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ANNUAL REPORT

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Mission

JIFSAN advances sound strategies that improve public health, food safety, and applied nutrition using risk analysis principles through cooperative research, education, and outreach programs.

Vision

To be a premier source of scientific information and education programs on food safety and applied nutrition that enables the development of sound public health policy and reduces the incidence of food-related illness.

From the Director

This report summarizes JIFSAN's accomplishment in its Research, Education and Outreach programs during calendar year 2013. The Institute continues to thrive in all four thrusts identified in its strategic plan developed in 2012: Innovative Research, Sustainable International Food Safety Trainings through Partnerships, Global Capacity Building in Risk Analysis, and Educational Resources for Training a Skilled Workforce.

JIFSAN will continue its efforts working closely with Food and Drug Administration (FDA) and other domestic and global partners to help prevent contaminated food from reaching the public and protect the public health.

Jianghong Meng, PhD

Director

Contents

Innovative Research

The JIFSAN research program was established to generate new knowledge in order to develop a strong scientific base that addresses ongoing and increasingly complex public health issues. JIFSAN continues to work with scientists at FDA, UM and other organizations to conduct innovative research to address major issues in food safety, applied nutrition, and other areas that impact the public health. JIFSAN also provides support for collaborative projects, and promotes and leverages public-private research partnerships. The program includes not only traditional laboratory and field research, but also educational, behavioral, and social research that promotes sound food safety practices. During this reporting period, projects funded through JIFSAN's internal research program and internship program, and research collaborations between JIFSAN and FDA have generated 12 publications in peer-reviewed journals and 6 presentations/abstracts at research conferences (Appendix C). Research progress of several projects is highlighted below:

Genomics of Foodborne Bacterial Pathogens

1) Pathogenicity Islands of *Salmonella*

Nontyphoidal *Salmonella* serovars cause approximately 1.4 million illness cases and several billion dollars in economic losses each year in the United States. *Salmonella* Newport ranks among the top three serovars associated with foodborne salmonellosis. *S*. Newport consists of three lineages with extensive genetic diversity (1, 11). Due to the importance of *Salmonella* pathogenicity islands 5 and 6 (SPI-5 and SPI-6) in virulence of *Salmonella*, the genetic diversity of these two SPIs may be highly associated with *S*. Newport pathogenicity. SPI-5 was identified in all *S*. Newport strains (n=28) containing 146 single nucleotide polymorphisms (SNPs). There were 39 lineage-defining SNPs identified including 18 non-synonymous SNPs. Moreover, two 40 kb genomic islands (SPI5-GI1 and SPI5-GI2) encoding bacteriophage genes were determined between tRNA-*ser* and *pipA*. SPI5-GI1 was only present in *S*. Newport multidrug-resistant strains of lineage II. SPI-6 was determined in all *S*. Newport strains but three Asian strains in lineage II, whereas these three Asian strains shared one common genomic island (SPI6-GI1) at the same locus. SPI-6 contained 937 SNPs and *S*. Newport displayed clear geographic structure in the phylogenetic tree. The diversity in SPI-5 and SPI-6 suggested the possible evolutionary events and virulence potential of *S*. Newport. The SNPs

could be used as biomarkers for source tracking of *S*. Newport during epidemiological investigations.

2) CRISPR of Shiga Toxin-Producing *Escherichia coli*

Shiga toxin-producing *Escherichia coli* (STEC) have been implicated in foodborne illnesses causing diarrhea and hemolytic uremic syndrome (HUS) worldwide. Although *E. coli* O157:H7 is the major enterohemorrhagic *E. coli* (EHEC) linked to HUS in the United States, other non-O157 STEC strains have caused several outbreaks and have been isolated in similar frequency. The mechanisms underlying the evolution and emergence of new bacterial pathogens are not well understood. The objective of this study was to elucidate the evolution of virulence and pathogenic mechanisms. A potential association of clustered regularly interspaced short palindromic repeat (CRISPR) elements with specific serotypes and virulence of STEC was determined (abstract 4). There was no association identified between the presence of subtype I-E cas and virulence genes, but the total number of spacers had a negative correlation with potential pathogenicity ($P<0.05$). Fewer spacers were found in strains that had a greater probability of causing outbreaks and disease than in those with lower virulence potential ($P<0.05$). The relationship between the CRISPR-cas system and potential virulence needs to be determined on a broader scale, and the biological link will need to be established.

