Preference for salts in cooking as perceived by sensory panelists

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Abstract

This study was conducted to determine if consumers have a preference for sea, table or kosher salt. Mashed potatoes were tested and accepted as an adequate carrier. Preliminary sensory research was conducted over two trial days in the Food Science and Human Nutrition Department. The panelists ($n = 100$) conducted evaluations on three samples of mashed potatoes seasoned with three types of salt (sea, kosher and noniodized table) using preference testing. A control sample, unsalted mashed potatoes, was presented with each set. The objective of this study was to determine the 'best overall salt flavor'. Consumers preferred the table and sea salt samples more than the kosher salt, but there was not a distinguishable difference between the table and the sea salts. However, there was no statistical preference by the participant for either of the salts.

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Introduction

Chefs throughout the world are integrating new varieties of salt other than regular table salt into their specialty dishes. These salt varieties include various sea, kosher, and *fleur de sel* salts (Stein 2002; Kasabian & Suzuki 2002). This new trend has also entered the kitchens of many homes via magazines, cooking shows and friends' suggestions. Salt itself has been used for cooking for thousands of years to enhance the flavor of food (Pszczola 1997). It comes from two places: the sea, or from inland salt deposits (Crane 2005).

Sea salt is created by evaporating seawater (Daciuk 2006). It is perceived that sea salt is less dense than table salt and brings about a less salty taste (Crane 2005). Kosher salt gets its name because of its use in making kosher meats. Kosher salt is raked during evaporation procedures in order to form the block-like structure that is ideal for absorbing moisture such as animal blood in the kosher kitchen (Crane 2005). Table salt is produced by sending water into salt deposits and then evaporating the mixture until only the salt crystals remain (Crane 2005).

Upscale restaurants' dishes include salts other than table salt in the hope that it will create a new and pleasant experience for the consumer's palette (Kuchment 2006). The food industry also has begun using sea salt in snacks and other line items. For example, Frito–Lay launched a natural potato chip line that uses sea salt and claims to have no preservatives or colors. Campbell Soup Co. also plans to launch a line of 30 soups to be sold on supermarket shelves containing natural low sodium sea salt (Wall Street Journal 2006).

The increased usage of sea salts means that consumers may have to pay a few extra dollars for the product (Crane 2005). The question, however, is whether the added cost is worth the benefit. Many would agree that sea salt has a

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different taste when compared with table salt, the difference possibly being the result of particle size, purity of each sample or mineral composition in the salts. On the other hand, many people would disagree and believe the use of sea salt is just a trend in hopes of rekindling consumers' love for the taste of food. According to research at the University of Pennsylvania, the taste of salt is a learned preference and can determine whether or not a person likes the salt flavor (Coldwell & Tordoff 1993).

Research on consumer tests typically uses ranking to determine consumer preference of various foods. A difference test is defined in *Sensory Evaluation of Food: Principles and Practices* as '. . . any of a class of tests designed to demonstrate the sensory difference of two products, or to eliminate that possibility, including the simple discrimination tests such as forced choice, the rated-choice, the rated-degree-of-difference procedures and scaled attribute ratings when focused on the simple question of a difference' (Lawless & Heymann 1998). In the same work, a preference test is described as '. . . a test involving choice or ranking of two or more products for their appeal on a sensory basis' (Lawless & Heymann 1998).

The objective of this study was to determine if consumers can taste a difference between sea, table or kosher salt.

Materials and methods

The project idea was discussed with both Morton Salt and Diamond Crystal companies for samples, further insight and advice. Morton products, distributed by Morton Salt Morton International Inc. (Chicago, IL), were used in the research and testing. The products included three types of salt: Sea Salt Coarse, 99.8% NaCl (Lot # z04034), produced in Spain; Morton Table Salt (not iodized), 99.4% NaCl due to the addition of the anticaking additive but which runs about 99.8% before addition of additive, produced in Rittman, OH (Lot # 17A5BA2); and Coarse Kosher Salt, 99.8% NaCl (Lot # 21K4BA), produced in Rittman, OH. Literature and prior research was investigated to determine which salts and food carrier were ideal (Coldwell & Tordoff 1993).

