

Impact of Adding Food Defense Modules to Three Different Undergraduate Curricula

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Abstract

The concept of Food Defense is relatively new and focuses on shielding the food supply from intentional contamination making it different from food safety which focuses on unintentional contamination. The purpose of this study was to assess student satisfaction, level of awareness, teaching efficacy and knowledge gained by the inclusion of Food Defense teaching modules across three different undergraduate curricula. Undergraduate curricula were chosen to encompass the entire food chain of animal based products; animal science (AS), food science (FS) and hotel and restaurant management (HRM). Regardless of curriculum, students found the material was easy to understand, presented in a logical sequence and at the appropriate level for the course. Students enrolled in cross-listed courses found the food defense information a valuable addition to the course. FS students self-reported the modules increased their awareness of food defense and these students also felt they could assess food defense risks, describe the steps in developing a food defense plan, create a plan for a specific situation and determine a response plan. Students in all curricula gained knowledge of food defense as evidenced by an increase between pre- and post-test scores with the largest magnitude of increase among HRM students.

Introduction

The former secretary of the U.S. Health and Human Services, Tommy Thompson, mentioned in his departing statement in December 2004 that the threat of terrorist attack on the U.S. food supply was one of his main worries.

U.S. agriculture is vulnerable to an attack because it is concentrated. Factors associated with production and processing concentration that increase food supply risk include the increased susceptibility of livestock disease, rapid movement over broad geographies and insufficient agriculture related security and surveillance (Crutchley et al., 2007). There have been 21 attacks on agriculture or the food supply recorded globally since 1952 (Turvey et al., 2007). In 2004, the USDA Food Safety and Inspection Service proposed a rule requiring federally inspected establishments to develop food defense plans that protect food against intentional contamination. In response to this proposed rule, the meat and poultry industry asked for voluntary adoption of food defense plans. In 2010, 74% of all federally inspected establishments have functional food defense plans (FSIS.USDA.gov). The only required food defense plans for the USDA are for those vendors wanting to participate in the federal feeding programs. However, the passage of the FDA Food Safety Modernization Act in late 2010 requires food production facilities under inspection of the Food and Drug Administration to have functional food defense plans.

Previous findings from research focused on consumers reported after food recalls showed that consumers have decreased confidence in food defense systems and they perceive government and manufacturers as being the most responsible for food defense (Stinson et al., 2008). Therefore, graduates of AS, FS and HRM programs need to be familiar with recent government directives and industry initiatives that deal with food

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defense for animal products to be more competitive and such knowledge will ultimately help the food and animal industries become more prepared for the upcoming changes related to the FDA Food Safety Modernization Act. Because food defense is an emerging area that during the course of this study was not required by any federal or state agency, food defense plans had been introduced to the food industry but had not yet been introduced into undergraduate curricula. The approach used was to introduce food defense through a series of one to two lecture or laboratory modules placed in a variety of courses that covered the farm to fork continuum focusing on animal based food products.

Previous research related to food defense education has focused on the education of individuals already employed by the food or allied industry. Shutske et al. (2008) reported on educating public and private sector food professionals through a series of lectures, table top exercises and field trips. Shutske et al. (2008) reported a progression of learning starting with increased awareness of food defense and ended with the participants being able to identify vulnerabilities when touring food plants. Additionally, participants increased their knowledge as determined by pre- and post-test scores (Shutske et al., 2008). Harrison et al. (2010) trained first responders in agrosecurity issues through a series of eight modules presented state wide by extension agents who had attended a “Train the Trainer” course and received curriculum materials and specific dialogue for each module. The first responders increased awareness and found the training helpful (Harrison et al., 2010).

Purpose and Research Questions

The purpose of this study was to describe and explain the overall effectiveness (satisfaction with curriculum and instruction) of incorporating food defense modules in to undergraduate curriculums (AS, FS and HRM) that span the entire food chain for animal-based food products. The following research questions guided this study:

1. What are the differences in students' level of satisfaction toward the food defense curriculum and instruction among academic courses?
2. What are the differences in food defense awareness and efficacy (self-assessment of student ability in food defense) among participants of various academic courses?
3. What are the differences in students' achievement scores and effect size by academic course?

