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Dominique J. Monlezun, Nathalie Matamoros, Courtney Huggins, Dakota Michaud, Leah Sarris & Timothy S. Harlan

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Biting into integrated quality improvement: medical student and staff blinded taste test for sodium reduction improving medical education and care?

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Abstract Over 90 % of Americans consume an excessive amount of sodium as a key salt ingredient, despite its contribution to morbidity and mortality. No known studies have analyzed the optimal salt reduction level for medical students and staff in characteristic restaurant recipes. Increased studies linking such quality improvement in medical education and care through lifestyle-based modifications with medical professionals in training may provide a promising model for competency-based medical education in the age of healthcare reform. A volunteer sample ($n = 105$) of medical students and staff was recruited over 3 weeks to test three-course meal components from representative restaurants prepared under a trained chef's supervision. Subjects were not informed that sodium levels were decreased in three samples by 15, 25, and 35 % with the fourth sample being the control of 0 % reduction. The largest sub-group of subjects identified the 15 % reduced sample as the optimal saltiness sample compared to the 0, 25, and 35 % reduced samples overall among the shrimp, jambalaya, and gumbo dishes (29.23 % vs. 23.59 %, 22.56 %, 24.62 %, $p = 0.567$). The Kruskal–Wallis test with post hoc analysis with the Wilcoxon-Mann–Whitney test revealed that sodium-reduced samples had a significantly higher rank sum than the zero-reduced sample for favorite dish ($p < 0.001$). Our results suggest chefs may reduce sodium while still preserving consumer preference. Future studies are needed to investigate the impact of first-hand nutrition study participation on medical students and staff improving their own nutrition education for their future patients.

Keywords Quality improvement · Clinical nutrition · Culinary medicine · Sodium reduction

Introduction

Over 90 % of American adults consume excessive sodium at a rate of 3,466 mg/day, placing them at increased morbidity and mortality risk from such vascular diseases as stroke and heart disease [1–4]. Recent findings demonstrate that sodium can be moderately reduced by 15–25 % without consumer detection, though larger reductions may lose consumer acceptability [5–10]. Nearly $20 billion annual savings in medical costs could result from sodium reductions of just 1,200 milligrams [2, 5]. Promising health improvements have been shown with such nutritional initiatives as the DASH diet that was shown to reduce blood pressure by 9 mmHg (systolic) and 4.5 mmHg (diastolic) [11–13]. According to the Centers for Disease Control and Prevention (CDC), current dietary guidelines recommend that American adults consume no more than 2,300 mg of sodium per day. Adults who are 51 years of age or older, African American, or have high blood pressure, diabetes,

D. J. Monlezun and N. Matamoros are Co-first authors.

D. J. Monlezun (✉) · N. Matamoros · C. Huggins · D. Michaud · L. Sarris · T. S. Harlan
The Goldring Center for Culinary Medicine, Tulane University School of Medicine, 1430 Tulane Avenue #8541, New Orleans, LA 70112, USA
e-mail: djmonl37@gmail.com

D. J. Monlezun
Department of Global Health Systems and Development, Tulane School of Public Health and Tropical Medicine, New Orleans, LA, USA

N. Matamoros · C. Huggins · D. Michaud
College of Culinary Arts, Johnson & Wales University, Providence, RI, USA

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or chronic kidney disease are recommended to maintain even lower levels at no more than 1,500 mg/day [1, 2]. However, reducing a major source of sodium intake from the supply side—processed and restaurant foods—has yet to be fully analyzed [2, 14].

The medical community has provided little published data for chefs and restaurateurs on best practices in healthier recipe design and development, with optimum macro- and micronutrient balance and their levels in relation to changes in flavor. This is at a time that 93 % of chefs in a recent study assert consumers' inability to detect a 10–25 % calorie reduction in restaurant dishes [15]. The same study reports 71 % of chefs identifying taste as the largest determining factor in a reduced-calorie dish's success with consumers. Though much of the related research has focused on restaurants' suboptimal caloric profiles [16], less is known regarding sodium.

