Spicy Taste Rating of Chili Pepper and Kimchi

Seongweon Jeong
Food Standard Research Center
Korea Food Research Institute
donow@kfri.re.kr

Jongchan Kim & Yusin Sim
Food Standard Research Center
Korea Food Research Institute
jckim@kfri.re.kr, ysshim@kfri.re.kr

***Abstract*—In order to introduce spicy taste ratings of Chili pepper(powdered) and Kimchi, many kinds of products in circulation were selected as specimens and the correlation of the sensory taste results and capsaicinoids contents were analyzed. When compared the spicy taste levels(capsaicinoids) of specimens with their sensory test results, they were found that capsaicinoids content(capsaicin and dihydrocapsaicin) and sensory test results had a high correlation (R^2) at more than 0.9 in HPLC analyzing method.**

Categorizing the pungency of the Chili pepper(powdered) into five levels best reflected the status of Chili pepper products on the market(mild hot, slight hot, medium hot, very hot, extreme hot), while the Kimchi into three levels reflected the status of Kimchi products on the market(mild hot, medium hot, very hot). capsaicinoids contents of five levels in Chili pepper(powdered) were less than 150 mg/kg, 150~300 mg/kg, 300~500 mg/kg, 500~1,000 mg/kg and more than 1,000 mg/kg. capsaicinoids contents of three levels in Kimchi were less than 4 mg/kg, 4~12 mg/kg, and more than 12 mg/kg.

***Index Terms*: spicy taste, Chili pepper (powdered), Kimchi, sensory taste, capsaicinoids (key words)**

I. INTRODUCTION

Korea, which is a country with high consumption of spicy chili peppers, naturally recognizes the importance of attempts to rate the spicy taste levels of food. Especially, Chili pepper(powdered) and *Kimchi* circulating worldwide is the representative Korean foods featuring spicy taste. To make spicy taste ratings, many kinds of Chili pepper and *Kimchi* products in circulation were tested and the correlation of the sensory taste results and capsaicinoid contents were analyzed.

II. MATERIAL AND METHODS

A. Sensory Test

Consumer panel: 80 general consumers made evaluations (9 point category scale) and carried out the analysis of variance and ANOVA tests using SPSS.

Expert Panel: Of the 25 person panel, 20 experts who passed training carried out tests using the ASTM E1871-06 method(15 line scale). The results conducted correlation with results analyzed using SPSS and sensory test results, and the analysis of variance and ANOVA tests were carried out.

B. Awareness Investigation

Valid consumer samples were carried out for 300 people and the collected data were statistically processed using SPSS.

C. High Performance Liquid Chromatography

HPLC System.—HPLC apparatus including the following: an eluent reservoir; Model 980 pump (JASCO Co. Ltd, Tokyo, Japan).

HPLC Analytical Column.—Mightysil RP18GP (particle size 5 µm, 4.6 mm id, length 150 mm; Kanto Chemical Co. Chuoku, Japan).

HPLC Detector.—Fluorescence detector, Model FP 920 (JASCO Co. Ltd), excitation wavelength 280 nm, emission wavelength 325 nm.

HPLC mobile phase.—acetonitrile–1% acetic acid in water (6 + 4, v/v).

D. Reagents and Sample Preparation

Capsaicin(>99%, C18H27NO3, FW 305.42, CAS No.404-86 - 4) stock solution, squalene(CAS No. 111-02-4, Sigma) internal standard solution, hexane, methanol, methanol–water(80 + 20, v/v), 95% ethanol, DCM, saturated sodium, chloride, and anhydrous sodium sulfate.

HPLC.—Weigh approximately 2g Chili pepper(powdered) into 100 mL or 10g *Kimchi* into a 250 mL boiling flask. Add 40mL or 100 mL ethanol and several glass beads, and attach the flask to a reflux condenser. Gently reflux the solution for 5 h and allow to cool. Filter 1–4 mL solution through a 0.45µm syringe filter into a small glass vial and use it for HPLC analysis. Calibration graphs for HPLC were based on peak area and were prepared by injecting 20 µL of the 5, 25, 50, and 100 µg/mL solutions prepared by dilution of capsaicin stock solutions with 95% ethanol.