3) Sequence Analysis of Multi-Drug Resistant (MDR) *Salmonella*

We characterized the evolutionary genetic diversity of *Salmonella* Heidelberg using whole genome sequences of 44 isolates (abstract 1). The isolates, some having the same *Xba*I and *Bln*I pulsed field gel electrophoresis (PFGE) pattern, were collected from various sources between 1982 and 2011 and includes those associated with a multistate outbreak (34 states) of antimicrobial-resistant *S.* Heidelberg infections due to contaminated ground turkey in 2011. Using two different SNP analyses, we were able to distinguish and separate strains sharing the same PFGE patterns, including strains isolated in the same year. The isolates from the recent 2011 outbreak clustered together sharing only a few SNPs differences between them. Additionally, we have shown that whole genome sequencing not only identified stable SNP targets that can be utilized for differentiating closely-related *S.* Heidelberg isolates, but also virulence determinants, including antibiotic resistance genes, MDR plasmids and the VirB4/D4 virulence plasmid, which carries the Type IV secretion system (T4SS). As a consequence, we acquired evidence suggesting a higher degree of pathogenicity among *S*. Heidelberg carrying the T4SS. The whole genome sequencing technology offers a powerful

tool to discriminate strains of the same serotype and to identify virulent strains that have a high potential to cause human illness.

Nanotechnology and Nanosafety in Food

The goal of this project was to evaluate the functionality and examine the safety of nano-materials employed in food, dietary supplements, and cosmetics. The research focused on the investigation the antioxidative property and enzyme-similar activity of commonly used noble metals in conjunction with their interaction with other significant endogenous and dietary antioxidants.

The project integrated lipid chemistry, biochemistry, biophysics, and nanotechnology to study free radical related biological activity of nanomaterials. Electron Spin Resonance (EPR) instrumentation in conjunction of spin-label and spin-trap technology was used to detect reactive oxygen species resulted directly or indirectly from noble metal nanomaterials. Equally noteworthy was that ESR spin label oximetry was powerful and used to precisely detect the change of dissolved oxygen, enabling monitoring of any oxygen involved reactions, even at an extremely low concentration, such as oxidase related enzymatic reactions.

Because oxidative damage is the most common mechanism for toxicity induced by nano-materials, we studied the free radical related biological activity of nano-metal oxides using ESR as well as SEM and TEM. We found dual enzyme-like activities of iron oxide nanoparticles diminish long-term toxic potential. In addition, pH dependent generation of hydroxyl radicals and oxygen induced by silver nano-particles (a class of manmade nanomaterials widely used in commercial medical and consumer products) contributed to their biological activity. The silver nano-particles were involved in self-oxidative dissolution and cyclic redox reaction, in acidic and alkaline condition, respectively. As another important noble metal nanomaterial, the behavior of gold nanoparticles was found to depend on pH, similar to Ag nanoparticles (12). Furthermore, Au nanoparticles exerted enzymatic activity similar to that of superoxide dismutase.

Platinum nanoparticles behaved as an antioxidant; however, they were ineffective to hydroxyl radicals. To reduce the antioxidant activity of ascorbic acid (Vitamin C), Pt nanoparticles exhibited ascorbate oxidase like property in catalyzing oxidation of ascorbic acid. Pt

nanoparticles acted as a catalyst in oxidizing selected phenolics. Thus, the antioxidant activity of the phenolics was affected by Pt nanoparticles. The oxidase mimetic property of platinum nanoparticles may result in an antagonistic effect toward some antioxidants.

