

Evaluation of Applied Nutrition Concepts in Culinary Arts Education¹

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Abstract

Chefs need to be academically prepared to ensure their menus are nutritionally balanced while meeting the demand for taste, low cost, and convenience. Culinary educators at post-secondary institutions balance culinary and nutrition knowledge with the needs of patrons, staff, and management. Based upon previous nutrition inquiry, educational intervention lessons on protein and sodium were designed and pilot tested with two groups ($n_1=20$) and ($n_2=21$) of post-secondary culinary arts students. These educational intervention lessons improved knowledge of protein and sodium as measured on topic specific knowledge test instruments. The difference before and after the education program on protein was statistically significant for 14 out of 19 survey items. For the sodium intervention lesson, changes for eight items out of 26 were statistically significant. The evidence suggests that the intervention lesson for improving applied knowledge about dietary proteins and sodium through an intervention lesson is positive. It is recommended that culinary arts post-secondary programs incorporate reinforcement lessons on the applications and the techniques of healthy cooking into their curricula to meet the needs of their constituents. Decisions on academic emphasis based on current nutrition research and trends can contribute to wider availability of healthy foods served away from home. The depth and level of applying nutrition concepts to food preparation behavior is affected by the academic experiences of the culinary students as they aspire to work in professional kitchens in menu and recipe development.

Keywords: nutrition education, culinary education, chef, chefs' education.

Introduction

Chefs generally agree that they need more education to equip themselves with skills necessary for the preparation of healthy food. According to the USDA, Economic Research Service, data indicates an increase in United States spending on foods away from home (FAFH) 43.1% from 1970 to 2012. (USDA, 2016) According to survey results reported by Obbagy et al. (2011), chefs generally were receptive to the idea of making dishes healthier but faced some barriers such as access to information on calories and additional skills training for staff. Frequent consumption of FAFH at full-service and quick-service restaurants has been linked to higher obesity rates, chronic diseases such as diabetes with overconsumption of many nutrients including fat, protein and salt. (Fulkerson et al., 2011)

Observations suggest that chefs may need education not only in portion control but also in reduction of sodium in recipes, as well as how to incorporate and complement healthy plant proteins into their menu.

Traditionally, culinary arts programs offer nutrition education to train students in the preparation of healthier foods. However, there is little peer-reviewed information or techniques for sharing educational innovations' and research between institutions of culinary arts education (Abdulsalam, 2015). An applied culinary nutrition educational method is needed to minimize the gap for culinary educational programs to teach students about healthier nutrition applications. Additionally, the study by Obbagy et al. (2011) indirectly suggested that culinary schools may not have been as successful in imparting culinary nutrition application in the past since approximately a quarter of chefs surveyed felt they could use additional training to design specific menu niches.

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Evaluation of Applied Nutrition

Before the question of designing an applied culinary nutrition program can be approached, it is necessary to identify knowledge and practical components that should be reinforced by the instructors in post-secondary culinary arts programs with students. The purpose of this study was to identify areas of culinary nutrition that should be taught to culinary arts students at the collegiate level. Once knowledge gaps are identified, specific educational programs can be designed and evaluated. The objective of this pilot assessment was to determine if there is a change in students' knowledge, perceptions, and practices regarding nutrition science pertaining to protein, sodium, and healthy cooking techniques as a result of using an applied nutrition intervention lesson.

Materials and Methods

Site Description

With permission from a community technical college's administration and the research institution's Institutional Review Board, the convenience sample of $n=41$ culinary arts students was recruited. The participants in this study were from a culinary arts program at a technical college that provides an associate degree in culinary arts within the southeast region of the United States. The culinary arts program curriculum included one nutrition course. In this setting, the nutrition course required was basic human nutrition science. In most traditional culinary arts, associate degree programs (and required for American Culinary Federation, ACF, accredited programs) students take a minimum of 30 hours of nutrition. Emphasis for these programs is on culinary technique as well as business management. All participating students in this pilot study were enrolled in at least one nutrition class. A professional chef, nutrition educator, and culinary lab assistant supported the set-up and delivery of the lesson.