Methods

Curriculum modules (n = 9) with test questions and/or homework (n = 6) were developed to be used as 50

minute lectures or 110 minute laboratories depending on the structure of the class. Curriculum modules consisted of lecture materials in the form of slides with instructor notes and scenarios of a variety of food production examples ranging from animal production to a farmer's market which provided a starting point for discussion and working through a food defense plan. When homework was employed, students were asked to develop food defense plans specific to the course. Instructors for this material were active participants on the grant, involved with the development of the materials used in order to minimize variation in content delivery. The curriculum modules were implemented in three undergraduate, senior-level production courses in AS (beef production, swine production and poultry production), two senior level quality courses in FS (food product development and food quality assurance), one junior level (principles of meat science) and one senior level (processing muscle foods) processing courses that were cross listed in AS and FS, and two freshmen level culinary courses in HRM (culinary fundamentals and topics in hotel and restaurant management) between 2007 and 2009. These courses were chosen because they, in totality, explore the entire food continuum related to animal production and products and because they are taken by students likely to find employment in either animal or food production.

A researcher-developed instrument (paper questionnaire) was used to determine student satisfaction with instruction and curriculum, awareness of food defense and food defense efficacy. A five-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree and 5 = strongly agree) was used for all nine questions. To determine satisfaction with instruction, students were asked if the materials were presented in a way that was clear and easy to understand, if the materials were presented in a logical sequence and if the materials were at a level appropriate for the course. To assess satisfaction with curriculum, students were asked if the materials were a valuable addition to the course. Awareness of food defense was assessed by asking for level of agreement/disagreement with the statement, “The increased awareness of food defense issues will be an asset to me in my future career.” To determine food defense efficacy students were asked if they were able to assess food defense risks, to describe the basic steps of developing a food defense plan, create a food defense plan for a specific situation and determine a plan for response in case of a suspected incident. In areas where more than one question was used the responses were averaged by participant. A test consisting of nine multiple choice questions about general knowledge of food defense was developed and administered before and after the food defense materials were delivered to

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assess knowledge gained. Homework was completed outside of class and turned in during class. All other assessments were completed by students in the classroom. This was deemed exempt by the University of Missouri Institutional Review Board.

Data were analyzed using SPSS 15.0. Means, standard deviations and frequencies were generated to summarize the data. Effect size was calculated for determining differences using Cohen's *d* (Cohen, 1988) with *d* values of where, small effect size (*d* = 0.20); medium (*d* = 0.50); large (*d* = 0.80 or larger). Only students completing the pre- and post-tests were used in data analysis.

Results and Discussion

Regardless of undergraduate curricula, students felt that the food defense instructional materials were clear and easy to understand, presented in a logical sequence, and at the level appropriate for the course (Table 1) based on mean combined scores higher than 4. These results are similar to those reported by Shutske et al. (2008) who used modules to train food industry professionals. Additionally, students in cross listed classes thought the materials were a valuable addition to the course (4.09) whereas students in animal science and food science courses had no opinion (3.71 and 3.98, respectively) about the value the material. This may have been due to the fact that the cross listed classes are meat science classes where the current government regulations are discussed in the context of the comprehensive food system as opposed to courses where food defense might not be as integrated into the course objectives. When students were asked if an increased awareness of food defense would be an asset to their future career only food science students (4.04, Table 2) agreed. However, students in animal science and cross listed classes had no opinion (3.67 and 3.94, respectively). These answers were given prior to the passage of the Food Safety Modernization Act so food defense was not a required regulatory element of food production at the time.

Food defense efficacy was a self-assessment by students about their ability to assess risks, describe and create a plan, and develop a response plan. Food science students agreed that they were able to complete the tasks above (4.05, Table 2) whereas animal science and cross listed classes had no opinion (3.90 and 3.93, respectively) Both food science and animal science students completed an assignment related to food defense and the animal science students

Table 1. Comparison of Students' Satisfaction Levels of Curriculum by Academic Course^a

	Academic Course ^b											
	AS			AS & FS			FS			HRM ^c		
Satisfaction	n	M	SD	n	M	SD	n	M	SD	n	M	SD
Instruction	167	4.12	.66	96	4.42	.49	40	4.23	.71	148	4.22	.66
Curriculum	120	3.17	.83	47	4.09	.78	46	4.09	.83	-	-	-

