

# Master of Professional Studies in Agriculture and Life Sciences offered through the Field of Food Science and Technology at Cornell University: A Model for the Development of a Course-Based Graduate Degree in Food Science and Technology

Daniel Weller, Janette Robbins, Andrea Elmore, and Martin Wiedmann

**Abstract:** The shortage of highly qualified graduates with advanced training in food science is a pressing problem facing government agencies and the food industry. This has created a need to recruit and train food scientists at the graduate level. However, most graduate level programs are research-based and do not meet the needs of many students. The College of Agriculture and Life Sciences at Cornell Univ. has a Master of Professional Studies Program in Agriculture and Life Sciences (MPS-ALS), which is offered through the Field of Food Science and Technology (FFST), as an alternative to research-based masters and doctoral degrees. Although the MPS-ALS program began in the 1970s, the FFST did not take an active role in recruiting students or tracking alumni until 2000. From 2000 to 2013, a total of 56 students, representing an internationally and academically diverse student body, have received MPS-ALS degrees through the FFST. In May and August 2013, alumni were asked, via e-mail, to complete an online survey to assess the long-term impact of the MPS-ALS program on their career success. The results of the survey indicate that the MPS-ALS program at Cornell Univ. is a strong program that attracts excellent candidates from a variety of undergraduate fields. Program alumni have been very successful in obtaining full-time employment, graduate positions and internships, and are highly satisfied with the program. The MPS-ALS offered through the FFST at Cornell Univ. is a model for the development of course-based graduate programs that seek to increase the supply of and meet the demand for trained professionals in food science.

One of the major challenges facing food science is the insufficient number of qualified food scientists to fill positions in industry, government, and academia (Fletcher 2006; McGrath 2008; Ali 2012). Approximately 2700 food and agricultural science positions remain unfilled each year in the United States, while more than half of employers in the United Kingdom report a shortage of food science and technology workers (Chikthimmah and Floros 2007). These shortages threaten the food industry's ability to meet needs for future growth. Since food manufacturing accounts for over 10% of all manufacturing exports from the United States (United States Department of Commerce 2008), declining production due to an inadequately trained workforce has deleterious effects on the national economy. The shortage also contributes to the small number of qualified scientists available for careers in critical government agencies such as the Food and Drug Admin-

istration. The recruitment and retention of qualified students to graduate-level food science programs is therefore critical to satisfy industry needs, maintain economic viability, and ensure food security (Fletcher 2006; Ali 2012; Hedges and Wetteman 2012).

Declining enrollment in undergraduate and graduate food science programs throughout the 1990s and 2000s is a major factor contributing to the shortage of qualified food scientists (Gilmore and others 2006). Despite a slight reversal in enrollment trends in the early 2000s (Kuhn 2001), competition for qualified individuals with bachelor's degrees in food science remains intense. Well-qualified food science undergraduates often receive multiple internship and job offers. As a result, few undergraduate food science students pursue advanced degrees in food science, exacerbating the shortage of food scientists with graduate-level training (Roberts and others 2010). The issue is further compounded by the poor visibility of food science graduate programs and misunderstandings about food science careers among undergraduates and their advisors (Chikthimmah and Floros 2007).

The shortage of qualified food scientists is exacerbated by the fact that many food industry employees have degrees in related

---

MS 20141010 Submitted 6/11/2014, Accepted 8/30/2014. All the authors are from Dept. of Food Science, Cornell Univ., Ithaca, NY, 14850, U.S.A. Direct inquiries to author Wiedmann (E-mail: [mw16@cornell.edu](mailto:mw16@cornell.edu)).

fields of science but lack formal training in food science. These employees would benefit from a degree in food science, but a thesis-based graduate degree may not be an appropriate or desirable route for them. Moreover, the number of assistantships available to pursue thesis-based graduate degrees often does not meet demand for this degree track. This is a particular issue in food science since many graduate programs in the United States will only admit students into thesis-based programs if assistantship funding is available or a student has external funding, often excluding self-funded students from admission into thesis-based graduate programs. Similar challenges exist for students from related scientific fields who lacked access to food science courses and training as undergraduates but are interested in food science careers. Clearly, there is a pressing need for course-based food science graduate programs as an alternative to traditional, thesis-based degrees. To meet this need, the College of Agriculture and Life Sciences at Cornell Univ. established the Master of Professional Studies Program in Agriculture and Life Sciences (MPS-ALS), a course-based degree offered by the Field of Food Science and Technology (FFST). Since 2000, the FFST has made a significant effort to increase enrollment in the MPS-ALS program.

The MPS-ALS program at Cornell Univ. provides an ideal model for the development of a class-based graduate program as an alternative to research-based degrees. The goal of the MPS program at Cornell is to offer a course-based, professional master's degree that prepares students who already hold bachelor's degrees for a career in the food industry. While this is the goal of the program, the MPS-ALS degree offered through the FFST at Cornell Univ. is not designed to be a terminal degree.

Since the inception of the MPS-ALS program in the 1970s, other universities have established similar programs, such as the Professional Science Master's in Food Science and Human Nutrition at the Univ. of Illinois, Urbana-Champaign, and the Master of Professional Studies in Dairy Product Technology at California Polytechnic State Univ., San Luis Obispo (California Polytechnic State University 2012; Engeseth 2014).