Description of the Evaluations

The student sample was randomized into two groups (Figure 1). Half received an educational lesson on protein ($n1=20$) while the other half received a lesson on sodium ($n2=21$). The students received a knowledge test before and after one of the two separate lesson presentations to assess their culinary nutrition knowledge.

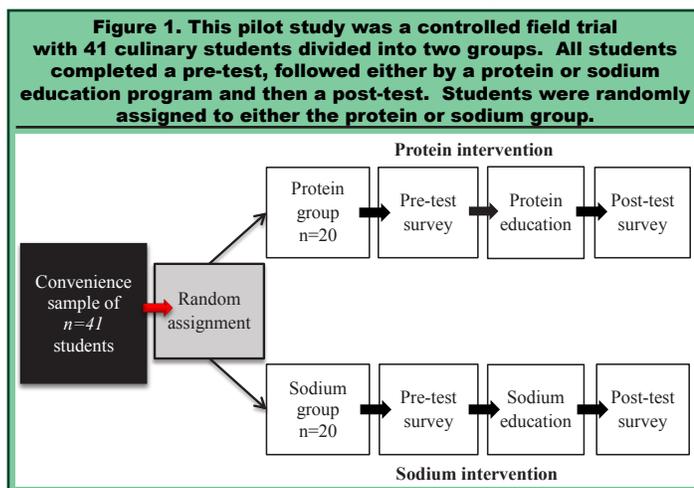
Survey Design

The tests were guided by previous work administered to professional chefs at the national level on the topics of fat, protein, sodium, and healthy cooking techniques (Condrasky et al., 2015). The tests were developed using interviews with culinary educators, research team discussions and by drawing on earlier research studies. Experts in foods and nutrition reviewed the first draft of both surveys for intended purpose, usefulness, and comprehensiveness. Subsequently, the tests were revised and reviewed again by experts to establish content validity. Since each survey measured factual knowledge rather than complex constructs, the validity of each survey was established by examining test questions. Such examination suggested that the face-validity of the test was at an appropriate level.

The goal of developing the tests was to use them to determine if there was a change in nutrition knowledge, perceptions, and practices as a result of using applied lessons to teach nutrition concepts. The information collected from both tests would help in developing materials on culinary nutrition to support the ongoing instruction for culinarians. This study also provided a conduit for the research team to learn more about how chefs make food ingredient selections for menus.

Each knowledge test included a brief demographic section (three items) followed by questions on nutrition knowledge, nutrition perception, and practices relating to protein or sodium. The protein survey had 19 questions: six items focused on nutrition knowledge and had a best answer, and 13 items did not have a best answer but were designed to determine students' perceptions and practices about nutrition and healthy cooking techniques. The questions on the protein survey covered key points about protein and portion size, customer demand, vegetarian concepts, as well as factors limiting the feasibility of placing vegetarian or less meat dishes on the menu. The sodium test had 26 questions: items 1 through 5 had a best answer and pertained to nutrition knowledge, and items 6 through 26 did not have a best answer but were designed to determine students' perceptions and practices about nutrition and healthy cooking.

Prior to participating in each culinary nutrition lesson, participants received a consent form describing the goal of the survey, the number of items, the time needed to answer the test, the contact information of the primary investigator, and their rights as a research participant. Students were asked to complete the test on their own. Students completed the demographic form and a pre-survey before the intervention lessons. These tests took approximately 15 minutes to complete. Following this, students participated in an applied culinary nutrition lesson provided by the chef and nutrition educator team. The lesson included a PowerPoint on one topic, a cooking demonstration, and sample tasting. Following the lesson, students completed the post-test. The pre- and post-treatment tests were identical. Students were instructed to complete the tests on their own.



