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Relationship between savory/sweet and contents of protein, sodium, sugar, and fat of Korean ready meal products

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ABSTRACT

The aim of this study was to find a method for describing the specific savory level of individual ready meal products by using quantitative nutrient information labeled on packages of most commercial food products. In order to find a regression equation for savory/sweet according to nutrient contents, perceived intensities of savory flavor and sweetness of twenty-four ready meal products were measured with a 9-point scale. Contents of protein (g), sodium (g), fat (g), and sugar (g) per 100 g of each product were calculated from the nutrient labels on their packages. A correlation analysis, multiple regression analysis, and three dimensional scatter plot were used to examine relationships between the level of savory/sweet (Y) and the four nutrient contents (Xs). Among the four factors, protein/sodium, and sodium/sugar were selected as significant independent variables to predict levels of savory/sweet with R^2 of .915.

The relationship between savory/sweet and nutrient contents was also validated with the other twenty-eight products. Various commercial ready meal products could be categorized by the level of savory/sweet. The categorized savory/sweet information together with a qualitative sensory description could be applied to improve communication effects of the overall flavor impression of ready meal products to consumers.

1. Introduction

Savory is the term that has been used for a broad range of food products with meaty aromas, roasted notes, allium odor of onion and garlic, spicy, smoky, and cheesy odors (Rowe, 1998). Consumers often find snacks, grocery products, and frozen products grouped into savory and sweet (Lobry, 2012) The Oxford Encyclopedic English Dictionary defines the term "savory" as "1. (of food) salty or piquant, not sweet. 2. having an appetizing taste or smell. 3. pleasant; acceptable". Among the various notes of savory characteristics, the meaty, smoky, and cheesy notes could be explained by umami caused by glutamate, inosinate, and guanylate, which are present naturally in meat, seafood, seaweed, cheese, etc. (Marcus, 2005; Ninomiya, 2002; Yoshida, 1998). Although umami itself is not particularly palatable, it changes the flavor profile of foods by increasing continuity, mouth fullness, impact, mildness, thickness, and amplitude (Yamaguchi & Ninomiya, 2000). Prescott (2001) demonstrated a potential connection between glutamate preference and a biological signal for protein.

In Korea, chilled, ambient, and frozen ready meals are pre-prepared main meals and snack products that can be safely kept chilled, at room temperature, and in a frozen state, respectively. Usually they require heating or cooking before eating in the case of main meals. Some of them require the addition of water in their preparation, while some ready meals such as pastas or curries include a sauce packaged in a retort pouch that can be warmed up in boiling water or a microwave for a few minutes. Convenience oriented products are packaged in a microwaveable tray or bowl, and can be microwaved in minutes for immediate consumption. Since ready meals are usually consumed without adding extra salt or seasonings, consumers can easily estimate their nutrient intake from the nutrient information offered on the packages of the product. The quantitative nutrient information such as sodium, sugar, and protein appears to be quite straightforward in terms of communication to consumers. However, there has been a lack of quantitative communication of flavor balance or amplitude of commercial food products. One of the reasons for the lack of quantitative communication of the flavor impression might be that consumer responses to food products are subjective and it has been difficult to find a standard for relative description of a product's flavor that can be agreeable to most consumers.

This study was performed to find a simple method that can be used for quantitative description of savory/sweet level of commercial ready meal category. The quantified information might help

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consumers' understanding of the qualitative sensory descriptions on product packages. A high level of agreement between expected sensory characteristics and perceived sensory characteristics of a product could contribute to increased acceptability of the product (Imm, Lee, & Lee, 2012). Consumers may have already classified the savory or sweet product category based on the balance of saltiness or umami and sweetness of products. If we can estimate individual locations of products on the savory-sweet axis, advantages for communication of the overall flavor impression of new products to consumers may be realized. In particular, a standard for the location of products on the savory-sweet axis could be described quantitatively based on the nutrient information labeled on packages, this aspect would be more understandable to most consumers. The purpose of developing the savory-sweet axis was to offer a quantitative categorized level of the savoriness/sweetness of ready meal products. The aim of this was to improve agreement between expected and perceived flavor characteristics. The level of [savory/sweet] estimated by nutrient contents could support the objective aspect of the sensory data.

