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The perceived saltiness of soup affected by tasting protocols

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ABSTRACT

The objective of this study was to investigate the effect of tasting protocols on perception of saltiness in two different soup systems, soybean-sprout soup and chicken soup, containing six different levels of salt, respectively. One hundred participants evaluated the level of saltiness with the just-about-right (JAR) scales for the soup samples using two different tasting protocols: a beaker-tasting protocol (BTP) and a spoon-tasting protocol (STP). The results indicated that the sample tasting protocol significantly ($P < 0.01$) affected the perception of saltiness in both soup systems. The optimum NaCl concentrations determined by BTP were lower than those determined by STP in both soup systems. These findings emphasize the importance of sample presentations and tasting protocols in sensory tests to determine optimum levels of ingredients in food products.

1. Introduction

The sensory characteristics of a food product depend on the types and proportions of the ingredients. The purpose of food developers is to find the best product formula, by optimizing the sensory characteristics of the food product to maximize consumer preference. Food companies often use various sensory techniques to determine the optimum level of ingredients based on the consumer response.

Sensory perception, however, is not only affected by sensory factors of the product, but is also influenced by test protocols such as procedures (Lähteenmäki & Tuorila, 1994; McBride, 1986), sample size (Lucas & Bellisle, 1987; Zandstra, De Graaf, Van Trijp, & Van Staveren, 1999), serving temperatures (Brown & Diller, 2008; Cardello & Maller, 1982; Lee & O'Mahony, 2002), serving containers (Cardello, Maller, Masor, Dubose, & Edelman, 1985; Raudenbush, Meyer, Eppich, Corley, & Petterson, 2002; Schifferstein, 2009), etc.

Several reports have demonstrated that sample presentation methods and tasting protocols affected consumer acceptability. In a study of yogurts with various sucrose concentrations (Lucas & Bellisle, 1987), a higher sucrose concentration was preferred in a taste-and-spit protocol than an *ad libitum* protocol. Zandstra et al. (1999) also showed in a sweetened yogurt study under various tasting protocols that the optimum sucrose concentration determined from a taste-and-spit protocol was higher than that determined from the other tasting protocols: the taste-and-swallow protocol, the fixed quantity protocol, and the *ad libitum* consumption protocol.

It has been shown that serving temperature affects sensory perception and acceptance of foods (Drake, Yates, & Gerard, 2005; Engelen et al., 2003; Kähkönen, Tuorila, & Hyvonen, 1995; Mony et al., 2013). Kähkönen et al. (1995) reported in a study of cheese soup, the odor intensity and the acceptability were rated higher when the soup was served at hot temperature (63 °C) than at lower temperature (33 or 48 °C). In a study of the effects of various temperature of water serving prior to the consumption of chocolate, Mony et al. (2013) demonstrated that the intensity of sweetness, chocolate flavor and creaminess of dark chocolate were lower when serving with water at 4 °C than at 20 or 50 °C.

Serving containers also affects sensory perception of their contents. Raudenbush et al. (2002) reported that beverage served in congruent container (e.g., beer in bottle) had higher acceptability scores than when it was in incongruent containers (e.g., beer in coffee cup). Similar results were shown in a study of soup and dental liquid (Cardello et al., 1985), where the acceptability was greatest within its appropriate container (e.g., soup in bowl, dental liquid in glass).

In other to build on these findings, the present study investigated whether the tasting protocol can affect the perception of saltiness and the optimum levels of NaCl in two different types of soup: soybean-sprout soup and chicken soup. Soybean-sprout soup is commonly consumed in Korea that has a simple flavor system since it made with simple ingredients, comprising only

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soybean-sprouts, water and salt. Chicken soup was additionally chosen to confirm the effect of tasting protocol and it has a more complex flavor system due to its larger diversity of ingredients.

The effects of tasting protocol on saltiness perception were examined using two tasting protocols: a beaker-tasting protocol (BTP) and a spoon-tasting protocol (STP). The BTP was applied since a laboratory beaker is often used as a serving container in a laboratory environment, while the STP reflects the typical way in which soup is consumed. The just-about-right (JAR) scale was used for this study since it measures the perceived intensities for samples relative to a perceived optimum point, and has previously been used to determine the optimum attribute levels of food products (Johnson & Vickers, 1987; Lawless & Heymann, 1999; Shepherd, Farleigh, & Wharf, 1991; Vickers, 1988). Since it has been reported that physical states (Bell, 1993) and food consumption patterns can affect sensory perception and acceptability (Chung & Vickers, 2007; King, Meiselman, & Henriques, 2008), the hunger state of participants and the attitude toward saltiness of foods were also measured.

2. Materials and methods

2.1. Stimuli

Two different soups, soybean-sprout soup and chicken soup, varying in 6 NaCl concentrations were used in this study. The NaCl range and the levels were determined in a preliminary test. The NaCl levels for chicken soup decreased since the lowest level (0.2%) for soybean-sprout soup seemed to be perceived saltier when it was applied in chicken soup.