Data Collection and Sampling Plan

The researcher collected data over a six-month period. The pilot study was a controlled field trial. Due to time and cost constraints, the researcher used a convenience sample. Culinary arts students received the self-administered survey during regular school hours. Participants did not receive any incentive. The technical college visit was divided into two phases:

Phase I: On the predetermined dates, all the enrolled participants of the respective groups were asked to answer the pre-treatment survey to assess their knowledge, perception, and practices regarding culinary nutrition topics (protein and dietary sodium).

Phase II: On the same predetermined dates, all participants were requested to answer the post-treatment knowledge test regarding the culinary nutrition topics to assess their knowledge, perception, and practices after attending comprehensive face-to-face presentations with live cooking demonstrations. All students received instructions not to leave any answers blank. They had sufficient time to consider and record their answers. Forty-one students ($n=41$) were examined: ($n=20$) in the first group (protein) and ($n=21$) in the second group (dietary sodium).

Data Analysis Plan

The researcher calculated percentages and frequencies to assess changes in students' responses regarding knowledge, perception, and practice items. The data analysis began with the generation of descriptive statistics to understand demographic characteristics of the groups. The changes in scores of each survey item of pre- and post-test were compared using paired t-test for Likert-type items and Fisher's exact test for the categorical items. Changes in average scores and percentages that were statistically significant were identified. Because the study was a pilot, non-statistically significant changes were also reviewed to determine if the direction of change was consistent with predicted outcomes.

Results

Protein Survey Results

The results of the protein knowledge test are provided in Table 1. In this table, only Likert-type items were included (items 4 through 14). Most of the changes were statistically significant. To test for the difference categorical variables for items 1 through 3 and 15 through 19, Fisher's exact test was used (Table 2). There was not a statistically significant difference between pre- and post-test responses for item 1 ($p=0.61$), while there were statistically significant differences for items 2 ($p<0.01$) and 3 ($p<0.01$). There were statistically significant differences for the distribution of responses for each of items 15 through 19 ($p<0.01$). The results in Table 2 suggest that the proportions of correct answers substantially increased.

Protein Survey Discussion

Regarding knowledge items in the pre-test, the participants demonstrated a weak knowledge base regarding the dietary reference value for protein, sources of protein, and complementary proteins. The Recommended Dietary Allowances (RDA) is a reference value along with others such as upper limit which together comprise the Dietary Reference Intakes. (Ross et al., 2014) However, after the educational intervention lesson, the knowledge about dietary protein increased. Most of the changes were statistically significant, which suggested that the educational intervention lesson was effective. Additionally, the proportion of questions answered correctly increased, which was another indication of the lesson efficiency.

The post-test showed that students continued to rate consumer demand as a highly important factor in limiting the feasibility of placing vegetarian or meatless dishes on the menu. Their consistent opinion regarding consumer demand indicated that consumer demand is one of the most important factors for controlling what is on the menu (Johnson et al., 2002).

Sodium Survey Results

In general, students' knowledge increased after participating in the applied nutrition sodium lesson (Table 3 and Table 4). Only 38% recognized the 2010 Dietary Guidelines regarding the reduction in the upper limit for sodium from 2,300 mg/day to 1500 mg/day. This item increased to 90% in the post-treatment test. In addition, 62% answered incorrectly that sea salt is a healthier alternative to table salt while only 14% answered this question incorrectly in the post-test.

For categorical test items 1 through 7 (Table 3), there was a statistically significant difference between pre- and post-test responses for item 1 ($p<0.01$), 2 ($p<0.01$), 3 ($p<0.01$) and

Table 1. Results for Paired t-tests for Likert-Type Items on Protein knowledge test as administered pre and post a protein education program with 20 culinary arts students.

