# Assessment of Culinary Students' Knowledge, Perceptions and Practices of Nutrition Science[1]

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## Abstract

Currently, the research on the nutrition competence of two year culinary arts students prior, and during their program is very limited. A search of major academic databases (EBSCO), (PUBMED) and (CINAHL) found no peer-reviewed articles addressing the level of nutritional knowledge culinary students have as a result of a culinary arts education. Thus, there is a gap in the literature as it is unknown what would be the optimal way to design culinary nutrition education programs that would produce students well versed in the preparation of healthy and great-tasting food. The study sought to assess knowledge about dietary fat, protein, and sodium among culinary arts students nationwide. This study reports the results of an online survey on general nutrition knowledge of culinary students (n=250) enrolled in associate degree programs across the country. The descriptive online nationwide survey results suggest that knowledge about dietary fat, protein, and sodium was less than satisfactory. Based on these results, it is recommended that culinary arts post-secondary programs incorporate reinforcement lessons beyond the one required nutrition course into their curricula. Decisions on academic emphasis based on nutrition knowledge and current trends contribute to future R & D and food service culinarians at the application level in food design and production.

**Keywords:** nutrition, nutrition education, culinary arts, culinary education

## Introduction

Nutritional knowledge of students studying culinary arts, who represent future food preparers and product developers, is critical, yet little is known about their knowledge on fat, protein, sodium, overall portion sizes, and healthy food preparation techniques. By investigating nutrition knowledge in topics relevant to current trends at a baseline, researchers and culinary arts program directors can interpret and modify the future curriculum that may impact the quality of food prepared by today's culinary students.

It is important to increase nutritional awareness among culinary arts students. This awareness relates to the typical role and responsibility of professional chefs. Chefs frequently determine both the composition and the portion size of their menu offerings and these determinations should directly relate to the nutritional needs and concerns of customers (Condrasky et al., 2007). Ma et al. (2014) studied chefs' attitudes and knowledge of healthy eating and found that chefs feel that they had adequate nutrition knowledge even when their interpretation of nutrition science principles was no better than that of that of the average customer. This could be explained by the limited amount of nutrition coursework and training within chef programs. The study brought into question the chef's ability to build nutritionally balanced menus and practice healthy cooking. Middleton (2002) suggested that enhanced nutrition training and education could have a significant role in changing chefs' knowledge, perceptions, and practices regarding the design and service of nutritionally balanced menu options.

Many chefs are unaware of correct portion sizes and nutrient requirements. For example, Condrasky et al., (2007) reported that chefs' responses in a national survey indicated that the average steak entrée they served was

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several times greater than the recommended protein amount for an entire day. Furthermore, when chefs were asked whether they considered portion control (or, more accurately, portion consumption control) to be the responsibility of the chef or of the patron, chefs differed. Thirty-nine percent responded that it was their responsibility as chefs while 58% consider it to be entirely up to the diner. Whoever makes the decision on portion size maintains a considerable influence with implications on calories consumed, facility overhead costs, as well as on the environment.

Nutrition subjects in most culinary arts programs are often being taught in a traditional lecture method rather than in conjunction with application of culinary techniques. It appears that instructors often give lectures about nutrition using the assigned book with an emphasis on human nutrition science and little information regarding culinary technique and practices (Abdulsalam, 2015). Culinary students need to see solutions in ways that are more applicable to their food service as well as new product development careers.

It would be prudent to educate chefs on overcoming barriers to healthful commercial food preparation. The current literature identifies barriers, such as the need for additional time, staff training (Gase et al., 2014), customer demand, the relative economic cost of dish components, customer expectations, the degree to which portion size affects presentation (Condrasky et al., 2007), and the attitudes of restaurant owners (Gase et al., 2014). Culinary arts education should emphasize the opportunities that chefs have to contribute talent and technique with their recipes, menus and products. The very menu description of their dishes can go a long way to helping their customer to make healthy food choices. Culinary arts students should also receive appropriate training on how to share on-the-job nutrition information and clarification for their kitchen and dining room coworkers. This study assessment sought to contribute to the design of applied nutrition education models in culinary arts education.