Preparation of samples

The first carrying agent tested was cut potatoes (Sidoti 2005) boiled in salt water. The potatoes were found to be too irregular in both flavor and texture, and a second carrying agent was investigated. The second carrying agent tested was boiled cooked spaghetti, which was prepared as in patent work (Sidoti 2001). Experimentation with rigatoni was also conducted for comparison of carrier attributes. Both types of pasta created several barriers, such as regulating the concentration of salt lost within the cooking water. Having tested these multiple carriers and being faced with several barriers, the team contacted the Morton Salt Company. Discussion of carriers led to a suggestion to use products such as mashed potatoes or cooked oatmeal in which the salt load would be dissolved and absorbed into the product.

The mashed potato suggestion was tested and accepted as an adequate carrier. After experimenting with different brands of mashed potatoes, Hungry Jack Instant Mashed Potatoes (The J.M. Smucker Company, Orville, OH) proved to be the most conducive to the experiment and were used in the sensory panel. The potatoes were prepared according to the recipe on the box, and industry standards were used for the salt weight conversion (Kurlansky 2002). All ingredients were measured by the standardized weights indicated in Table 1.

For each salt type and reference, the water, salt and butter were heated to 212° F (boiling). The pots were then removed from the heat and milk and potato flakes were added. The mixture was then stirred with a fork 60 times and placed on the double boiler until served.

Once prepared, the potatoes were held in labeled double boiler sauce pans and kept at a temperature between 130 and 140°F. One-ounce

Table 1 Weights used for each mashed potato recipe ingredient

Ingredient	Weight (g)
Potato flakes	86.0
Water	285.5
Salt	2.4
Unsalted butter	13.74
2% milk	150.85

scoops were used to place exact amounts of potatoes into randomly numbered 4-oz styrofoam cups with lids.

The three salts used in this experiment were taken through a sieve test to determine their particle size (see Table 2).

Sensory-testing methods

The experimental design, sensory methods, panel, test conditions and statistical techniques were as follows.

For the sensory panel (Lawless & Heymann 1998), each salt type was assigned a random three-digit number. The reference was labeled R and contained no salt.

Two instruments were used in the panel evaluations: a demographic worksheet (Appendix 1) (Prescott 1997) and a rank order preference test ballot (Appendix 2). The ballot directed the participant to list the code for each sample in the order of their preference, from 'first choice' (best overall flavor) to 'third choice' (least overall flavor). These relate to a score of 1, 2, or 3 for purposes of analysis.

Using the Friedman's test and calculating the least significant difference (LSD) between the samples mean, it was determined that there were differences in the means of the three samples evaluated: sea salt (mean = 0.69), kosher salt (mean = 0.76) and table salt (mean = 0.68). Computing the LSD, it was determined that there was no significant difference in overall preference of sea salt samples (code #156) and kosher salt samples (code #387) (0.69 = 0.76); no significant difference in overall preference of sea salt samples (code #156) and table salt samples (code #942) (0.69 = 0.68); and no significant difference in overall preference of kosher salt samples (code #387) and table salt samples (code #942) (0.76 = 0.68) (see Table 3).

Preliminary study

Preliminary research was conducted over two separate days in order to evaluate the test protocol. The preliminary panel ($n = 20$), consisting of students and faculty within the Food Science and Human Nutrition department, sampled mashed potatoes prepared with the three salts, using the rank order preference test ballot designed for this study. It was observed that some ambiguities existed within the ballot, and it was modified accordingly.

Table 2 Morton Salt Company sieve test results for coarse kosher salt, coarse sea salt and table salt

USS sieve	% Retained coarse kosher salt	% Retained coarse sea salt	% Retained table salt
12	–	2	–
14	Trace	–	–
16	6	32	–
20	46	36	–
30	24	15	2
40	–	9	–
50	22	–	69
70	–	–	20
PAN	2	6	9

Table 3 Multiple comparison results

Sample (156 = sea salt; 387 = kosher salt; 942 = table salt)	Multiple comparison	Least significant difference 0.28	Significant difference
156 and 387	0.69 = 0.76	=0.07	No
156 and 942	0.69 = 0.68	=0.01	No
387 and 942	0.76 = 0.68	=0.08	No