Questions	Pre-test		Post-test		T
	M	SD	M	SD	
Circle your response from strongly agree to strongly disagree					
Vegetarian or meatless diets are lacking in essential nutrients and protein.	3.75	1.21	4.4	0.50	4.81*
Serving more vegetarian dishes reduces food cost which may increase profitability	2.9	1.07	1.8	0.77	-2.76*
Americans eat more protein than they actually need.	1.55	1.10	1.3	0.47	-6.22*
Reducing the portion size of meat offered in dishes would result in a decrease in business.	2.55	0.83	3.25	1.07	-5.64*
Rate the importance of each of the following factors in limiting the feasibility of placing vegetarian or meatless dishes on the menu.					
Need for specific staff skills and training.	4.05	1.05	2.35	1.60	-4.14*
High labor costs.	2.55	1.32	2	1.03	-3.58*
Limited ingredient availability.	3.1	1.37	2.9	1.21	0.61
High ingredient cost	2.95	1.15	2.4	1.14	2.46*
Short ingredient shelf life.	3.35	1.23	3.1	1.48	0.60
Consumer Demand.	3.75	1.29	3.9	1.37	0.24
Rate how confident you are in developing a vegetarian menu that contains complementing proteins.					
How confident you are in developing a vegetarian menu	3.15	1.50	4.15	0.99	-9.97*

*Significant at 0.05 α level

Table 2. Results of Fisher's Exact Test for the Changes in Categorical Items responses for the culinary arts student participants in a protein education program knowledge test.

Questions	Responses	Pre,%	Post,%	P-Value
1. Providing vegetarian meals offers a benefit to my establishment in terms of sales	1-True	85	95	0.61
	2- False	15	5	
2. There are no plant sources for complete proteins	1-True	60	5	p<0.01
	2- False	40	95	
3. Customer demand is NOT large enough to place vegetarian items on the menu	1-True	55	5	p<0.01
	2- False	45	95	
15. Complementary proteins are:	1- One food item providing all of the essential amino acids	15	5	p<0.01
	2- Two or more incomplete protein foods that when paired together give all of the essential amino acids.	25	85	
	3- Two protein sources that can be combined for enhanced flavor.	15	5	
	4- Are only found in animal-based foods.	45	5	
16. Which of the following non-meat foods provide complete proteins?	1- barely	0	0	p<0.01
	2- peanut butter	5	5	
	3- garbanzo beans	10	0	
	4- soybeans	15	80	
	5- spinach	5	0	
	6- None of the above	10	0	
	7- All of the above	55	15	
17. The recommended daily allowance of protein per kilo gram for an adult male is approximately:	1- 0.5 gram	10	0	p<0.01
	2- 0.8 gram	30	100	
	3- 0.9 gram	30	0	
	4- 1.0 gram	30	0	
18. Examples of complementary proteins are:	1- Macaroni and Cheese	5	0	p<0.01
	2- Peanut Butter and Jelly Sandwich	20	0	
	3- Beans and Rice	30	10	
	4- Hummus and pita bread	5	0	
	5- None of the above	10	5	
	6- All of the above	30	85	
19. The recommended daily allowance of protein for a 70kg (~154 lb.) adult male is approximately:	1- 105 grams	45	0	p<0.01
	2- 42 grams	0	0	
	3- 56 grams	20	95	
	4- 78 grams	30	5	

*Correct answers are shown in bold
*Significant at 0.05 α level

5 (p=0.02). The results for Likert-type items on the sodium test are presented in Table 4. At significance level $\alpha=0.05$, it appeared there was a statistically significant increase in knowledge about strategies to use unsalted butter in place of salted butter, to avoid pickles, and cooking with wine instead of soy or barbeque sauces.

Sodium Survey Discussion

A recommendation by the Institute of Medicine (2010) stated, "Food manufacturers and restaurant/foodservice operators should voluntarily accelerate and broaden efforts to reduce sodium in processed foods and menu items, respectively" (Henney et al., 2010 p.288). As stated earlier, consumer wishes are very important for chefs (Johnson et al., 2002). The same percentage of respondents (76%), in both pre- and post-tests, reported that reduced-sodium menus would lead to complaints from guests. This was even after the applied nutrition lesson when most participants agreed that sodium reduction would not be a major challenge to chefs, in terms of flavor, if they used their creativity in cooking. Ninety percent agreed simple flavor additions could enhance dishes containing reduced sodium, and 67% agreed that food service establishments should promote lower sodium versions of their menu items to guests.