## Materials and Methods

### Site Description

Human subjects were recruited by contacting American Culinary Federation (ACF) programmatically accredited associate degree culinary arts program coordinators with a request to invite their second-year culinary students to participate in an online survey via Survey Monkey™.

### Description of Evaluations (Methodology)

#### Knowledge Assessment Design

The researcher developed a knowledge assessment tool guided by previous results on questionnaires on opinions, knowledge, and current practices of culinary arts instructors and professional chefs regarding healthy food techniques. These questionnaires had been administered to instructors and industry chefs (n=327) at eight collection times at professional conferences. They were given at culinary meetings across the country. The questionnaires included current topics on sodium, lipids, protein as well as healthy food preparation techniques and was organized at a foundational level. The goal of this pilot research was to contribute to the design and delivery of resources to support future enhancement of culinary education. (Condrasky et al., 2015) Informed by the guidance of this previous work, the research team for the current study, discussed the design of a knowledge assessment tool with culinary arts instructors, nutrition educators, as well as experts in food services. This team reviewed the draft of this new tool for its intended purpose, usefulness, and comprehensiveness. Subsequently, the tool was revised and reviewed again by experts to establish content validity. Since the tool measured factual knowledge rather than complex constructs, the validity of the survey was established by examining survey questions. Such examination suggested that the face-validity of the tool was acceptable.

The new knowledge assessment tool included a brief demographic section, containing seven items, followed by nine items that measured nutrition knowledge and perception. The tool focused on fat (three items), protein (three items), and sodium (three items) as key nutrition topics or factors. The tool would be applied to determine if current culinary art students were knowledgeable on topics suggesting areas that need to be included in future culinary arts education. Prior to completing the knowledge assessment tool participants provided informed consent. This study was approved by the Institutional Review Board in the Office of Research Compliance for Human Studies Research at the University.

#### Data Collection and Sampling Plan

These data were collected using an online self-administered survey over a thirty-day time period. The selection of participants proceeded in two phases. In the first phase, the principal investigator contacted program coordinators from the ACF's accredited schools list with the request to invite their senior students to participate in the survey. Students were asked to complete the survey on their own. In the second phase, email invitations with links to Survey Monkey™ were emailed to n=300 senior students. Each email contained an explanation of the purpose of the survey and explanation on why their participation was beneficial. A total of (n=250) responded.

#### Data Analysis

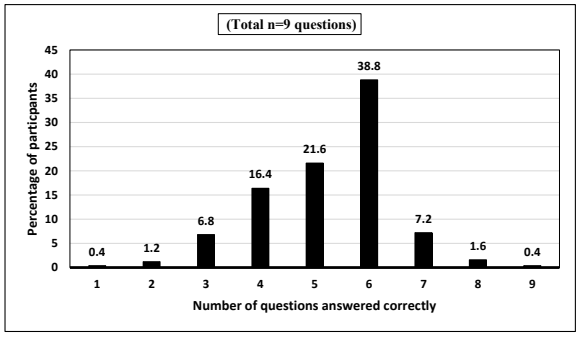
Descriptive statistics of the sample were generated to understand characteristics of the target population and their nutritional knowledge level on the sodium, fat, and protein items. Subsequently, four new variables were generated to represent the number of correct answers on each subscale and for the overall survey. Histograms showing distribution of the correct answers were generated to better illustrate knowledge gaps on these specific nutrient items.

To assess the impact of socio-demographic factors on the level of knowledge, multiple analysis of variance (ANOVA) were conducted. For the ANOVA, the dependent variables represented the number of correct responses while independent variables represented socio-demographic characteristics.