2.1.1. Preparation of the soup samples

The soybean-sprout soup was prepared by boiling 500 g of soybean-sprout in 5 L of water for 35 min. The soup was then frozen at −20 °C until use (within 1 week). The soybean-sprouts were removed from the soup and kept frozen separately. Before the test, the frozen soup was thawed for 15 min in microwave and cooled until the temperature reached 20 ± 2 °C and then NaCl (Duksan Pure Chemical Co., Ltd., Ansan Gyeongi-do, South Korea) was added at various levels (0.2%, 0.4%, 0.6%, 0.8%, 1.0% and 1.2%).

The chicken soup was prepared by boiling 1.2 kg of chicken breast, 300 g of lower white part of green onion, 50 g of garlic, and 2 g of black pepper in 5 L water for 1 h and 30 min. Solid ingredients were removed from the soup and the removed chicken breasts were shredded and kept frozen separately. The soup was cooled and kept in the refrigerator for 10 h and was then strained with filter paper to remove solidified fat. It was kept frozen at −20 °C until used (within 1 week). Before the test, the soup was thawed and heated for 1 h, and then NaCl was added at 6 different levels (0.1%, 0.3%, 0.5%, 0.7%, 0.9% and 1.1%). The samples were transferred to 3 L thermoses (TAE2500P, Thermos®, Tokyo, Japan) prior to serving.

2.1.2. Presentation of the soup samples

For the beaker-tasting protocol (BTP), aliquots (70 mL) of samples were presented in 100 mL laboratory beakers. For the spoon-tasting protocol (STP), the same amount of sample was presented in disposable polypropylene soup bowls (diameter: 115 mm, depth: 50 mm) and was served with disposable polypropylene spoons (wide: 3.8 mm, length: 5.6 mm, depth: 7 mm). The spoon can hold approximately 8.36 mL (±0.26) of water on top ($N = 10$). The frozen soybean-sprout and shredded chicken breast were thawed 2 h before the test, and then two or three soybean-sprout and thin strings of chicken breast were put into the samples, respectively. The temperature of the soybean-sprout soup sample was 20 ± 2 °C and the chicken soup sample, 55 ± 3 °C at the time of tasting.

Filtered tap water was presented to the participants for mouth rinsing between tasting the samples. To minimize the alteration of oral temperature during the tasting, the temperatures of the rinsing water were similar to the temperatures of the soup samples; 20 ± 2 °C for the soybean-sprout soup samples and 40 ± 2 °C for the chicken soup samples.

The samples were coded with 3 digit random numbers and presented in a modified random order in such a way that the lowest salt level sample never followed the highest salt level sample in each soup system, and vice versa.

2.2. Participants

Total of 100 female students (ages 19–28) at Ewha Womans University (Seoul, South Korea), voluntarily participated in the experiment. They were randomly recruited over the internet, and by flyers in the campus. The participants were informed about stimuli and the procedure of the experiment before the test, but no information about the purpose of the study was provided. The participants received monetary compensation at the end of the experiment.

2.3. Procedure

Participants attended 2 sessions on separated days. To avoid a learning effect, more than 3 days were allowed as an interval between the sessions. The test was conducted in individual sensory booths. BTP or STP was applied for each session. If the participant evaluated the soup samples with BTP for the 1st session, STP was used for the 2nd session. The order of evaluation between two tasting protocols was counter-balanced over the participants and also between two soup systems (Fig. 1). Oral and written instructions were given to participants at the beginning of each session. First, the participants were provided 6 different samples of one soup system. They rated the elapsed time since their last meal and then evaluated level of saltiness for the samples using a 15-point JAR scale (−7: too weak; 0: just-about-right; 7: too strong). After finishing the evaluation of the first soup system, a 5 min break was given before tasting the other soup system.

For BTP condition, the participants were instructed to drink the sample directly from the beakers. They were allowed to consume the sample as much as they needed to evaluate the sample. Once

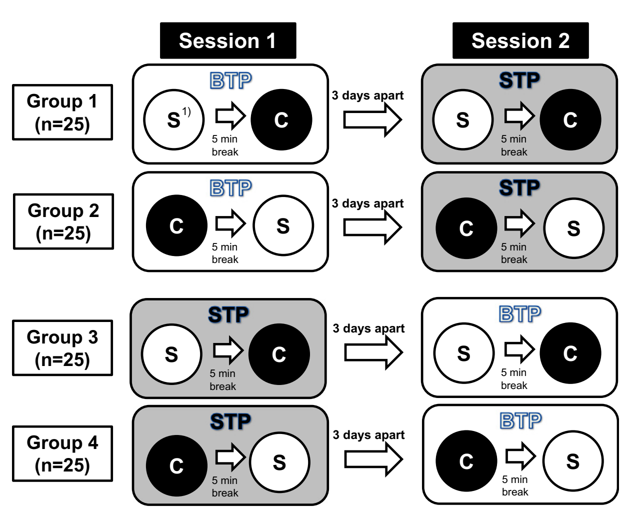

Fig. 1. Order of tasting protocols and soup systems. (1)S: soybean-sprout soup system; C: chicken soup system.