Since the FFST has actively been recruiting students into the MPS-ALS program for 13 y and similar programs are being developed at other universities, it is an appropriate time to review the efficacy and quality of the program. To assess the long-term impact of the MPS-ALS program at Cornell Univ., alumni were asked via e-mail to complete an online survey. Information was collected on their academic and employment background, current employment, and overall satisfaction with the program. Demographic and academic data that were generally available to program administrators were also analyzed.

## Methods

### Program format

The MPS-ALS program offered through the FFST is a course-based, 1 to 2 y graduate-level program offered by the College of Agriculture and Life Sciences at Cornell Univ. The program is appropriate for food industry professionals who want a short, intensive graduate program to upgrade their skills and knowledge, as well as 2nd career and reentry students. The MPS-ALS program is also suitable for individuals with bachelor's degrees who want to pursue a food science career but lack the necessary base. Entry into the MPS-ALS program is through a competitive application process and does require a strong science background. Students who hold a bachelor's degree in a nonscience field are eligible

for entry provided that they have completed 15 credits of science coursework before applying.

Students who are admitted to and enroll in the MPS-ALS program are required to complete 30 credits. At least 24 credits must come from senior- or graduate-level on-campus courses, and up to 6 credits can be transferred from another institution. While students have up to 4 y following admittance to complete these requirements, most students graduate in 2 semesters. Indeed, to better meet the needs of nontraditional students, the timeline for completing the MPS-ALS is flexible. MPS-ALS students can hold internships or jobs during their time at Cornell because they can complete their degree during discontinuous on-campus semesters.

To graduate, students must also complete a MPS project, either a literature review or a short research-based, problem-solving project. To better meet the needs of students who are currently employed or who endeavor to work in industry, the research for the MPS project can be done on campus or at an off-campus site, such as the student's place of employment. Indeed, many MPS projects have an applied focus and help prepare students to work in the food industry. For example, an alumnus who is currently working as a winemaker used his MPS project to explore new methods of free sulfur dioxide detection in wine using air safety tubes. Another alumnus, whose laboratory-based project focused on developing new apple-based food products, is now working in research and development where she uses skills cultivated during her MPS research.

Students in the MPS-ALS program specialize in 1 of 7 areas: General Food Science, Dairy Processing, Enology, Food Chemistry/Product Development, Food Safety, Food Engineering, and Sensory Evaluation. Faculty mentors are paired with students during the admissions process based on the student's area of specialization and interests. With the help of their mentor, students put together a unique program to meet their individual needs (Table 1). The wide variety of courses available within the Dept. of Food Science, and throughout Cornell Univ. engenders a high degree of flexibility and allows for personalization of the MPS-ALS program based on the student's background, interests, career goals, and their advisor's recommendations.

The goal of the MPS-ALS programs is to provide students with advanced training in food science in order to better prepare them for jobs in industry or the public sector. As part of this effort, the MPS-ALS program provides opportunities for students to participate in workshops and short courses in specialty areas such as food packaging and cheese making. Experiential learning courses have been specifically designed to provide students with hands-on-training in essential skills for work in the food industry. For example, experiential food processing, a course on the industrial aspects of food processing, provides students with hands-on training in product packaging, food processing, industry food safety programs, and product evaluation.

To better expose students to industry practices on an international level, Cornell Univ. offered a dual-degree option with Tamil Nadu Univ. in India from 2009 to 2011. Students in the dual degree program would spend 1 y at Cornell Univ. in the United States of America and 1 y at Tamil Nadu Univ. in India. Many dual degree programs are not practical for students in 2-y research-based masters programs due to the difficulties associated with the short time frame and conducting research in multiple countries. Therefore, the MPS-ALS program, as a course-based degree, offered an ideal way to expose students to international food industry practices. By doing so, the MPS-ALS program opened up opportunities for students to develop an understanding of the food

Table 1—Sample 2-semester curriculum for a student specializing in food engineering.

| Fall semester Course   | Title  | Credits |
|------------------------|--|---------|
| BEE 2600               | Principles of Biological Engineering                                       | 3       |
| FDSC 4210              | Food Engineering Principles  | 3       |
| FDSC 4230              | Physical Principles of Food Preservation and Manufacturing                 | 3       |
| FDSC 5000              | MPS Project  | 3       |
| FDSC 6000 <sup>1</sup> | Graduate Seminar   | 1       |
| FDSC 6010 <sup>1</sup> | Principles and Applications of Food Science and Technology                 | 2       |
| Spring Semester Course | Title  | Credits |
| BEE 3299               | Sustainable Development  | 3       |
| FDSC 4250              | Unit Operations and Dairy Foods Processing                                 | 3       |
| FDSC 6640              | Food Polymer Science: Principles and Applications                          | 2       |
| FDSC 6650              | Food and Bioprocessing Systems   | 2       |
| FDSC 6940              | Experiential Course in Industrial Aspects of Food Processing and Packaging | 2       |
| FDSC 5000              | MPS Project  | 3       |
| FDSC 6000 <sup>1</sup> | Graduate Seminar   | 1       |

<sup>1</sup> Superscript denotes required courses.

systems in the developed and developing world. These students are then well-poised to fill much needed positions in government and supranational regulatory agencies, as well as multinational food companies. Despite the benefits of the dual degree program, the collaboration with Tamil Nadu Univ. ended in 2011 due to a lack of funding.