A second preliminary panel ($n = 26$) with the same demographic profile as the first preliminary panel was satisfactorily conducted using the revised rank order preference test ballot. Additionally, a procedural modification to provide each participant with 2 oz of the reference and 1 oz of each of the three salt sample types was tested. This was determined to be the appropriate amount of sample for panel testing. A preliminary data review of this panel using the Friedman, Kendall and *P*-values was conducted. The Kendall value was 0.0693, indicating that the panelists were not in strong agreement in terms of their ranking of the three samples. The null hypothesis stated that there is no agreement in the ratings; however, a *P*-value = 0.2683 was achieved, meaning that the reviewers failed to reject this null hypothesis. Therefore, there exists insufficient evidence to conclude that the ratings of all panelists were in agreement.

A rank order preference test (Lawless & Heymann 1998) was used for the study. However, various types of tests, such as simple difference, were considered.

Preference testing (actual panel study)

The sensory evaluation of the mashed potatoes with various salts panels was conducted over two days in half-hour prescheduled time blocks. The panelists ($n = 100$), recruited through on-campus announcements, bulletin boards and an undergraduate class, conducted their evaluations of three samples of mashed potatoes seasoned with three different types of salt (sea, kosher and table without iodine) to determine the 'best overall salt flavor', with one additional unsalted sample serving as the control. Directions were given to all panelists, including the information that salt was added at a less than normal level (the study was not designed to make a salty food product).

Data analysis

Two-sample *t*-tests with equal variances and the Friedman/Kendall test were conducted on the panel data ($n = 100$). The relative measure and distribution of particle size was estimated through sieve testing provided by Morton Salt Company (Table 2). The sieve separation is documented by the percentage of the original 100-g sample retained by weight that is held back at each sieve marking in the testing series. Particle size is related to the rate the salt dissolves in solution. The three salts that were used in this experiment were taken through a sieve test.

The table salt was the finest, the coarse sea salt the largest and the coarse kosher salt in-between. This is of particular interest in various topical salt applications such as in baking or in solution as in this experiment. The panel data evaluation included ranking and determining any difference noted between the samples.

Results

Panel demographics

The age of the panel ($n = 100$) ranged from 18 to 29 years, to more than 60 years, with the highest percentage (73%) in the 18–29 age bracket and the next largest group (10%) in the 40–49 age bracket. Seventy-eight percent of the participants were female, and 82% of panelists indicated that they used salt.

Rank order preference testing result

Data were analyzed to determine the overall preference for each individual salt. A ranking of '1' on the sensory ballot indicated best overall flavor, whereas a ranking of '3' indicated least overall flavor (see Table 4). The means of all the samples (sea, 0.69; table, 0.68; kosher, 0.76) reflect the closeness in ranking by the consumers (see Table 3).

The Friedman test was applied to determine if there was a significant difference between samples. If the null hypothesis is not rejected, then stop; if it is rejected, then calculate the LSD as if applied in this data set. A multiple comparison procedure in which all pairs of rank means were compared was followed by multiple comparison calculations. All pairs of rank means were compared. Two treatments were declared different if $|R_i - R_j| > LSD_{ij}$ and followed with multiple comparisons. Results indicate that the participants did not note a preference between sea, kosher and table salts.

Table 4 Participant responses on rank order preference test (salt ballot)