Metrics for Evaluating Effectiveness of International Food Safety Trainings

Since its inception JIFSAN has conducted a multitude of training and outreach programs in collaboration with FDA, US Department of Agriculture Foreign Agricultural Service (USDA-FAS), other government organizations and partners in promoting best practices in food safety. JIFSAN has developed and piloted evaluation tools/instruments to measure the effectiveness and impact of its international capacity building training programs. The "Metrics" project established a process to evaluate and improve the impact of JIFSAN's training programs incorporating process indicators, outcome indicators, and impact indicators. For JIFSAN's train-the-trainer programs, the purpose of the intermediate assessment (i.e. outcome indicators) is to measure the multiplier effect (e.g., how many additional training events occurred within a country aimed at the farmer/grower; food processor; food inspector; or laboratory analysts); to understand which components from the training program they were able to use; and if parts were not implemented to understand why. These are currently being piloted for all the train-the-trainer courses where the process indicator tools were administered. These post training assessments are administered 6 and 12 months after the training event. In the case of the international GAP, GAqP, FIT and CSFP programs the evaluation tool is being developed jointly by us and the organization requesting the training and translated into the local language. The partnering organization contacts participants 6-12 months after the initial training requesting to conduct the intermediate assessment. In the case of the laboratory training programs the evaluation tool is being developed with the laboratory manager and administered by JIFSAN, through Google Docs. The evaluation process is ongoing, and more information on the project is available at http://research.jifsan.umd.edu/metrics/.

Sustainable International Food Safety Trainings through Partnerships

JIFSAN's International training programs are conducted with co-sponsors in the host country. Partnerships with host countries, with industry, and with government agencies have been a key to JIFSAN's success with acquiring resources for expanding the Institute's activities. JIFSAN offers four different international training programs which are delivered in-country. These are Good Agricultural Practices (GAP), which is directed to fresh produce, Good Aquacultural Practices (GAqP) including seafood Hazard Analysis and Critical Control Points (HACCP), Commercially Sterile Packaged Foods (CSPF), and Food Inspector Training (FIT). Most recently Supply Chain Management for Spices and Botanical Ingredients (SCMSBI) was added to GAP. Programs conducted in 2013 are listed in Appendix D.

Global Collaborative Initiatives

As an extension of these training programs, JIFSAN has undertaken the establishment of *Collaborative Training Initiative* (CTI) with in-country partners. In concept the CTI is a mechanism for JIFSAN to leverage and enhance its training effort by developing a cadre of in-country trainers in selected countries and commodities. These resident trainers have significant advantages in that they understand local problems, language and culture.

This effort has been highly successful with the establishment of a GAqP-CTI in Bangladesh, a Food Processing-CTI under development in Thailand, and a GAP-CTI is being developed in Mexico. Since India is the largest supplier of spices to the U.S. market, the SCMSBI program was developed with the intent of establishing a CTI in India to assist the public and private sectors with the development and implementation of their own capacity building programs in safe practices for spices and botanical ingredients. This requires partnerships with entities having the capability of reaching out to primary producers and subsequent handlers in the supply chain. The in-country partners in this initiative are the Spices Board (India) and the Confederation of India Industry Food Agriculture Centre of Excellence (CII-FACE). The FDA, as a partner with JIFSAN, helps with oversight and technical expertise when appropriate to

advance the mission of the CTI. The development of the CTI involves at least three Phases or levels of activity.

Phase I for the SCMSBI-CTI development was the delivery of a GAP program in September 2012 in India with the intent of reaching as many people as realistically possible.

Phase II entailed the selection of a small group of trainees having extensive training skills and food safety experience to travel to the U.S. for advanced training. In March and April of 2013, nine of the trainees from Phase I traveled to the U.S. They received six days of instruction at the JIFSAN training center in College Park, Maryland. Sessions included lectures on specific topics but focused heavily on interactive discussion sessions and case studies. A visit to a large food manufacturing facility was included. The group then traveled to the University of Mississippi National Center for Natural Products Research for three days of instruction on laboratory techniques and analytical procedures.