The medical community can profoundly influence sodium reductions nationwide by seeing and demonstrating patients' preferences for reduced sodium. Thus not only for their own training as current or future educators for their patients but also as sources of published studies, medical professionals and students may thus better counsel patients and inform the restaurant industry considering that the majority of restaurants' senior menu development and marketing executives cite profit as the main consideration in creating menus [17]. Further, physicians' own improved dietary habits and beliefs about the link between suboptimal dietary habits and obesity in health are known influential factors on physicians educating their patients on healthy nutrition [22, 23]. Future medical professionals in their formative education years and current professionals may thus be ideal recipients of quality nutrition education to allow them to better advocate for their patients on a societal level and educate them on an individual level. Yet only a minority of medical schools achieve the National Academy of Sciences-outlined minimum of 25 required instruction hours [24], and recent attempts to improve nutrition education for medical students have largely failed [25]. The Goldring Center for Culinary Medicine at Tulane University School of Medicine (GCCM) responded to these challenges by becoming the world's first known medical school-based teaching kitchen and research lab led by a physician and professional chef, overseeing an integrative curriculum teaching medical students how to educate patients on nutrition through hands-on cooking and nutrition science [18–21]. GCCM launched this study to determine the amount of decreased sodium possible in blinded taste testing of representative dishes without compromising flavor in a population of current and future medical professionals and support staff. Such a quality improvement is designed to test long term if integrating improved medical education can also improve how medical professionals provide medical care (including nutrition education) for their patients.

Table 1 Sodium macronutrient comparison for characteristic restaurant appetizers

Recipe name	Sodium (mg)
Crab bisque	180
Oyster stew	1,260
Fried crab cakes	1,180
Shrimp and Tasso henican	5,190
Chicken and andouille smoked sausage gumbo	510
Turtle Soup	750
Garlic broiled oysters	590
Gumbo	1,410
Average of appetizer sodium	1,384
Standard deviation	1,594

Table 2 Sodium macronutrient comparison for characteristic restaurant entrees

Recipe name	Sodium (mg)
Louisiana shrimp and andouille over grits	3,200
Gnocchi w/jumbo lump crabmeat and truffle	460
BBQ shrimp	3,850
Shrimp tchefuncte	1,540
Chicken and Tasso jambalaya	1,680
Blackened redfish	1,110
Louisiana crab cakes	2,000
New York strip steaks	6,820
Average of entrée sodium	2,583
Standard deviation	2,030

Methods

Participants

A volunteer sample ($n = 105$) of medical students and urban medical center staff was recruited over 3 weeks to test three entrée dishes prepared under the supervision of a trained chef. The dishes were named without specifying their originating restaurants to protect restaurateur privacy.

Test foods

The recipes and their respective restaurants were selected due to their representative nature of popular dishes and the chef's significant influence on the culinary community in one of America's foremost restaurant cities. Recipes from leading restaurateurs' cookbooks were considered for the

Table 3 Sodium macronutrient comparison for characteristic restaurant desserts

Recipe name	Sodium (mg)
Bread pudding with brown butter sticky rum sauce	500
Bread pudding soufflé with whiskey sauce	260
Strawberry shortcake	220
Banana beignet with foster sauce	800
New Orleans bread pudding (lemon sauce and chantilly cream)	1,090
Sweet potato pecan pie	360
Bananas foster bread pudding (with vanilla ice cream and caramel sauce)	770
Banana cream pie with banana crust and caramel drizzles	630
Average of dessert sodium	579
Standard deviation	301

study if they were currently available on their restaurant menus. Using the Food Care program, recipes were analyzed to determine an average of sodium consumption during a three-course dinner (Tables 1, 2, 3). A three-course meal of an appetizer, an entrée and a dessert in these restaurants averages 4,545 mg sodium, or 198 % of the recommended daily dietary intake.

The three recipes chosen for the tasting included Chicken and Tasso Jambalaya (control recipe = 1,680 mg sodium), Gumbo (control recipe = 1,410 mg sodium), and BBQ Shrimp (control recipe = 3,850 mg sodium). Each dish was formulated into four samples that included a control (100 % of the salt specified in the recipe, or no reductions), 15 % reduction in added sodium in salt, 25 % reduction in added sodium, and 35 % reduction. Each sample was assigned a randomized number with a corresponding letter for each dish so subjects were not aware of the sodium reduction levels. To further limit bias, participants were not informed that the study was focused on sodium, but were simply informed that macro- and/or micronutrients in samples may have been altered.