Participants	Sea salt	Kosher salt	Table salt	Participants	Sea salt	Kosher salt	Table salt
1	1	3	2	52	3	2	1
2	3	1	2	53	2	3	1
3	2	3	1	54	3	2	1
4	1	2	3	55	2	3	1
5	1	2	3	56	2	3	1
6	3	2	1	57	2	1	3
7	1	3	2	58	1	3	2
8	2	3	1	59	2	3	1
9	1	2	3	60	1	2	3
10	3	2	1	61	1	3	2
11	3	2	1	62	1	3	2
12	1	2	3	63	1	3	2
13	1	3	2	64	2	1	3
14	1	3	2	65	3	1	2
15	3	1	2	66	2	3	1
16	2	3	1	67	2	1	3
17	3	2	1	68	3	1	2
18	1	3	2	69	2	1	3
19	2	3	1	70	2	3	1
20	2	1	3	71	1	2	3
21	2	3	1	72	3	2	1
22	3	2	1	73	1	3	2
23	3	2	1	74	2	1	3
24	2	3	1	75	3	2	1
25	2	1	3	76	2	3	1
26	2	1	3	77	3	1	2
27	1	3	2	78	3	1	2
28	2	1	3	79	2	3	1
29	2	3	1	80	2	1	3
30	2	1	3	81	2	3	1
31	1	3	2	82	3	1	2
32	2	3	1	83	2	3	1
33	2	1	3	84	1	3	2
34	1	3	2	85	1	2	3
35	2	1	3	86	3	2	1
36	3	2	1	87	1	2	3
37	3	2	1	88	1	3	2
38	2	3	1	89	3	1	2
39	2	3	1	90	1	3	2
40	1	3	2	91	2	1	3
41	1	3	2	92	1	2	3
42	2	1	3	93	3	1	2
43	1	2	3	94	2	3	1
44	2	3	1	95	1	2	3
45	3	1	2	96	2	3	1
46	1	2	3	97	1	3	2
47	3	1	2	98	2	3	1
48	2	1	3	99	1	3	2
49	2	1	3	100	2	3	1
50	2	3	1				
51	2	3	1	Total (sum)	68	75	67

Panelists' comments

The panelists were given the opportunity to comment on the samples presented for evaluation; they commented on 21% of the ballots for table salt, 24% for sea salt and 23% for kosher salt.

The comments were coded into the following major areas:

1 Flavor of the carrier, e.g. 'brings out the flavor of potatoes', 'does not mask the box flavor', 'salt flavor makes potatoes taste home cooked'.

2 Amount of salt flavor, e.g. 'less salty flavor', 'very bland', 'too salty', 'balanced flavor'.

3 Other flavors perceived, e.g. 'garlic taste', 'spicy', 'very buttery', 'salt tastes similar to cheese'.

Panelist comments about the flavor of the salt informed the researchers as to the reason a particular salt was ranked above another.

Conclusion, discussion and limitations

A preference test on three salts commonly applied in the culinary preparation of foods within the foodservice industry was carried out. Results indicate that participants could not taste a significant difference between sea, kosher and table salts. Consumers preferred the table and sea salt samples more than the kosher salt, but there was not a distinguishable difference between the table and the sea salts. Thus, there was no statistical participant preference of the three salt samples.

In looking at the comments from the panelists, the next apparent step in salt research would be to conduct an attribute acceptance test that incorporates panelists' comments on sweetness, blandness, cheese notes, etc. within the profiles of the salts sampled. Research aimed at identifying which attributes are preferred by panelists vs. the attributes not preferred would offer valuable information.

Further questions that will be important for future consideration of this salt investigation include determining whether salt preferences are learned; which consumers use various salts and what their preferred carrier food item is; what the chefs' perceptions are regarding the application of various salts dissolved within a product or topically applied; and the point at which salt is applied in food preparation. Future areas for research also include alternate applications of salt, such as whether it is added topically to a prepared product, and the mineral composition's relationship to flavor.

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Appendix I

Demographic questionnaire for salts in cooking sensory panel

- Please check: Male_____ Female _____
- Please check your age group:

18–29 _____ 30–39 _____ 40–49 _____ 50–59 _____ 60+ _____

- Do you typically use salt in cooking and/or at the table?
  Please check: _____ Yes
  _____ No
- What types of salt do you purchase most frequently? (please write in)

Appendix II

Rank order preference test

Product: Mashed Potatoes **Test For**: Overall Salt Liking for Flavor

Initials _____ Date _____

- Before beginning and between each sample take a drink of water.
- Sample the reference first.
- These samples have three different salts for you to taste and tell me which salt flavor you like the best.
- Sample in the order presented, from left to right; after the first taste, you may resample in any order and taste reference multiple times as well if you like.
- List the code for each sample in the order of your preference, from 'first choice' (best overall flavor) to 'third choice' (least desired overall flavor).
- If there is a tie, or if you like all the samples equally, write that on the ballot.

Sample Code	Ranking	Comments about the Samples
387	_____	_____
156	_____	_____
942	_____	_____