III. RESULTS AND DISCUSSION

Based on the most representative Chili pepper(powdered) and *Kimchi* products most widely circulated and distributed in Korea, categorizing the spicy taste of Chili pepper(powdered) into five levels of capsaicinoids content(less than 50~150 mg/kg, 150~300 mg/kg, 300~500 mg/kg, 500~1,000 mg/kg and more than 1,000 mg/kg) best reflected the status of Chili pepper products(powdered) on the market(TABLE Ⅰ), while the *Kimchi* into three levels(less than 4 mg/kg, 4~12 mg/kg, and more than 12 mg/kg) reflected the status of *Kimchi* products on the market. (TABLE Ⅱ) As the *Kimchi* specimens are not homogeneous, the tolerance must be taken with range of less than 4.4 mg/kg, 3.6~12.6 mg/kg, and more than 11.4 mg/kg. (TABLE Ⅱ)

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Table I: Comparison Between Spicy Units For The Five Spic Levels Of Chili Pepper(Powdered)

Name of Level	ppm (mg/kg)	Median/Scale (mg/kg)	percentage (%) on the market
Mild Hot (level 1)	50~150	100/100	12.0
Slight Hot (level 2)	150~300	225/150	35.5
Medium Hot (level 3)	300~500	400/200	33.5
Very Hot (level 4)	500~1,000	750/500	17.0
Extreme Hot (level 5)	More than 1,000	(1,125)	2.0

Table II: Comparison Between Spicy Units For The Five Spicy Levels Of Kimchi

Name of Level	ppm (mg/kg)	Three fields with Tolerance (mg/kg)	percentage (%) on the market
Mild Hot (level 1)	Under 4.0	Under 4.4	65.0
Medium Hot (level 2)	4.0~12.0	3.6 ~ 12.6	31.7
Very Hot (level 3)	12.0 or higher	11.4 or higher	17.0

When compared the Korean spicy levels and units of Chili peppers with the CODEX spicy levels and units of Chili peppers, all Korean spicy units and levels(five levels) of Chili peppers are included in two levels(mild level and medium level) of the CODEX only. (TABLE III)

Table III: Comparison Between Spicy Units For The Korean Standard Five Spicy Levels And For The Codex Standard Four Spicy Levels Of Chili Pepper

Korean Standard (CHILLI PEPPERS)	Mild Hot	Slight Hot	Medium Hot	Very Hot	Extreme Hot
	50~150 scale 100	150~300 scale 150	300~500 scale 200	500~1,000 scale 500	More than 1,000
	median 100	median 225	median 400	median 750	median 1,125
Product distribution ratio in Korea	12%	35.5%	33.5%	17%	2%
CODEX Standard (CHILLI PEPPERS)	MILD	MEDIUM		HOT	EXTRA HOT
	60~133 scale 73	134~1,333 scale 1,199		1,334~6,600 scale 5,266	6,600~ Habanero

(ppm, mg/kg)

Six different *Kimchi* specimens(S1, S2, S3, S4, S4.5, S5) were made for the sensory test. Capsicinoids(capsaicin and dihydrocapsaicin) content range of six different *Kimchi* specimens were from 1.5 to 55ppm. General consumers classified into three stages in case of the three kinds of hot tastes (taste intensity, scent intensity, flavor intensity). But, general consumers classified into two stages in case of the one hot taste (taste preference). (Fig. 1).

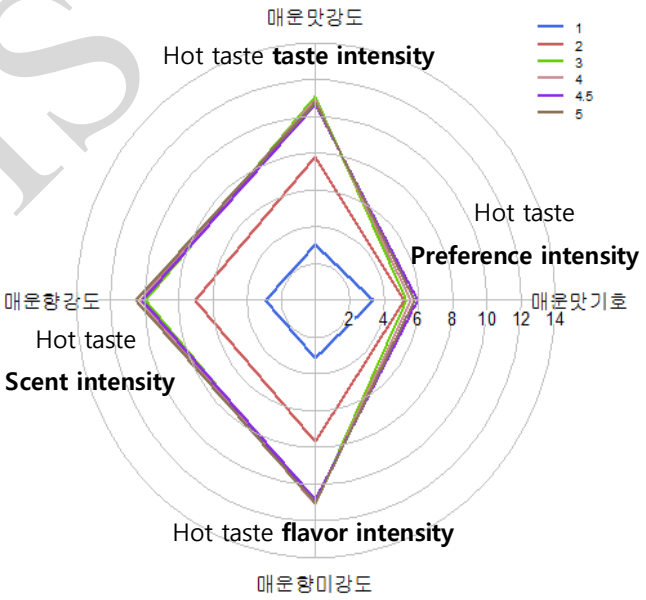


Fig. 1: General Consumer Classify Into Three Stages In Case Of The Three Hot Tastes(Taste Intensity, Scent Intensity, Flavor Intensity) Of *Kimchi*