Procedure

Approval was obtained from the Institutional Research Board of Tulane University. Healthy participants were recruited from the Tulane School of Medicine faculty, staff, and students. Subjects who had been directed to follow a low sodium or low fat diet by their physician, or who had allergies to specific ingredients in the study recipes were excluded from the study. After written consent was obtained, participants completed a sensory evaluation of each recipe's respective four samples (from the four salt formulations) based on a 10-point Likert scale, and a

Fig. 1 Study design

separate hedonic selection of the favorite sample for each dish, respectively (Fig. 1). The sensory evaluation used a Lickert scale ranging from 1 (not at all) to 5 (just right) to 10 (too much) for subjects to rank how much a sample was according to sensory categories: salty, sweet, bitter, sour, spicy, and savory. Participants could only one sample per dish as their perceived just right sample for each sensory category, and one sample per dish as their favorite. The testing occurred on three consecutive Friday's at noon, with each dish tested on a different day. Consumption status prior to the study was not documented due to the study being conducted at the commencement of subjects' lunch breaks and due to water used to cleanse the palate before each sample tasted.

During the blind testing, each participant was assigned a seat separated from other participants by four feet and were instructed not to converse during the study. They were given a glass of water (at room temperature), sensory evaluation form, list of ingredients highlighting potential allergens, and four numbered samples per dish that were placed on a laminated placemat in designated spots with the sample number. The placemats were varied in the order of sample numbers between subjects. Participants were instructed to taste the samples in clockwise order, taking a small sip of water between each taste. The four taste samples were heated and maintained at 165 °F in a water bath during the study. Participants were served 2 oz. samples in identical 4 oz. plastic cups, with a clean plastic spoon for each sample.

Results were analyzed using STATA 12.0 (StataCorp LP, College Station, Texas) statistical software to calculate univariate analyses with one-sample Chi-square goodness of fit for saltiness and favorite sample by sodium reduction sample level. Kruskal–Wallis H test, as a rank-based nonparametric alternative to the one-way ANOVA, was used to determine statistically significant differences in the

Table 4 Results of blinded taste test for four sodium reduced samples per dish

Dish, no. (%)	0 % reduced sodium dish	15 % reduced sodium dish	25 % reduced sodium dish	35 % reduced sodium dish	*p* value
Optimal saltiness					
Shrimp	14 (17.50 %)	21 (26.25 %)	20 (25.00 %)	25 (31.25 %)	0.377
Jambalaya	18 (28.57 %)	21 (33.33 %)	13 (20.63 %)	11 (17.46 %)	0.263
Gumbo	14 (26.92 %)	15 (28.85 %)	11 (21.15 %)	12 (23.08 %)	0.857
OVERALL	46 (23.59 %)	57 (29.23 %)	44 (22.56 %)	48 (24.62 %)	0.567
Favorite dish					
Shrimp	12 (32.43 %)	10 (27.03 %)	3 (8.11 %)	12 (32.43 %)	0.116
Jambalaya	11 (28.95 %)	10 (26.32 %)	8 (21.05 %)	9 (23.68 %)	0.913
Gumbo	11 (34.67 %)	7 (23.33 %)	8 (26.67 %)	4 (13.33 %)	0.343
OVERALL	34 (32.38 %)	27 (25.71 %)	19 (18.10 %)	25 (23.81 %)	0.224

ordinal scale for sodium-reduced samples and favorite dish. Post-hoc analysis according to favorite dish averaged over all dishes and individual sodium level samples was done with the Wilcoxon-Mann–Whitney test, a non-parametric analog to the independent samples *t* test.

Proportions were calculated for each of the three dishes in each of the four samples, differentiated by salt reduction level. Responses were identified as 'incomplete' and excluded for the favorite dish rankings if participants failed to identify one favorite dish (6.25 % of 112 responses for all dishes; 5.00 % of the 40 responses for jambalaya; 6.25 % of 32 responses for gumbo; and 7.50 % of 40 responses for shrimp). Of the 112 responses from 85 unique subjects (63 one-dish participants, 17 two-dish participants, 5 three-dish participants), there was a 93.75 % response rate of 105 complete surveys.

Results

The largest sub-group of subjects identified the 15 % reduced sample as the optimal saltiness sample compared to the 0, 25, and 35 % reduced samples averaged all the dishes (29.23 vs. 23.59 %, 22.56 %, 24.62 %, $p = 0.567$) (Table 4). Yet the 15 % reduced samples overall were second in ranking of favorite dish after the 0 % reduced sample (25.71 vs. 32.38 %, $p = 0.224$). By the Kruskal–Wallis test, there was a statistically significant difference in the median favorite dish among the four sample levels of sodium reduction ($p < 0.001$). Post-hoc analysis of favorite sample averaged over all the dishes with the Wilcoxon-Mann–Whitney test by individual sodium reduction samples revealed that sodium-reduced samples had a significantly higher rank sum than the zero reduced sample ($p < 0.001$). Further, the 15 % reduced samples had a significantly higher rank sum than other sodium levels for favorite dish ($p < 0.001$).