Throughout all Phase II sessions the focus remained on the manner in which the trainees would develop and deliver their own educational programs in India. They considered the requirements for production of different spice crops and subsequent handling procedures. Methods of instruction and tools to facilitate instruction, including printed literature, videos, computer-based tools, etc. were discussed in detail. The goal is not only to identify challenges but to offer practical and pragmatic management solutions to mitigate potential food safety risks. The partnership between JIFSAN, Spices Board and CII-FACE provides a means of sharing knowledge and resources to address this wide variety of training needs. By the close of the Phase II program the trainees had developed and presented for discussion their preliminary plan for furthering the mission of the SCMSBI-CTI in India.

Phase III and additional phases of CTI activity require the trainers to refine and implement their own training programs in India directed to primary producers and subsequent handlers of the products.. The CTI leaders began with a series of meetings with National/State Horticulture Mission officials in May and June 2013 in the Southern, Central and Northern regions of the country. Program leaders worked to sensitize Mission officials to food safety issues and to encourage them to join with the newly formed CTI to conduct food safety training.

Plans were laid by CTI to develop two-day Train-the-Trainer programs. Two of these will be delivered in each state, giving a total of twenty planned programs. The goal is to train approximately fifty persons in each program so a total of 1,000 newly trained trainers were projected. In October the first three programs were delivered to a total 176 persons. These newly-trained participants are expected to branch out and deliver training programs to constituents in their region. This is the concept that has been advanced in JIFSAN GAP Train-the-Trainer programs for more than a decade. Phase III Program evaluation forms completed by course participants indicate that the methods and training materials are on-target. Going forward, the effectiveness of training will be monitored and evaluated not only for the purpose of measuring success but also with the intent of continuously searching for ways in which programs can be improved.

International Food Safety Training Laboratory (IFSTL)

The IFSTL continues to grow and expand its course offerings. We have expanded our networking activities in an effort to secure additional funding and increase participant enrollment. Extramural funding was secured through U.S. government funding opportunities to provide both partial and full support for select participants during the current reporting period as well as the industry. Nine courses were delivered in 2013 (Appendix E) with participants representing government, industry and private laboratories. IFSTL actively participated in the Asia-Pacific Economic Cooperation-Partnership Training Institute Network (APEC PTIN) initiative, and the World Bank's Global Food Safety Partnership, InterAmerican Network of Food Analysis Laboratories and many foreign government contacts. Countries served by IFSTL have grown to 30, including Australia, Barbados, Canada, Chile, China, Costa Rica, Dominican Republic, Egypt, El Salvador, France, Guatemala, Honduras, India, Indonesia, Iraq, Kenya, Korea, Malaysia, Mexico, Netherlands, Pakistan, Peru, Philippines, Russia, Saint Lucia, Saudi Arabia, Sudan, Thailand, USA and Vietnam.

Global Capacity Building in Risk Analysis

JIFSAN's Food Safety Risk Analysis Professional Development Training Program offers an integrated program involving both a qualitative and quantitative track, residency risk analysis fellowship, customized in country training programs, and online distance learning. In 2013, the program piloted additional trainings that provide a refresher on quantitative risk assessment, advanced quantitative risk assessment, international food law, and food defense which were very well received.

The demand for the integrated program has increased. In 2013 the integrated program was offered both in the summer and the fall with a record number of attendants. For the summer there were 117 class seats (39 individuals) filled with 26 in overview, 25 in qualitative risk assessment, 25 in risk management, 23 in risk communication, and 18 in quantitative risk assessment. Participants represented Belize, China, Hong Kong, Indonesia, Jamaica, Japan, Malaysia, Nigeria, Saudi Arabia, Taiwan, Switzerland as well as the United States. The fall integrated program's quantitative track offered both an introductory quantitative risk assessment coupled with an advanced quantitative risk assessment. The registration numbers for the fall program were again impressive with a total 102 seats (41 individuals) filled with 25 in overview, 17 in qualitative risk assessment, 16 in risk management, 14 in risk communication, 19 introductory quantitative risk assessment, and 11 in advanced quantitative risk assessment. Participants represented Canada, Korea, Indonesia, Nigeria, Saudi Arabia as well as the United States.