Currently in Korea, spicy taste levels are applied not only on various spicy product (powdered chili pepper, *Kimchi*, *Gochujang*) being distributed in Korea, but also on export products for the convenience of consumers with different tastes. Korea, which is a country with high consumption of spicy chili peppers, naturally recognizes the importance of attempts to rate the spicy taste levels of food.

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By developing and applying designs that could be easily understood by consumers, the marking illustrations as seen in Fig. 2 ~ Fig. 4 were confirmed and applied in products.

The result showed that general consumers easily comprehended the spicy taste level. And 85.0% of 1,000 consumers showed positive responses to the markings.

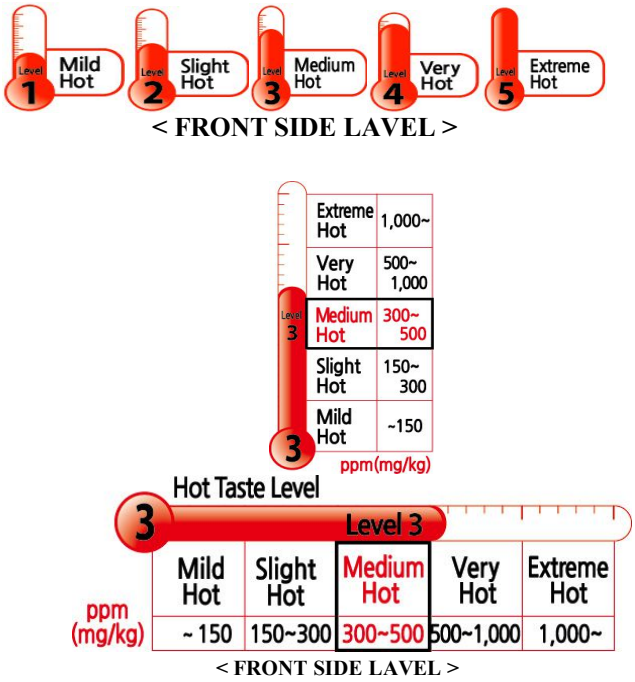


Fig. 2: Various graphic designs for the labelling of Chili pepper

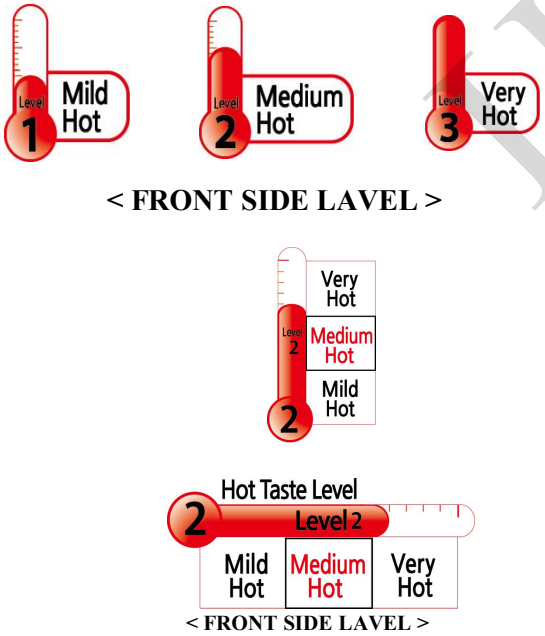


Fig. 3: Various graphic designs for the labelling of kIMCHI

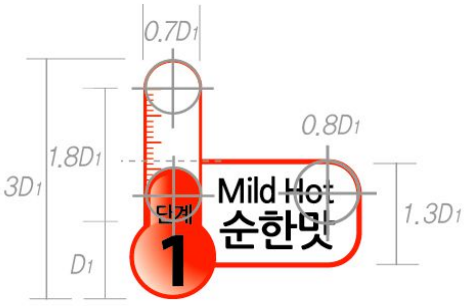


Fig. 4: General consumers labelling methods of Korean standard

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