For the highest sodium dish, BBQ shrimp, the largest sub-group chose the most drastic sodium reduction samples, 35 %, as the optimal saltiness samples compared to 0 %, 15 %, 25 % reduced samples (31.25 % vs. 17.50, 26.25, and 25.00 %, $p = 0.377$). The 35 % sodium reduced BBQ shrimp sample tied the 0 % reduced sample as the favorite (32.43 %, $p = 0.116$). The second highest sodium dish, jambalaya, reflected the overall trends in that 15 % reduced samples were chosen as the optimal saltiness samples over the 0, 25, and 35 % reduced samples (33.33 vs. 28.57 %, 20.63 %, 17.46 %, $p = 0.263$). Yet the 0 % reduced sodium sample for the jambalaya dish was the favorite sample selected among 15, 25, and 35 % reduced samples (28.95 vs. 26.32 %, 21.05 %, 23.68 %, $p = 0.913$). The lowest sodium dish, gumbo, again demonstrated that its 15 % reduced sample was the most popular sample according to optimal saltiness rating compared to 0, 25, and 35 % samples (28.85 vs. 26.92 %, 21.15 %, 23.08 %, $p = 0.857$). Yet the 0 % reduced sample was the favorite sample compared to 15, 25, and 35 % reduced samples (34.67 %, 23.33 %, 26.67 %, 13.33 %, $p = 0.343$).

Discussion

Our blinded taste test results indicate that 15 % sodium reduced samples are preferred according to perceived saltiness over their original version in a medical student and staff population. However, 15 % dishes trail behind the 0 % reduced dishes as the favorite dishes even when sodium is the only macronutrient altered. This likely points to the need to balance salt reductions with appropriate flavor changes since the recipes were designed by the original restaurant chefs with their saltiness level balancing the other flavor sensations. Our study thus suggests that restaurants can reduce sodium in their dishes with the benefit not only of improving the overall health of their patrons, but also of optimizing patient saltiness preference. Since our findings also indicate that saltiness may impact other aspects of taste that may influence subject preference

for the overall favorite dish, follow-up studies are needed to subsequently identify proper flavor balancing with nutritional improvements in such macronutrient levels as sodium, sugar, and fats. Such investigation may deepen understanding of possible sodium and other macronutrient alternatives to maintain optimal nutrition levels while also boosting perception of overall favorite dish ratings.

Our study also illustrates that dishes with higher sodium content may have their sodium content even further reduced for consumers' taste preferences compared to only moderate reductions in moderate-level sodium dishes. This is seen by the 35 % reduced sodium samples being selected as the favorite dish over even the 0 % reduced samples for the highest sodium dish, the BBQ shrimp. Further studies thus are warranted to investigate the optimal sodium level threshold for dishes that can most benefit from sodium reduction to ultimately enhance subject acceptability and thus strengthen food industry support. Limitations in this methodology include a single-site study design, variance in subjects' abilities to differentiate taste sensations, tasting a sample compared to a full meal, personal preference of traditional New Orleans dishes, and physiologic or anatomical alterations in palate.

Future research is needed to validate these results and so improve subjects' health through public policy and the food industry by also expanding the study population to physicians and patients. With the average three-course restaurant meal containing 4,545 mg of sodium, a reduction of 15 % could save consumers 682 mg of dietary sodium, which is over half the daily reduction recommended by the CDC and thus represents if adopted nationwide $20 billion annual savings for the United States. Our study suggests that sodium reductions may influence consumers to not only select a dish as their preferred salt balanced dish, but also as their favorite compared to a dish without such reductions. Our findings provide justification for chefs to reduce added salt in their popular dishes as major sources of dietary sodium, simultaneously boosting their clients' taste preferences and decreasing a significant contributor to chronic cardiovascular diseases. As a meal is more than just what is placed on the table, substantial quality improvement thus must result not only from improved medical care but also by getting back to the kitchen, back to medical education, where it is cooked up. Such hands-on studies and teaching exercises are thus needed to train current and future medical professionals in lifestyle education for patients to complement their other skill sets managing their care.