The FFST at Cornell Univ. also tries to actively foster extracurricular opportunities, such as product development teams (PDTs), that allow students to apply what they have learned in class to solving real-world problems. The Dept. of Food Science at Cornell Univ. sponsors an average of 7 PDTs each year. As members of a PDT, students develop, market, and produce a new food product in a manner akin to a commercial production team. The products are then submitted to various competitions depending on the teams focus, for example, the Heart Healthy Product Development Competition sponsored by the Institute of Food Technologists (2014). These competitions allow students to gain useful experience, create networking opportunities, and demonstrate how skilled they are to potential employers. It is the expectation that these hands-on experiences provide additional training in critical thinking and self-directed learning, as well as the requisite skills needed for students to be competitive on the job market and successful as food scientists and professionals.

Networking opportunities with food industry professionals are also available through the department's Seminar Series, biweekly departmental coffee hours, and the Cornell Inst. of Food Systems Advisory Council, which is an industry council with more than 25 members.

### Evaluating the MPS-ALS program

To assess the quality and long-term impact of the MPS-ALS program, all alumni who graduated after 1999 were asked by e-mail to complete an online survey in May and August 2013. The survey tool is available through the Cornell Univ. Food Safety Laboratory website (<https://foodsafety.foodscience.cornell.edu/research-and-publications/supplementary-materials-manuscripts/2014>). Fifty-two percent of alumni (29/56) completed the survey, which gathered information on students' academic and employment background, current employment, and overall satisfaction with the program. The survey was supplemented with data that were available to program administrators such as annual class size, demographic information, and GRE scores for applicants and admitted students. As part of the data analysis, the salary of alumni at their 1st job following graduation was obtained as an indirect

measure of employer satisfaction with alumni and the training they received through the MPS-ALS program. Classification of employment by industry and job title was achieved through alumni self-reporting, and checked against each company's website.

### Results and Discussion

The MPS-ALS program has been successful in recruiting and training students in food science. Since 2000 when the FFST started tracking alumni, the number of degrees awarded has increased substantially, corresponding to an increasingly large and diverse student population. Other indicators of the program's success include high levels of student satisfaction with the program and the large number of alumni entering careers in food science.

#### The MPS-ALS student population is growing and increasingly diverse

Although the MPS-ALS degree was been offered since the 1970s, FFST did not take an active role in recruiting students or tracking alumni until 2000, limiting available data to students who enrolled in or after 2000. Fifty-six students have graduated from the MPS-ALS program offered through the FFST at Cornell Univ. since 2000 (Table 2). While only 1 student enrolled per year from 2000 to 2007, class size started to increase in 2008 and reached peak enrollment in Spring 2012 with 24 students. Since 2012, class sizes have remained large, averaging 17 students (Table 2). The number of MPS-ALS degrees conferred follows a similar trend. The number of degrees conferred each year has continued to rise with 15 being awarded in 2013, an 8-fold increase from the number of degrees conferred in 2008. There is not a perfect one-to-one relationship between the number of degrees conferred and the number of students enrolled in any given year, as some students take 3 to 4 semesters to graduate or are enrolled in discontinuous semesters. Similarly, 8 students are currently on a leave of absence and are likely to finish the degree upon returning while 2 students who were part of the dual degree program with Tamil Nadu Univ. withdrew from the MPS-ALS program at Cornell Univ.

As the MPS-ALS program has grown, it has attracted a diverse student population, specifically with regards to nationality and academic background. Indeed, our alumni come from 14 countries, and hold prior degrees from 43 different institutions in 28 different fields.

Table 2—Profile of students graduating from the MPS program and number of students actively enrolled in the MPS program in a given semester.