Table 3. Results of Fisher's Exact Test for the Changes in Categorical Items responses for the culinary arts student participants in a sodium education program knowledge test.

Questions	Responses	Pre N%	Post N%	p-value
The 2010 Dietary Guidelines recommends reducing the upper limit for sodium intake for at risk groups from 2,300 mg/day to ____mg/day.	2,000	14.29	0.00	p<0.01
	1,750	28.57	4.76	
	1,500	38.1	90.48	
	1,200	19.05	4.76	
What percentage of Americans are concerned with their sodium consumption?	25%	14.29	4.76	p<0.01
	36%	42.86	4.76	
	40%	14.29	0.00	
	65%	28.57	90.48	
Sea salt is a healthier alternative to table salt.	True	61.9	14.29	p<0.01
	False	38.1	85.71	
When preparing a pasta dish with meat sauce, approximately how many times do you add salt from start to finish?	1	0.00	42.86	p=0.245
	2	14.29	23.81	
	3	42.86	19.05	
	4	19.05	4.76	
	> 5 times	23.81	9.52	
What do you think is the maximum percentage of sodium reduction before customers would notice?	10%	47.62	0.00	p=0.02
	25%	28.57	38.1	
	45%	19.05	57.14	
	55%	4.76	4.76	
Do you ever use purchased bases, such as stocks and sauces, when making dishes?	Yes	95.24	95.24	p=1.0
	No	4.76	4.76	
If you answered "Yes," do you ever seek out low-sodium or sodium-free bases?	Yes	38.1	66.67	p=1.0
	No	61.9	33.33	

*Correct answers are shown in bold
*Significant at 0.05 α level

Most students saw the importance of the training lesson. Ninety percent agreed that educational programs must be developed and adapted for employees working in the various sectors of the food industry to inform them about sodium and the sodium reduction strategies. Only 48% agreed to the same statement before participating

in the applied nutrition education lesson.

At significance level $\alpha=0.05$, there was no statistically significant evidence that the sodium education lesson reached effectiveness. However, the lack of statistical significance does not automatically indicate that the program was ineffective because pre-test scores on many test items, especially opinion items, were relatively high. In other words, students were already familiar with much of the material and for this reason the program provided limited benefit to this audience. This finding may indicate that the sodium education program redundantly targeted knowledge domains that students were already familiar with, as relevant to current trends in away-from-home food service. For this reason, an option of refocusing the sodium lesson could be considered for future applications.

Conclusion

Chefs play an important role in determining nutrient composition of the food and in affecting the food choices available for consumers. The foods designed by chefs with healthy nutrition applications can benefit the consumer and provide healthy options. These steps can help reduce the health-related consequences of oversized food portions and over-salted foods. Chefs can contribute to efforts geared at serving the right portion with less sodium in foods. Delicious and nutritious food choices can contribute to the goal of reducing the burden of obesity and other health related issues for the consumer. Culinary arts educators can promote healthy recipes and menus that arm the culinary arts graduate with techniques and nutrition knowledge that will improve offerings on the menu in food service establishments across the country. This notion is supported by Cohen et al. (2012). Trained cooks prepared healthier school lunches that contained more vegetables, had larger selection of whole grain menu items and a lower energy content of the food. Training only one chef in nutrition can affect lives of hundreds or even thousands of consumers. Culinary arts programs offer nutrition education to train students in the preparation of healthier foods. Yet, the research about how these programs are structured related to application of nutrition concepts in the foods lab is limited. A search of major academic databases located no peer-reviewed studies that specifically discussed scientific bases of culinary nutrition application in culinary arts programs (Abdulsalam, 2015). The absence of this information suggests that culinary arts programs may have a very limited basis for the design of applied culinary nutrition concepts. The

Table 4. Results for Paired t-tests for Likert-Type Items on Sodium knowledge test as administered pre and post a protein education program with 20 culinary arts students.

