	0.6
Sourness	4.1
Saltiness	0.5
Sour/Sweet	7.1
Salty/Sweet	2.2

also noticed and analyzed as a preliminary inspection to determine if a specific manufacturing line is appropriate to maintain sensory quality of a product. A production line which has poor capability for certain product's sensory quality may have excellent capability for other products.

As the demand of home meal replacement (HMR) products increases, sensory quality control becomes more complicated in testing attributes, testing method, etc. Individual product has a sensory specification and the sensory specification has been described as certain ranges of 9-point scale, 15-point scale, 15-cm line scale etc. Transformation of individual sensory score to a ratio by dividing into reference score has an advantage of decreasing individual differences and minimizing training period. The sensory ratio divided into individual references can be utilized to compare capabilities of maintaining sensory qualities among different categories of products. The specification of each sensory QC factor can be described by a sensory ratio range, [0.7-1.3] or a percentage range, [70-130%]. The proportion or percentage of out-spec

products obtained by capability analyses may have values for following purposes;

- Comparison of capability for maintaining optimum sensory quality among different products through the same manufacturing process.
- Comparison of capability for maintaining optimum sensory quality among different production periods of the same products through the same manufacturing process.
- Comparison of capability for maintaining optimum sensory quality among different products through different manufacturing process.

References

1. Keane P. The flavor profile. pp. 5-14. In: Manual on Descriptive Analysis Testing. Hootman RC (ed). American Society for Testing and Materials, Philadelphia, PA, USA (1992)
2. Lawless HT, Heymann H. Descriptive analysis. pp. 341-378. In: Sensory Evaluation of Food. Lawless HT, Heymann H (eds). Chapman & Hall, New York, NY, USA (1998)
3. Bonnans S, Noble AC. Effect of sweetener and acid levels on temporal perception of sweetness, sourness, and fruitiness. Chem. Senses 18: 273-283 (1993)
4. Martin N. Sweet/sour balance in champagne wine and dependence on taste/odour interactions. Food Qual. Prefer. 13: 295-305 (2002)
5. McBride RL, Johnson RL. Perception of sugar-acid mixtures in lemon juice drink. Int. J. Food Sci. Tech. 22: 399-408 (1987)
6. Pelletier CA, Lawless HT, Horne J. Sweet-sour mixture suppression in older and young adults. Food Qual. Prefer. 15: 105-116 (2004)
7. Schifferstein HNJ, Frijters JER. Sensory integration in citric acid/sucrose mixtures. Chem. Senses 15: 87-109 (1990)
8. Stampanoni CR. Influence of acid and sugar content on sweetness, sourness, and flavor profile of beverages and sherbets. Food Qual. Prefer. 4: 169-176 (1993)
9. Minitab User's Guide 2. Data Analysis and Quality Control. Minitab Inc., State College, PA, USA (2000)
10. Munoz AM, Civille GV, Carr BT. Statistical quality control. pp. 220-226. In: Sensory Evaluation in Quality Control. Munoz AM, Civille GV, Carr BT (eds). Van Nostrand Reinhold, New York, NY, USA (1992)