| Semester | Year              | Degrees conferred | U.S. citizens | Minority students | International students | Female students | Nr of registered students |
|----------|-------------------|-------------------|---------------|-------------------|------------------------|-----------------|---------------------------|
| Fall     | 2002 <sup>1</sup> | 0                 | 0             | 0                 | 0                      | 0               | 1                         |
| Spring   | 2003              | 0                 | 0             | 0                 | 0                      | 0               | 1                         |
| Fall     | 2003              | 1                 | 0             | 0                 | 1                      | 0               | 0                         |
| Spring   | 2004              | 0                 | 0             | 0                 | 0                      | 0               | 0                         |
| Fall     | 2004              | 0                 | 0             | 0                 | 0                      | 0               | 0                         |
| Spring   | 2005              | 0                 | 0             | 0                 | 0                      | 0               | 0                         |
| Fall     | 2005              | 0                 | 0             | 0                 | 0                      | 0               | 1                         |
| Spring   | 2006              | 0                 | 0             | 0                 | 0                      | 0               | 1                         |
| Fall     | 2006              | 1                 | 0             | 0                 | 1                      | 0               | 0                         |
| Spring   | 2007              | 0                 | 0             | 0                 | 0                      | 0               | 0                         |
| Fall     | 2007              | 0                 | 0             | 0                 | 0                      | 0               | 1                         |
| Spring   | 2008              | 1                 | 0             | 0                 | 1                      | 0               | 2                         |
| Fall     | 2008              | 0                 | 0             | 0                 | 0                      | 0               | 2                         |
| Spring   | 2009              | 2                 | 0             | 0                 | 2                      | 2               | 2                         |
| Fall     | 2009              | 0                 | 0             | 0                 | 0                      | 0               | 14                        |
| Spring   | 2010              | 1                 | 0             | 0                 | 7                      | 5               | 16                        |
| Fall     | 2010              | 8                 | 0             | 0                 | 0                      | 0               | 12                        |
| Spring   | 2011              | 6                 | 1             | 0                 | 3                      | 3               | 16                        |
| Fall     | 2011              | 6                 | 1             | 0                 | 6                      | 3               | 23                        |
| Spring   | 2012              | 9                 | 3             | 1                 | 7                      | 7               | 24                        |
| Fall     | 2012              | 6                 | 0             | 0                 | 6                      | 3               | 20                        |
| Spring   | 2013              | 10                | 2             | 1                 | 7                      | 7               | 16                        |
| Fall     | 2013              | 5                 | 0             | 0                 | 4                      | 2               | 16                        |
| Total    |                   | 56                | 11            | 2                 | 45                     | 35              | N/a                       |

<sup>1</sup> Demographic data were not available prior to 2002 due to changes in recordkeeping and technology.

International students have continuously comprised the majority of the enrolled student population since 2000. Indeed, from 2000 to 2008, all enrolled students were international. In total, 46 international students have obtained MPS-ALS degrees at Cornell Univ. The dual-degree program with Tamil Nadu Univ. in India is partially responsible for the large number of international alumni. While the collaboration with Tamil Nadu Univ. ended in 2011 for financial reasons, the program was successful in recruiting students and introducing them to international food industry practices. Indeed, 15 dual degree students participated in the program and 13 graduated from Cornell Univ. with a MPS-ALS degree. The program illustrates the potential for dual-degree, international professional programs in food science.

Since 2008, 11 U.S. citizens have received MPS-ALS degrees, including 2 students who are traditionally underrepresented minorities (African-American, Hispanic, and/or Native American). Among all students, the ratio of female to male students was 3-to-1. Table 2 summarizes the number and diversity of program graduates for each year.

The diversity of enrolled students has also increased as the program has grown due to the recruitment of students with a variety of undergraduate degrees and work experiences. Indeed, 1 student mentioned under the comments section of the survey that the academic diversity of their MPS-ALS class was a major strength of the program. While science-related and food science degrees predominate, alumni have held degrees in fields as divergent as Aquaculture, European Studies, Communications, and Veterinary Science. Since 2000, 18 incoming students have held bachelor's degrees in food science and technology, and 34 incoming students have held degrees in science or engineering fields. In addition, 2 incoming students have held master's degrees in food science-related fields, and 1 incoming student held a 2-y culinary degree in addition to a bachelor degree. Almost a third of students who responded to the survey (8/29) had experience in the food industry prior to entering in the MPS-ALS program. On average, students who had worked in the food industry had 2.5 y of experience upon enrollment. No student had more than 4 y of experience.

### The program applicant pool is similar academically to the applicant pool for MS/PhD programs

Although the MPS-ALS program has been developed as an alternative to thesis-based research degrees, the MPS-ALS program attracts the same high caliber of student as the MS/PhD programs in Food Science and Technology at Cornell Univ. This is clearly evidenced by the similarities between the GRE scores for MPS-ALS and MS/PhD applicants and admitted students (Table 3). Although the average scores on the verbal and quantitative portions of the GRE are slightly higher for students applying for a research-based degree (Table 3), the difference is not significant ( $P = 0.2727$  and  $0.1087$ , respectively). In fact, the average verbal scores for MPS-ALS applicants in Fall 2013, Fall 2011, and Spring 2011 are higher than the average verbal scores for MS/PhD applicants for the same year and season (Table 3). Similarly, the average GRE scores for admitted MPS-ALS students are not significantly different from the scores of admitted MS/PhD students. Furthermore, the average GRE score for admitted MPS-ALS students is higher than that of admitted MS/PhD students despite the slightly lower GRE scores for MPS-ALS applicants.

It is important that MPS-ALS and MS/PhD students are of a similar caliber because MPS-ALS students take courses, participate in research, and, as members of PDTs, work with MS/PhD students. Multiple students noted in the comments section of the survey that one of the MPS-ALS program's strengths was that the classes and opportunities offered to MPS-ALS students are the same as those offered to MS/PhD students.