	Pre-test		Post-test		T
	M	SD	M	SD	
Do you think that:					
If gov't regulation restricted salt content on restaurant menu items, how difficult would it be for your establishment to comply?	2.81	0.93	2.43	1.08	1.50
Will following strategies be effective in reducing sodium?					
Use fresh tomatoes instead of canned.	4.24	0.70	4.43	0.51	-1.45
Use herbs and spices instead of using salt to add flavor.	4.29	0.56	4.48	0.51	-1.45
Use unsalted butter in place of salted butter.	4.15	0.75	4.57	0.51	-2.63*
Skip the pickle.	3.14	1.24	3.81	1.03	-4.18*
Cook with wine and vinegar instead of soy / bbq. sauce.	3.71	0.90	4.38	0.50	-3.35*
Easiness to change to produce reduced-sodium dishes					
Use fresh tomatoes instead of canned.	2.00	1.00	1.81	0.75	0.89
Use herbs and spices instead of using salt to add flavor.	1.71	0.64	1.62	0.50	0.57
Use unsalted butter in place of salted butter.	1.86	0.96	1.57	0.60	1.19
Skip the pickle.	2.14	0.96	2.00	0.71	0.68
Cook with wine and vinegar instead of soy / bbq. sauce.	2.29	0.85	2.05	0.97	1.56
Do you think that:					
A reduced-sodium menu will lead to complaints from your guests	2.48	1.03	2.33	0.73	0.77
Sodium will not be a major challenge to chefs in terms of flavor	3.52	0.98	3.67	1.02	-0.77
Simple flavor additions can enhance dishes with reduced sodium	4.10	0.55	4.14	0.73	-0.81
Establishments should promote lower sodium menu items	4.00	0.77	4.05	1.02	-0.18
Education programs are needed to teach sodium reduction strategies	4.10	0.54	4.24	0.62	-1.14
Consumers prefer salty food and will resist change.	3.19	0.98	3.10	1.14	0.32
High salt content foods must be labeled.	3.62	0.97	3.81	1.25	-0.78
It is very costly for the restaurant to reduce salt in food products.	2.76	0.94	2.43	0.93	1.28

*Significant at 0.05 α level

direction of the changes in survey scores suggested that experiential learning worked successfully in teaching nutrition to culinary arts students. Hence, experiential learning is a promising method to teach nutrition within culinary arts programs. This approach needs additional development before it can be recommended for culinary nutrition lesson implementation.

Limitations

This study represents a controlled field trial and was limited to two locations, one project, and a small sample due to time and cost constraints. This limitation presents a constraint to the generalization of the findings, but also provides opportunities for future research. A greater sample size would improve external validity. The reactivity or Hawthorne effect has been described as follows: "Research participants sometimes favor a certain method because they know the researcher wants that result" (Leedy and Ellis, 2000, p.231). Students may favor the current study's alternative teaching method because of the Hawthorne effect.

Recommendations and Further Research

For further research, researcher should request the research sample to participate in further longitudinal research to deepen understanding of how students learn best and to assess their knowledge, knowledge, ease of use, strategies, and attitudes over time. The research team has collaborated with the American Culinary Federation (ACF) Accreditation team in the design and administration of this preliminary work as well as in follow-up research activities. Further investigation with a greater representation of ACF programs who receive 30 hours of nutrition within the curriculum is recommended. The plans include the development of innovative practical instructional methods to teach nutrition in practical (kitchen) settings.

Evaluation of Applied Nutrition

Assessment of the practical application of nutritional concepts in order that student chefs will be prepared for their future work is indicated. Further investigation may follow the application of sensory science techniques for food product characteristics including taste and overall acceptability given attention to reduced sodium and appropriate protein portions. An investigation into the impact of practical approaches to enhance the execution of healthy cooking technique practices in food service kitchens can follow. These efforts will rely on the improvement of sampling methodology to reduce probability of biases and would benefit from multi-stage sampling. Activities and educational strategies may further be supported in part by a registered dietitian nutritionist who may be on faculty to teach the nutrition component to the culinary arts students.

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