2. Material and methods

2.1. Samples

Fifty-two commercial ready meal products were used as samples in this study. Among them, twenty-four products (Table 1) were used for generation of a model, and the other twenty-eight products (Table 2) were used for validation of the model. The samples used for the validation were grouped into the ready meal category, which was included for generation of the model, and the other categories were not included for generation of the model. All samples were manufactured by Pulmuone Co. Ltd. in Seoul, Korea. The fifty-two samples included chilled, ambient, and frozen products. None of the samples include artificial flavors, artificial colorings, or monosodium glutamate (MSG). Each product was cooked before testing by the method suggested on the packages. All the products included nutrient tables on their packages.

2.2. Perceived intensities of savory flavor and sweetness

Perceived intensities of savory flavor and sweetness of the fifty-two products were measured with a 9-point scale from 1 (very weak) to 9 (very strong). 50 housewife consumers (30–49 years old) who purchase ready meal products more than twice a month were recruited for participation in the sensory test by an on-line announcement. Five sessions of consumer tests were conducted to measure perceived intensities of savory flavor and sweetness of the fifty-two samples. Four sets of samples were presented sequentially in each session, and two or three samples were included in each set. There were five minute breaks between each set of samples. Two or three samples within each set were presented side by side. The consumer panel was paid for their participation in the sensory test. Tables 1 and 2 show the tested fifty-two products with their cooking time and methods. The cooking time varied from 40 s to 14 min depending on the product. For each set of samples, cooking was completed at the same time to minimize any difference in temperature between samples within a set. No information on the samples was presented before the sensory testing. Each sample of 50–60 g was presented in disposable paper cups coded with three digit random numbers.

2.3. Nutrient contents of protein, sugar, sodium, and fat of 100 g samples

Nutrient information per one serving size of the fifty-two samples was obtained from their packages. Since one serving size of each product varied depending on the product, the contents of protein, sugar, sodium, and fat of 100 g of each product were calcu-

Table 1
Twenty-four samples for generation of relationships between savory/sweet and nutrient contents.

No.	Samples	Storage	Time	Cooking methods	Adding
1 2	Buchwheat noodle soup Hot & sweet buchwheat noodle mix	Chilled	40 s	1. Boil noodles in water, and then drain the water 2. Rinse them in cold water 3. Mix the noodles with a cold soup or a sauce	800 ml of water for boiling noodles
3 4 5 6	Meat sauce spaghetti Four cheese cream spaghetti Four cheese basil meat spaghetti Four cheese tomato spaghetti	Chilled	1.5 min	1. Boil pasta in water, and then drain the water 2. Warm up the sauce packet in boiling water 3. Mix the pasta with the heated sauce	400 ml of water for boiling pasta
7 8	Pesto cream basil spaghetti Pesto garlic basil spaghetti	Chilled	2 min	1. Stir-fry pasta in a heated pan with 50 ml of water 2. Add the sauce packet into the pasta and mix them	50 ml of water for stirfrying pasta
9 10	Jajang noodles (JW) Jajang noodles (IT)	Chilled	4 min	1. Boil noodles in water, and drain the water 2. Warm up the sauce packet in boiling water 3. Mix the noodles with the heated sauce	800 ml of water for boiling noodles
11 12	Udon noodle soup (K) Udon noodle soup (S)	Chilled	2 min	Boil noodles with soup and water	350 ml of water for boiling noodles
13	Chicken breast soup	Chilled	1–2 min	Microwave	
14	Mashed sweet potato salad	Chilled	–	No cooking is required	
15 16	Hot ramen soup Hot crab ramen soup	Ambient	4.5 min	Boil noodles in water with seasoning powder	550 ml of water
17 18 19	Boiled dumplings Steamed dumplings Pan-fried dumplings	Frozen	2.5 min 14 min 3 min	Boil dumplings and then drain the water Steam dumplings Pan-fry dumplings	Enough amount of water 5 ml of oil
20 21	Stir-fried rice with shrimp & vegetables Stir-fried rice with chicken breast	Frozen	3 min	Stir-fry the frozen rice in a heated pan	5 ml of oil
22	Corn dogs (snack)	Frozen			
23 24	Brito_chili chicken breast (snack) Brito_four cheese & sweet potato (snack)	Chilled	50 s	Microwave	