^a1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, 5 = strongly agree

^bAS = Animal Science, FS = Food Science, HRM = Hotel and Restaurant Management

^cCurriculum satisfaction was not assessed for HRM courses

Table 2. Comparison of Students' Level of Awareness and Efficacy by Academic Course^a

	Academic Course								
	Animal Science			Animal Science & Food Science			Food Science		
	n	M	SD	n	M	SD	n	M	SD
Increased My Food Defense Awareness	120	3.67	.97	47	3.94	.84	46	4.04	.70
Food Defense Efficacy	120	3.90	.50	47	3.93	.60	46	4.05	.52

^a1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, 5 = strongly agree

received higher scores on the assignment (94.15% vs. 88.74%) but that did not translate to increased confidence in their ability to complete a food defense plan. Shutske et al. (2008) reported that "site visits with hands-on learning experience" was considered one of the most valuable parts of their learning experiences and lead to a majority of participants (89%) being able to apply their knowledge.

Instructional materials are strong enough to increase knowledge in all curricula (Table 3). In all undergraduate classes, students increased their knowledge as evidenced by an increase in the mean test scores of 38.1% between the pre- and post-tests. All undergraduate curricula showed a large increase in scores between pre- and post-tests with HRM and cross listed students having the largest increase (2.49 and 2.35, respectively). These results are similar to those reported for agrosecurity training of first responders (Harrison et al., 2010). When food industry professionals were given pre- and post-tests there was no significant change in scores due to high levels of basic awareness of food protection and defense (Shutske et al., 2008). Students also felt more confident in their knowledge as evidenced by a 37.6% decrease in the use of "do not know for sure" between the pre- and post-tests. This underscores the need for education on emerging regulatory issues at the college level to prepare students for positions in all aspects of a comprehensive food industry. Course modules are available for use at <http://extension.missouri.edu/fooddefense/>.

Table 3. Comparison of Performance Scores and Effect Size by Academic Course

Course	n	Pre-Test Score			Post-Test Score		Cohen's
		M	SD	M	SD		
Animal Science	168	2.88	2.08	5.99	1.49	1.72	
Animal Science & Food Science	96	2.54	1.79	6.59	1.65	2.35	
Food Science	34	3.62	2.05	5.68	1.82	1.06	
Hotel & Restaurant Management	150	1.57	1.15	5.43	1.87	2.49	

Summary

Regardless of the curriculum, all students increased their test performance, awareness of food defense and ability to assess risks based on the modules taught. Students also found the level of curriculum and instruction appropriate. Based on the findings of this study, adding emerging regulatory issues to current, industry relevant upper level undergraduate courses is a viable option to creating new course offerings.

Literature Cited

- Cohen, J. 1988. Statistical power analysis for the behavioral sciences (2nd ed.) Lawrence Erlbaum Associates.
- Crutchley, T.M., J.B. Rodgers, H.P. Whiteside, Jr., M. Vanier and T.E. Terndrup. 2007. Agroterrorism: where are we in the ongoing war on terrorism? *J. Food Protection*. 70(3): 791-804.
- FSIS.USDA.gov. 2012. http://www.fsis.usda.gov/food_defense_%26_emergency_response/food_defense_plan_survey_results/. Accessed on 9/20/2012.

- Harrison, J.A., R.D. Hamilton and K.S.U. Jayaratne. 2010. Agrosecurity awareness curriculum design, delivery and evaluation with first responders to agricultural and food emergencies. *Food Protection Trends*. 30(6): 340-345.
- Shutske, J.M., J. Pierquet, L. Michel, R. Rasumussen and D. Olson. 2008. Evaluation of food protection and defense outreach education programs. *J. Food Sci. Ed.* 7(4): 69-77.
- Stinson, T.F., K. Ghosh, J. Kinsey and D. Degeneffe. 2008. Do household attitudes about food defense and food safety change following highly visible national food recalls? *Amer. J. Agr. Econ.* 90(5): 1272-1278.
- Turvey, C.G., B. Onyango, W. Hallman and S.C. Condry. 2007. Consumers' perception of food-system vulnerability to an agroterrorist attack. *J. Food Distribution Research*. 38(3): 70-87.

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