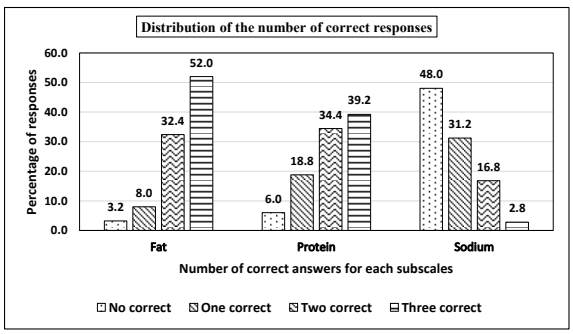
## Results

Examination of the sample demographics suggests that the sample was relatively well balanced with good representation of different socio-demographic groups. Within the study (n=250 respondents) the majority (46%) were 19-29 years of age. Thirty to 39 year olds represented 19%; 40 to 49 years (20%); and 50 years of age or older (15%) of the respondents. The study group was predominately white (73%) with black non- Hispanic (13%) and other ethnicity representation at 14%. Respondents represent four regions of the U.S. with 34% from the southeast; 19% from the northeast; 25% from the central area; and 22% from the west. Figure 1 provides information on the distribution of responses on each of the three topics including fat, protein and sodium. Nine questions are included in this analysis and in the top portion of the figure percentage of participants correctly answering the nine questions is provided. The bottom part of the Figure 1 reviews the number of correct answer provided by the participants within each of the fat, protein and sodium subscales with illustration of the number correct for each topic from none correct to three correct.

**Figure1. Distribution for the Number of Correct Responses for All Questions on the Knowledge Assessment Subscales.**




*Distribution of the Number of Correct Responses for All Questions on the knowledge*




*Distribution of the Number of Correct Responses for Knowledge Assessment Subscales*

Knowledge was assessed on a subscale for each of three topics including: dietary fat, protein, and sodium among culinary art students nationwide. The questions, response options and response percentages for each subscale is provided in Table 1.

Respondents provided information on their years in the food industry, positions they worked, and type of establishment that they had been employed.

To determine which socio-demographic characteristics affected the number of questions answered correctly, factorial ANOVA models were fitted with the dependent variable representing the number of questions answered correctly on each of the three subscales and the overall total of the correct answers (Table 2). For each dependent variable, the model of the following form was fitted with appropriate transformation of categorical predictors to dummy variables.

$$y=\mu_0 + Age_i + Gender_j + Ethn_k + Region_l + Exp_m + Empl_n + Facility_p + \epsilon_{i...p}$$

In this model, interaction effects were omitted because the sample size was not sufficiently large enough to achieve reasonable statistical power with the larger number of free parameters required for the model with interaction effects.

The analysis suggests that the "Region" was associated with the total number of answers on the protein survey *p=0.039* and overall number of questions answered correctly *p=0.016*. Type of the employment was associated with the number of questions answered correctly on the sodium survey *p=0.006*. The facility type was also strongly associated with the number of correct

**Table 2. Multivariate ANOVA: demographic characteristics impact on knowledge about fat, protein and sodium.**

| Independent Variable | Dependent Variable | F | p-value |
|---|---|---|---|
| Age | Fat | 0.688 | 0.560 |
| | Protein | 0.984 | 0.401 |
| | Sodium | 1.646 | 0.180 |
| | Overall | 0.701 | 0.553 |
| Gender | Fat | 2.292 | 0.132 |
| | Protein | 3.310 | 0.070 |
| | Sodium | 2.762 | 0.098 |
| | Overall | 1.224 | 0.270 |
| Ethnicity | Fat | 1.337 | 0.265 |
| | Protein | 0.265 | 0.768 |
| | Sodium | 1.479 | 0.230 |
| | Overall | 1.397 | 0.250 |
| Region | Fat | 0.855 | 0.465 |
| | Protein | 2.843 | 0.039* |
| | Sodium | 0.116 | 0.950 |
| | Overall | 3.526 | 0.016* |
| Experience | Fat | 1.887 | 0.154 |
| | Protein | 1.413 | 0.246 |
| | Sodium | 1.720 | 0.182 |
| | Overall | 0.202 | 0.818 |
| Employment | Fat | 1.094 | 0.353 |
| | Protein | 1.849 | 0.139 |
| | Sodium | 4.302 | 0.006* |
| | Overall | 0.092 | 0.965 |
| Facility Type | Fat | 2.144 | 0.062 |
| | Protein | 2.938 | 0.014* |
| | Sodium | 2.217 | 0.054 |
| | Overall | 1.476 | 0.199 |