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Conflict of interest None

References

1. Division for Heart Disease and Stroke Prevention, Centers for Disease Control and Prevention (2010) Sodium intake among adults. Morb Mort Week Rep 59(24):746–749
2. He FJ, MacGregor GA (2011) Salt reduction lowers cardiovascular risk: meta-analysis of outcome trials. Lancet 378(9789):380–382
3. Institute of Medicine (2004) Dietary Reference Intakes for Water, Potassium, Sodium Chloride, and Sulfate. http://www.nap.edu/catalog.php?record_id=10925. Accessed 04 Apr 2013
4. Miniño AM, Murphy SL, Xu J et al (2011) Deaths: final data for 2008, National Vital Statistics Reports. Natl Cent Hlth Stats 59:10
5. Girgis S, Neal B, Prescott J, Prendergast J, Dembrell S, Turner C et al (2003) A one-quarter reduction in the salt content of bread can be made without detection. Eur J Clin Nutr 57(4):616–620
6. He FJ, MacGregor GA (2009) A comprehensive review on salt and health and current experience of worldwide salt reduction programmes. J Hum Hyperten 23(6):363–384
7. Bolhuis DP, Temme EJM, Koeman FT, Noor MWJ, Kremer S, Janssen AM (2011) A Salt reduction of 50% in bread does not decrease bread consumption or increase sodium intake by the choice of sandwich fillings. J Nutr 141(12):2249–2255
8. Emorin M, Septier C, Thomas-Danguin T, Salles C (2013) Heterogenous salt distribution in hot snacks enhances saltiness without loss of acceptability. Food Res Intl 51(2):641–647
9. Kremer S, Mojet J, Shimojo R (2009) Salt reduction in foods using naturally brewed soy souce. J Food Sci 74:S255–S262
10. Lucas L, Riddell L, Liem G, Whitelock S, Kreast RS (2010) The influence of sodium on liking and consumption of salty food. J Food Sci 76:S72–S76
11. Frisoli TM, Schmieder RE, Grodzicki T, Messerli FH (2012) Salt and hypertension: is salt dietary reduction worth the effort? Am J Med 125(5):433–439
12. Appel LJ (2009) Dietary approaches to lower blood pressure. J Clin Hyperten 11:358–368
13. Karppanen H, Mervaala E (2006) Sodium intake and hypertension. Progr Cardio D 49:59–75
14. Monsivais P, Rehm CD, Drewnowski A (2013) The DASH diet and diet costs among ethnic and racial groups in the United States. JAMA Intern Med. doi:10.1001/jamainternmed.2013.9479
15. Jaworowska A, Blackham T, Stevenson L, Davies DG (2012) Determination of salt content in hot takeaway meals in the United Kingdom. Appetite 59:517–522
16. Obaggy J, Condrasky MD, Roe LS, Sharp JL, Rolls BJ (2011) Chefs' opinions about reducing the calorie content of menu items in restaurants. Obesity 19:332–337
17. Scourboutakos MJ, L'Abbe MR (2012) Restaurant menus: calories, caloric density, and serving size. Am J Prev Med 43:249–255
18. Glanz K, Resnicow K, Seymour J, Hoy K, Stewart H, Lyons M, Goldberg J (2007) How major restaurant chains plan their menus: the role of profit, demand, and health. Am J Prev Med 32:383–388
19. Kay D, Abu-Shamat L, Leong B, Monlezun DJ, Sarris L, Harlan T (2013) Improving medical student nutritional counseling competency. J Invest Med 61:511
20. Birkhead A, Foote S, Monlezun DJ, Loyd J, Joo E, Leong B, Sarris L, Harlan TS (2014) Medical student-led community cooking classes: a novel preventative medicine model easy to swallow. Am J Prev Med 46(3):e41–e42
21. Leong B, Ren D, Monlezun DJ, Ly D, Sarris L, Harlan TS (2014) Teaching 3rd & 4th year medical students how to cook: an innovative approach to balance lifestyle modification and medication therapy in chronic disease management. Med Sci Ed 24(1):43

22. Bleich SN, Gudzune KA, Bennett WL, Cooper LA (2013) Do physician beliefs about causes of obesity translate into actionable issues on which physicians counsel their patients? Prev Med 56:468–493
23. Jay M, Gillespie C, Ark T, Richter R, McMacken M, Zabar S, Paik S, Messito MJ, Lee J, Kalet A (2008) Do internists, pediatricians, and psychiatrists feel competence in obesity care? using a needs assessment to drive curriculum design. J Gen Intern Med 23:1066–1070
24. Adams KM, Kohlmeier M, Zeisel SH (2010) Nutrition education in U.S. medical schools: latest update of a national survey. Acad Med 85(9):1537–1542
25. Walsh CO, Ziniel SI, Delichatsios HK et al (2011) Nutrition attitudes and knowledge in medical students after completion of an integrated nutrition curriculum compared to a dedicated nutrition curriculum: a quasi-experimental study. BMC Med Ed 11:58