### Students graduating from the program are highly successful in obtaining employment, graduate positions, and internships in the United States and abroad

The majority of MPS-ALS graduates go on to pursue either full-time employment in the food industry or graduate study in food science fields immediately after graduating from the MPS-ALS program. According to the survey sent out to MPS-ALS graduates, 55% (16/29) of alumni obtained full-time employment, while 17% (5/29) obtained internships, 14% (4/29) entered graduate school, and 7% (2/29) started their own business immediately after

Table 3—Verbal (V), quantitative (Q), and analytical writing (A/W) GRE scores for students who applied to and were admitted into the MPS and MS/PhD programs in Food Science and Technology at Cornell Univ. between 2008 and 2013. Data were not available for MPS students prior to 2008.

| Semester | Year    | Applied                |     |     |                            |     |     | Admitted               |     |     |                            |     |     |
|----------|---------|------------------------|-----|-----|----------------------------|-----|-----|------------------------|-----|-----|----------------------------|-----|-----|
|          |         | Total research degrees |     |     | Total professional degrees |     |     | Total research degrees |     |     | Total professional degrees |     |     |
|          |         | V                      | Q   | A/W | V                          | Q   | A/W | V                      | Q   | A/W | V                          | Q   | A/W |
| Fall     | 2008    | 506                    | 729 | 4   | 417                        | 730 | 3.5 | 529                    | 716 | 4.8 | 555                        | 705 | 4.2 |
| Spring   | 2009    | 480                    | 717 | 3.8 | —                          | —   | —   | 420                    | 765 | 3.5 | —                          | —   | —   |
| Fall     | 2009    | 492                    | 703 | 3.8 | 438                        | 579 | 3.7 | 491                    | 696 | 3.9 | 463                        | 653 | 3.7 |
| Spring   | 2010    | 477                    | 653 | 4   | 300                        | 700 | —   | 472                    | 624 | 4.6 | 523                        | 710 | 4.8 |
| Fall     | 2010    | 509                    | 719 | 3.8 | 361                        | 662 | 2.9 | 536                    | 708 | 4.3 | 509                        | 757 | 3.9 |
| Spring   | 2011    | 394                    | 740 | 3.3 | 550                        | 595 | 4.8 | 550                    | 800 | 3.5 | 690                        | 770 | 5   |
| Fall     | 2011    | 515                    | 733 | 3.6 | 528                        | 712 | 3.2 | 540                    | 705 | 4.2 | 522                        | 743 | 3.5 |
| Spring   | 2012    | 551                    | 719 | 3.3 | 515                        | 735 | 4   | 525                    | 660 | 4.5 | 660                        | 710 | 4.5 |
| Fall     | 2012    | 540                    | 730 | 3.6 | 520                        | 680 | 3.8 | 580                    | 720 | 4   | 540                        | 680 | 3.5 |
| Spring   | 2013    | 460                    | 680 | 3.5 | 460                        | 680 | 3.3 | 490                    | 720 | 4   | 570                        | 630 | 3.5 |
| Fall     | 2013    | 510                    | 730 | 3.4 | 520                        | 720 | 3.3 | 570                    | 720 | 4   | 490                        | 720 | 3.4 |
|          | Average | 517                    | 691 | 3.6 | 460                        | 679 | 3.6 | 528                    | 707 | 4.2 | 552                        | 708 | 4   |

graduating (Table 4). Of those students who obtained full-time employment or an internship, 63% (15/24) were at companies with less than 500 employees, 17% (4/24) were at companies with more than 500 employees, and 13% (3/24) worked for academic institutions or nonprofits. Salaries for MPS-ALS students at their 1st job following completion of the program ranged from below 40000 dollars annually to above 70000 dollars annually (Figure 1A). For purposes of this study, the salary of alumni working internationally was directly converted from local currency to USD without accounting for cost of living in the respective country. This may explain the number of alumni making less than 40000 a year.

MPS-ALS students are not only able to secure positions in food industry and academia following graduation, but they are able to translate their strong education and early work experiences into long-term career success. Of the 56 students that have received MPS-ALS degrees through the FFST, 53 have kept in contact with the department, allowing us to track their career trajectories. Figures 1(B) to 1(D) summarize the types of jobs, companies, and countries where MPS-ALS alumni are currently working. Clearly, MPS-ALS alumni have been extremely successful at not only obtaining employment in the food industry, but also in obtaining senior-level positions. In addition to the 15 alumni holding managerial positions, 3 alumni are senior scientists or lab supervisors, and 1 is an academic. Many MPS-ALS graduates (8/53) have also continued onto graduate school at prestigious universities, such as Imperial College London and the Univ. of Illinois at Urbana-Champaign, or started their own businesses (2/53).

In the comments section of the survey, multiple students noted that networking during their time at Cornell played a key role in obtaining full-time employment. Similarly, 16 students participated in internships during and after completing the MPS-ALS degree, which they parlayed into full-time employment with large multinational companies, such as Mars and Camerican Intl. One student, with no experience in the food industry prior to enrollment, was able to obtain an internship with a local artisan cheese producer after graduation. After completing her internship, she found full-time employment as a production supervisor for a much larger company.