*Significant at 0.05 level

**Dependent variables represents the number of questions answered correctly

**Table 1. The percentage of responses to questions asked about dietary fat, protein and sodium among culinary art students nationwide. Responses are based on survey results of 250 culinary students enrolled in associate degree programs across the country.**

| Questions | Response Options | Response |
|---|---|---|
| **Responses on Fat Subscale** | | |
| 1. Many foods labeled "fat-free" are generally higher in sugar, refined carbohydrates and calories. | Strongly Agree* | 29.3% |
| | Agree* | 53.7% |
| | Neither Agree or Disagree | 11.0% |
| | Disagree | 4.9% |
| | Strongly Disagree | 1.2% |
| 2. Which is the best source of monounsaturated fat? | Olive* | 71.8% |
| | Palm | 3.2% |
| | Fish | 9.3% |
| | Canola | 13.7% |
| | Corn | 2.0% |
| 3. What type of fat do you primarily use to sauté? | Butter | 12.2% |
| | Vegetable oil (corn, canola, etc.)* | 24.1% |
| | Olive oil* | 58.4% |
| | Specialty oil | 5.3% |
| **Responses on Protein Subscale** | | |
| 4. The USDA's recommended portion size for a single serving of meat for the average adult is? | 2 to 4 ounces* | 66.7% |
| | 5 to 7 ounces | 30.9% |
| | 8 to 10 ounces | 2.0% |
| | 11 to 12 ounces | 0.4% |
| 5. Complementary proteins are: | One food item providing all of the essential amino acids. | 6.0% |
| | Two or more incomplete protein foods that when paired together give all of the essential amino acids.* | 85.1% |
| | Two protein sources that can be combined for enhanced flavor. | 7.2% |
| | Are only found in animal-based foods. | 1.6% |
| 6. Which of the following modifications to the normal hamburger and fries meal at a restaurant do you feel would be perceived as the most acceptable among children? | Using ground turkey meat with finely minced vegetables | 11.7% |
| | Substituting regular fries with baked sweet potato fries | 17.4% |
| | Using a whole-wheat bun | 14.6% |
| | Scaling back the portions of both the burger and fries* | 56.3% |
| **Responses on Sodium Subscale** | | |
| 7. In January 2010, the American Heart Association announced the sodium recommendation for all Americans should be reduced to 1,500 mg a day. Which food item below contains the daily recommendation for sodium of 1,500 mg? | 1 3/4 teaspoon of table salt | 43.8% |
| | 1 can of soup | 11.6% |
| | 1 cup grated Parmesan cheese | 10.8% |
| | All of the above* | 33.7% |
| 8. Which of the following is a better alternative to table salt to reduce sodium? | Sea salt | 44.0% |
| | Kosher salt | 19.2% |
| | Non-iodized salt | 10.8% |
| | None of the above* | 26.0% |
| 9. When preparing a pasta dish with meat sauce, approximately how many times do you add salt from start to finish? | 1 time* | 14.1% |
| | 2 times | 33.9% |
| | 3 times | 41.5% |
| | 4 times | 8.9% |
| | 5 times or more | 1.6% |

* Correct answer

responses on the protein survey. No other demographic variables were statistically significant.

For the statistically significant variables, post-hoc tests were run to determine which factor levels accounted for the differences. Least significant difference (LSD) post-hoc test suggested that only central and southeast regions were different from each other, both for the overall number of the questions answered correctly $M_C=5.53$ versus $M_{SE}=4.92$, $p=0.009$ and for the protein survey $M_C=2.25$ versus $M_{SE}=1.88$, $p=0.046$. With respect to the "Employment" variable, those who worked in the areas of "Bakery/Pastry/Kitchen helper/Culinary Apprentice" were different from all other groups on the sodium subscale. On average this group had lower knowledge about sodium than those with "No industry experience" ($p=0.038$), "Cooks/Line Cook/Sous Chef" ($p=0.024$) and "Other" positions ($p<0.001$). Those who worked at "Fine Dining" facilities had better knowledge about protein as compared to those working in "Fast Food" service $M=0.47$, $p=0.02$, or had "No industry experience" $M=0.59$, $p=0.005$ or worked "Other" $M=0.68$, $p=0.001$.