### Alumni express a high level of satisfaction with the MPS-ALS Program

Alumni report high levels of satisfaction with the MPS-ALS program and their experience at Cornell Univ. In the survey sent to program graduates, respondents were asked to rank various aspects of the MPS-ALS program. A standard-5 point scale, where 1 is extremely poor and 5 is extremely high, was used. On average, alumni ranked the program at 3.72 overall, with 58% (17/29) ranking the program a 4 or 5. Only 1 alumnus ranked the program as less than a 3. Of those students who ranked the program as a 3, many qualified their ranking in the comments section, expressing support and satisfaction with the program.

Alumni attitudes toward their faculty advisors are consistent with their attitude toward the program overall. When asked if their advisor met their expectations, alumni ranked their advisors at a 3.76 with 68% (20/29) ranking them at a 4 or 5. When asked about the quality of the mentoring received from their advisor, especially with respect to the MPS-ALS project, alumni were highly satisfied, ranking it, on average, at a 4.14. Similarly, alumni ranked the quality of the research and laboratory experience during the MPS-ALS program at a 3.92 with no student ranking their research and laboratory experiences below 3. Consistent with the high level

Table 4—Employment obtained by MPS students immediately after graduation.

| Position             | No. of students | Small companies<br>(>500 employees) | Large companies<br>(<500 employees) | Academic institutions<br>and nonprofits |
|----------------------|-----------------|-------------------------------------|-------------------------------------|---|
| Full-time employment | 16              | 10                                  | 3                                   | 2                                       |
| Internship           | 5               | 3                                   | 1                                   | 1                                       |
| Graduate school      | 4               | 0                                   | 0                                   | 4                                       |
| Self-employed        | 2               | 2                                   | 0                                   | 0                                       |
| Other                | 2               | —                                   | —                                   | —                                       |
| Total                | 29 <sup>1</sup> | 15                                  | 4                                   | 6                                       |

<sup>1</sup> While 29 students responded to the question about where they first obtained employment after graduation, only 25 students provide additional information on the nature of this employment.

of satisfaction expressed by alumni, 83% of MPS-ALS graduates (24/29) think that the cost of the MPS-ALS program is appropriate for the benefits gained and are likely to recommend the MPS-ALS program offered through the FFST at Cornell Univ. to a friend.

When asked to discuss the MPS-ALS program's strengths, alumni repeatedly mentioned the quality of the faculty, staff, and facilities, as well as the flexibility of the program, the diversity of classes available, and the diversity of the student population. Many graduates commented on the program's practical, experiential focus, and the variety of networking opportunities available to program participants. Several students also stated that the PDTs were very important to maximizing their time at Cornell Univ. While several students found the program to be too short, multiple students considered this to be a bonus and more desirable for their needs compared to 2-y, thesis-based programs for their purposes. Students who desire more time can take up to 8 semesters to complete the degree. Indeed, of the 56 students who have received MPS-ALS degrees 14 (25%) took 3 semesters to graduate, 4 (7%) took 4 semesters, and 1 (2%) took 5 semesters.

### Challenges faced by the MPS-ALS program

The lack of data on students enrolled between 1970 and 2000 is largely due to low enrollment during this period, and the associated lack of infrastructure and effort to collect program related data. Between 1970 and 2000, the FFST did not take an active role in recruiting students and the MPS-ALS program was not widely advertised. In 2000, when the MPS-ALS program offered through FFST came under new management, enrollment began to increase. The program's growth between 2000 and 2013 is demonstrative of the importance advertising and recruitment play in the success of course-based graduate degrees such as the MPS-ALS program.

Due to the relative novelty of course-based degrees and limited focus the FFST placed on advertising during the program's early years, potential employers were initially unsure how to treat applications from students graduating in the early 2000s. Indeed, several alumni that graduated in the early 2000s mentioned that world-wide recognition of the quality of the MPS-ALS program was limited and that greater effort needed to be made to put graduates, particularly international alumni, in contact with industry. The FFST has taken steps to address this issue through advertising and by bringing industry representatives in contact with MPS-ALS students. As greater numbers of MPS-ALS alumni obtain jobs, recognition of the program by industry has also increased. The primary challenge currently facing the MPS-ALS program is the cost of tuition, which is fully borne by the students as there is no Cornell-based financial aid available for the MPS students. As a consequence, each year several admitted students decide not to enroll, citing financial reasons as a cause.

### Challenges with evaluating the MPS-ALS program

A limitation of this evaluation is that we were unable to survey internship supervisors and employers of MPS-ALS alumni due to the challenges associated with contacting specific individuals within large multinational corporations (for example, language barriers due to international employment of graduates, difficulty identifying direct supervisors, and limited communication infrastructure during the programs early years). Instead, data were obtained on students' salaries at their 1st job following graduation. Salary level provides an indirect, yet highly quantitative and objective measure of employer satisfaction with MPS-ALS alumni and consequently the MPS program. Data were also collected on the current job title of MPS-ALS graduates as a second indirect measure of employer satisfaction. Professors and staff within the MPS-ALS program were not formally surveyed as input is obtained verbally during annual meetings, and the responses are used to continuously improve the program. Efforts will be made to survey both employers and faculty mentors for future evaluations; other programs would also be encouraged to complete these types of evaluations.

### Conclusion

Over the past 13 y, the MPS-ALS Program offered through the FFST at Cornell Univ. has been extremely successful in recruiting and preparing qualified students for careers in food science. To date, 56 students have graduated from the MPS-ALS program at Cornell Univ. As students in the MPS-ALS program the 56 alumni received upper-level advanced training in food science.

Based on responses from alumni, the program has been extremely effective in meeting its goals of providing students with practical experience in food science and connecting students with potential employers. The quality and efficacy of the MPS-ALS program at Cornell Univ., as inferred from the responses to the alumni survey and our indirect measures of employer satisfaction, suggest that course-based degrees are an effective means of reducing the current shortage of qualified food scientists with graduate-level training. As such, the MPS-ALS program in Food Science and Technology at Cornell Univ. can serve as a model for the development of similar course-based professional food science degrees at other universities.

#### Sidebar

Jeffrey (August) Deimel, MPS-ALS 2011

Undergraduate: Liberal Arts (St. John's College)

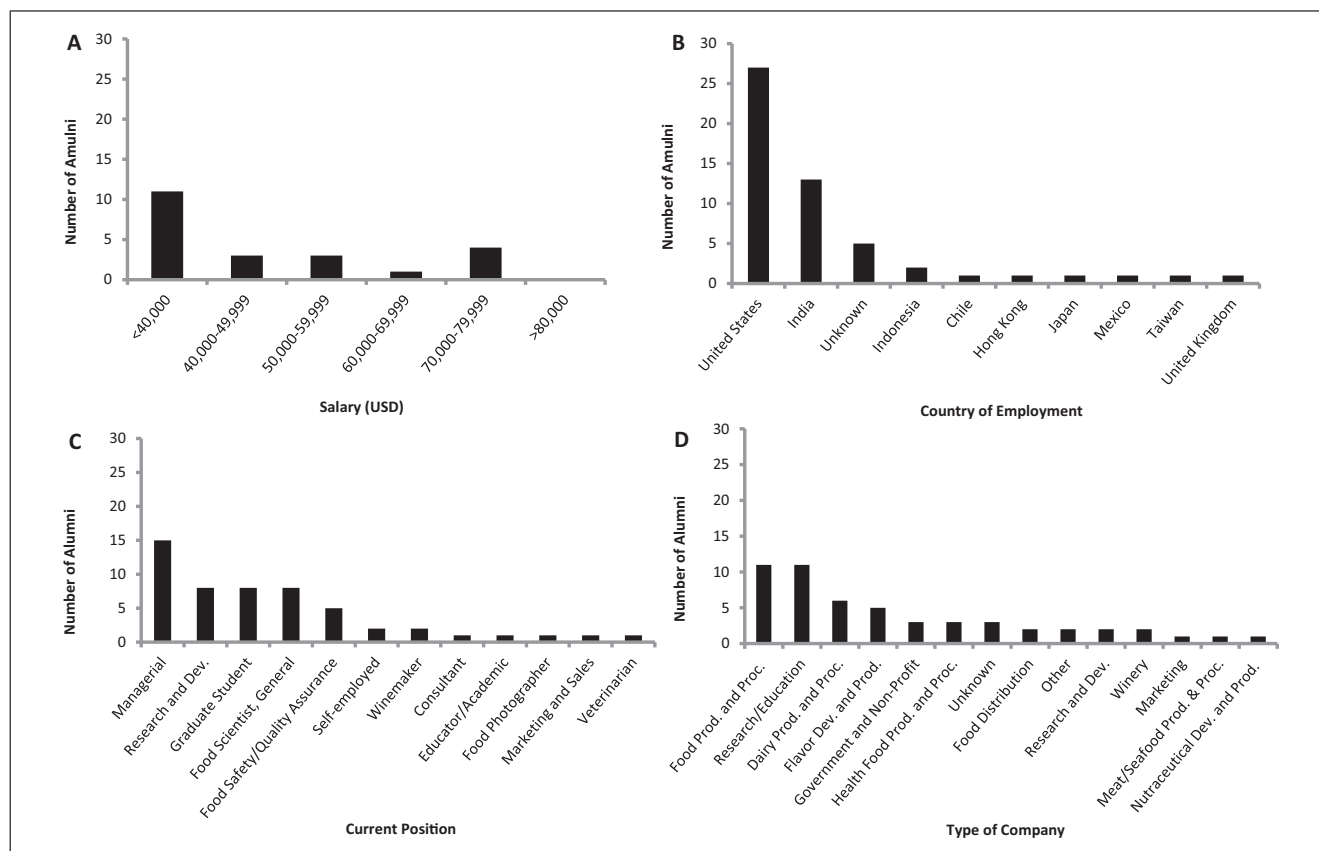


Figure 1—(A) Salary for MPS graduates at their 1st job following completion of their degree. For alumni working internationally, local currency was converted directly to USD. (B) Current country of employment for MPS alumni. Alumni with an unknown location are either self-employed, work for large multinational corporation, or failed to report the country in which they worked. (C) Current position held by alumni. Of the 14 alumni in managerial positions 3 oversee food safety and quality assurance, 2 oversee food production, 2 oversee research and development, 1 is in charge of marketing, and the rest hold general administrative positions. (D) Main focus of the companies MPS graduates currently work for as self-reported on the company's website. Development, production, and processing are abbreviated as Dev., Prod., and Proc., respectively.