Finally, to compare the average number of questions answered on sodium, protein, and fat surveys, repeated measures of ANOVA was used. Repeated measures ANOVA was selected to focus on the change in scores over time and to achieve higher statistical power since this procedure separates between subjects' differences from the error (Ott, 2010). There was a statistically significant difference within subject effect $p<0.001$. The series of paired post-hoc t-tests revealed that the average number of correctly answered questions was different for each subscale. Subscale means and standard deviations for fat, protein, and sodium subscales correspondingly were $M_{fat}=2.39$, $M_{prot}=2.09$, and $M_{sod}=0.74$.

Overall, the data suggested that those located in the Southeast region of the U.S. scored lower on the protein survey and overall as compared to any other region in the nation. Those who worked at fine dining facilities were better informed about protein that any other group. Finally, those employed in a bakery or pastry department scored the lowest on the survey.

## Discussion

The results suggest that knowledge items about specific nutritional practices was low. Only 0.4% of the respondents answered all nine questions correctly. The overwhelming majority 90.8% correctly answered six or fewer questions out of total nine questions. Knowledge about sodium was the least correct response, with 48% of students having no correct responses in this section. Fat and protein items had similar percentages of correct answers, 3.2% and 6% respectively. These rates of correct responses indicate room for improvement and is an important consideration given the responsibility for menu design and portion control that the executive chef in food services commands. Murray (2015) illustrated college age students working with culinary skills and gaining confidence with healthy cooking improve as they practice. The recommendation from this study was to define effective strategies to motivate and encourage this age group to improve food behavior practices for their future both for career and personal gains. Nutrition concepts introduced in traditional lecture classes are important and can provide a foundation for the hands-on application of topics related to sodium, fat and protein provided throughout a culinary arts program. Cooper (2016) documents an increase in food, culinary knowledge and skills in undergraduate food related students as they advanced in their matriculation in their academic and laboratory experiences.

Using non-probability sampling technique could be the reason for the regional differences detected on the protein survey or the effect of the facility type on knowledge about protein. Convenience sample can lead to the under-representation or over-representation of particular groups within the sample. Those who were employed by a bakery or a pastry department scored low in knowledge about salt. Possibly their work with bakery formulas provided little flexibility in seasonings and limited application of sodium in food preparation. According to Hess (1997) food service professionals must relay nutrition information to the consumer and act as role models. Chef involvement is important because taste preference is a part of individualizing culinary and nutrition advice. In general, demographic characteristics appear unrelated to the level of nutrition knowledge. Thus, the potential to reach the culinary arts student within the food laboratory can be instrumental in this hands-on experiential education focus across the country.

## Conclusion

The present research found that most of the students seem to have a better sense of fat and protein basic knowledge competencies as compared to sodium. This finding is largely unrelated to demographic characteristics. For most practical purposes, it can be assumed that lack of knowledge about healthy nutrition was relatively uniform across socio-demographic strata. Therefore, everyone can benefit from education about healthy nutritional guidelines as applied to sodium, fat, and protein. In general, for the purposes of any curriculum development, culinary arts students are most familiar with nutritional information about fat and least familiar with sodium while their level of knowledge about protein falls in between those two. Culinary arts programs should include more training on nutrition of all types and concepts as was measured in this study. An exploratory review of current educational strategies and resources will inform the enhancement of culinary nutrition resources. Development and testing of topical resources identified in this study and future reviews may continue to enhance the strategies chefs use in recipe design and thus improve the healthfulness of food away from home. Enhanced nutrition application of techniques in food service operations, restaurant kitchens, as well as in product development manufacturing units may provide healthy dividends both in dining and health for the public.

### Limitations

While a probability sampling technique would have been preferred, the convenience sample was the only sampling technique that could be used to collect data due to time and cost constraints and limited access to the lists of populations. Since the sample was not chosen at random sampling biases are a possibility.

## Recommendations and Further Research

This paper offers the following recommendations for further research. Request a research sample to participate in further longitudinal research to deepen understanding of how students learn best and to assess their knowledge, perceptions, and practices over time. Improve sampling methodology to reduce probability of biases. Instead of convenience, use multi-stage sampling and improve surveys by conducting in-depth analysis of validity and reliability. In addition, develop innovative practical instructional methods to teach nutrition in an applied setting including culinary arts program kitchens and laboratories. Likewise adding nutrition topics and concepts may better enhance the preparedness of culinary arts graduates for their future food and customer services work.

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