MPS Project: Double salt deacidification in high malic acid wines.

Current Position: Winemaker for Keuka Spring Vineyards, Penn Yan, NY, U.S.A.

Interesting Fact: The 2012 Riesling that August Deimel produces, as winemaker for Keuka Spring Vineyards, won the 2013 Governor's Cup for best New York wine at the New York Wine and Food Classic competition held in Watkins Glen. Deimel and Keuka Springs Vineyard also won 3 other awards, including Best Gewurztraminer and Best Riesling (Governor's Press Office 2013).

"I came to Cornell with a background in the wine industry, but without the technical knowledge to advance within the field. Though my program only lasted a year, it changed my perspective on winemaking and gave me the tools to begin a career in the industry. I appreciated the fact that the [MPS-ALS program] provided me a great deal of latitude to develop my own program, and I used that opportunity to pursue my interests

in viticulture and agricultural business in addition to my core enology and food science courses."

May Chinavanichkit, MPS-ALS 2013

Undergraduate: Biological Sciences (Connecticut College)

MPS Project: Developing an economic feasibility model for artisan cheese startups: case studies for Happy Cheese Maker & the Big Red Cheddar Cheese Project.

Current Position: Camerican Intl.

Interesting Fact: May held an internship at Camerican Intl. the summer before graduating from the MPS-ALS program.

"With an undergraduate degree in biology and some work experience in the nutraceutical industry, I believe the [MPS-ALS degree] was crucial to my career transition to the Food Industry. The [MPS-ALS degree] was the perfect option for me because I wanted to learn more about Food Science but did not want to pursue research as a career.

Through this program, I was able to integrate my interest in learning more about new product development, food microbiology, and even business management. Furthermore, the professors at Cornell are excellent mentors. With their guidance, I was able to develop a final project that best fit my varied interests. Within the short time span of this program, I acquired the Food Science fundamentals that were necessary for a career in the food industry.”

---

## References

- Ali R. 2012. Food and Agricultural Sciences National Needs Graduate and Postgraduate Fellowship (NNF) Grants Program. Available from: <http://www.csrees.usda.gov/fo/nationalneedsgraduatefellowships.cfm>. Accessed September 16, 2014.
- California Polytechnic State University. 2012. Master of Professional Studies in Dairy Products Technology. Available from: <http://mps dairy.calpoly.edu>. Accessed June 3, 2014.
- Chikthimmah N, Floros J. 2007. Challenges to food science in the U.S. *Food Technol* 9:38–44.
- Engeseth N. 2014. Illinois Professional Science Master's: Food Science and Human Nutrition. <http://psm.illinois.edu/food-science-human-nutrition>. Accessed June 3, 2014.
- Fletcher A. 2006. Lack of good graduates crippling food industry. *Food Navig*. Available from: <http://www.foodnavigator.com/Financial-Industry/Lack-of-good-graduates-crippling-food-industry>. Accessed June 3, 2014.
- Gilmore JL, Goecker A, Smith E, Smith G, Boteler F, González J, Mack T, Whittaker D. 2006. Shifts in the production and employment of baccalaureate degree graduates from US colleges of agriculture and natural resources, 1990–2005. In: *A leadership summit to effect change in teaching and learning*. Washington, DC: National Academies Press. p 155–68.
- Governor's Press Office. 2013. Governor Cuomo launches ad campaign promoting New York State Wines and announces winner of 2013 Governor's Cup. Albany, NY. Available from: <http://www.governor.ny.gov/press/08132013-governors-cup-winners>. Accessed June 3, 2014.
- Hedges K, Wetteman M. 2012. Tennessee statewide supply and demand analysis for the 16 education clusters. [www.jobs4tn.gov/admin/gsipub/htmlarea/uploads/TN%20Supply%20and%20Demand%20Analysis%20Nov%202012.pdf](http://www.jobs4tn.gov/admin/gsipub/htmlarea/uploads/TN%20Supply%20and%20Demand%20Analysis%20Nov%202012.pdf). Accessed June 3, 2014.
- Institute of Food Technologists. 2014. Competitions and awards. Available from: <http://www.ift.org/community/students/competitions.aspx>. Accessed June 3, 2014.
- Kuhn ME. 2001. Food science flourishes on campus. *Food Technol* 65:38–43.
- McGrath M. 2008. Overview of careers in the food science field. In: Hartel RW, Klawitter CP, editors. *Careers in food science: from undergraduate to professional*. New York, NY: Springer New York. p 23–42.
- Roberts AJ, Robbins J, McLandsborough L, Wiedmann M. 2010. A 10-year review of the food science summer scholars program: a model for research training and for recruiting undergraduate students into graduate programs and careers in food science. *J Food Sci Educ* 9:98–105.
- United States Department of Commerce. 2008. U.S. Department of Commerce Industry Report: Food Manufacturing NAICS 311. Available from: [http://trade.gov/td/ocg/report08\\_processedfoods.pdf](http://trade.gov/td/ocg/report08_processedfoods.pdf). Accessed September 16, 2014.
-