Thirty nine people were trained through the on-line risk analysis program with 19 in overview, 9 in qualitative risk assessment, 5 in risk management, and 8 in quantitative/qualitative risk assessment.

A risk analysis fellowship for the summer program was offered; among 6 applicants applied, Miguel Figueroa from Belize, received the fellowship. A Residency Fellowship (supported by ILSI China) was also offered; Dyah Kusumastuti (Indonesia) and Ning Ma (China) were the recipients. In addition, the Malaysia government supported two participants.

JIFSAN's Foodrisk.org, an on-line resource of food safety risk analysis, was revamped to highlight unique items exclusively available to the risk analysis community. Several new items have been included:

- **Interactive On-Line Catalogue on Risk Assessment (ICRA)** serves as a web tool offering a dynamic model catalogue for existing microbial risk assessments for risk assessors aiming to develop their own models. It allows users to compare and contrast models from the same pathogen and/or commodity. It is a partnership between the National Institute for Public Health and Environment (RIVM) in the Netherlands, the National Food Institute at the Technical University of Denmark, and JIFSAN. JIFSAN IT currently hosts and maintains both the front-end and the back-end on JIFSAN's local servers.

- **iRisk** - is a Web-based system that enables users to rank and compare risks from multiple foodborne microbial and chemical hazards and predict effectiveness of prevention and control measures. iRISK was built by Risk Sciences International (RSI). RSI host and maintains the tool. JIFSAN hosts the tool's public portal.

- **Environmental Protection Agency's (EPA) On-Line What We Eat in America - Food Commodity Intake Database (FCID)** was launched to: (1) improve transparency of coded fields; (2) make recipes fully searchable; (3) make recipe format more user-friendly; and (4) enable users to estimate consumption of food commodities based off weighted mean and percentile calculations. FCID was designed for assessment of dietary exposures to pesticide residues. JIFSAN hosts and maintains this tool.

Educational Resources for Training a Skilled Workforce

JIFSAN offers opportunities for both students and professionals through undergraduate research internship, graduate assistantship/postdoctoral fellow, and on-line distance learning programs. JIFSAN education programs have provided domestic and international participants tools and techniques to assure that food products are wholesome and safe for consumption. The **JIFSAN Internship Program** is a unique undergraduate research program designed to provide UM undergraduate students with an opportunity to collaborate with FDA scientists on specific research projects related to CFSAN's mission. The Internship Program continues to attract high caliber undergraduate students who are eager to have an opportunity to work with FDA researchers in a "hands on" environment. During the FY 2012-2013 periods, 23 students participated in the program (Appendix F).

Appendices

A – JIFSAN Staff

Administration
Jianghong Meng, DVM, Ph.D. Director
Vernora (Nora) Petty, Assistant to the Director
Mary Grimley, Financial Officer
Pamela Biery, Business Services Specialists

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George Evancho, Senior Fellow

Risk Analysis Program
Clare Narrod, Ph.D., Manager
William Bohlayer, Coordinator

International Food Safety Training Laboratory (IFSTL)
Janie Dubois, Ph.D., Manager
Romina Heymann, Chemist
Angela Winslow, Ph.D., Microbiologist
Marie Ahlgren-Stephanos, Program Management Specialist

IT Program
Kyle McKillop, Coordinator
Timothy Shaffer, IT Support Assistant
Paul Guevara, IT Support Assistant
Scott Feingold, IT Programmer

Internship Program
Kaci Thompson, Ph.D., Director of Undergraduate Research &Internship Programs, College of Computer, Math and Physical Sciences, UM

B – Research and Extramural Projects

COOPERATIVE PROJECTS:

Project	Funding Source	Outcome	Impact
Development and Validation of Isotope Methods for Distinguishing between Naturally Occurring and Synthetic phthalates in Food	FDA	Isotope methods were developed for distinguishing naturally occurring from synthetic phthalates. Results of this research have been published. (pub #4)	Help to differentiate synthetic phthalates from naturally occurring phthalates in food
Nanotechnology and Nanosafety in Food	FDA	Functionality and safety of nano-materials employed in food, dietary supplements, and cosmetics were elucidated. The work has been published in 9 research articles. (pub #12)	Findings on physical, chemical, and biological properties of nanomaterials provide important information to ensure safety of these materials used in food and other products regulated by FDA
Disseminating the "Food Safety on the Go" Course to Home-Delivered Meal Programs	FDA	Created an on-line version of "food safety on the go" course which is also available on DVD. The link to course materials: http://www.nfsc.umd.edu/programs/foodsafety	Improve safety of foods produced for meals to go program at local level
Sources of Food Safety Information for American Consumers: A Cross-Sectional Analysis of the 2010 FDA Food Safety Survey	FDA	Drafted a literature review on food safety information sources and a manuscript on mapping sources of food safety information for American consumers: findings from a national survey	The findings revealed top sources of food safety information for American consumers: TV and radio news, followed by friends and family and newspapers. Helpful to develop effective risk communication tools.

Molecular Detection, Characterization and Genomics of Foodborne Pathogens	FDA	Using molecular tools, detecting methods have been developed, virulence traits, and evaluation history have been determined for major foodborne pathogens including Shiga toxin-producing E. coli, Salmonella and Listeria. Data from the studies have generated 16 manuscripts have been published (Pubs: #1, 2, 3, 5-11; and abstracts #1-4)	better tools are made available to analyze important pathogens and to track down the source of contamination
Enhance Model Capacity and Expand Library of Risk Scenarios of FDA-iRisk tool	FDA	Availability of additional risk scenarios for users and enhancements to increase usability of the tool by risk assessors and other professionals. Continued updating of an institutional version of iRisk that allows for developing and testing of new applications. This is a collaborative effort with Risk Science International.	It is anticipated that the improved tool will enable users to expand their ability to rank and compare risks from multiple foodborne microbial and chemical hazards and predict effectiveness of preventive control measures; and increase collaborations with other U.S. federal agencies, other countries and private industry.
Extracting Mentions of Adverse Effects of Nutritional Supplements from Social Network Postings by Consumers	FDA	Initiated data collection, and developed approaches for data extraction, analysis, and validation	Will provide useful signals to complement the already established processes and data sources for extracting adverse effects of nutritional supplements from social network

EXTRAMURAL PROJECTS

Project	Funding Source	Outcome	Impact
Student research project on measuring the effectiveness of hand washing	in-kind	A method to measure the effectiveness of hand washing should be developed in this project. This method may become a reference for stakeholders who wish to use hand washing techniques other than suggested by the Food Code to demonstrate the effectiveness of the proposed alternatives.	It is expected that the method developed in this research will enable stakeholders from the farming and food service industries to present quantitative data to FDA in support for proposals to implement hand washing techniques that differ from the technique described in the Food Code.
Toward a rapid and reliable pathogen detection system in produce	UC David Center for Produce Safety grant; $152,000	Molecular Assays were developed to detect Salmonella and STEC in fresh produce. The work was presented at food safety conference (abstract #5 and 6). A manuscript has been accepted for publication at Applied & Environmental Microbiology journal.	It provides a rapid and portable method for detecting pathogens in the field to the industry and regulatory agencies. This could help to quickly identify the source of a pathogen and reduce exposure to the public.
Leafy Greens and Tomatoes Safety Metrics	USDA grant; $440,000	Microbiological data of leafy green, tomato, water, and environment showed that pathogens in well managed field operations are rare.	It provides scientific and technological knowledge to develop metrics to enhance produce food safety, and identify improved approaches and techniques that allow the attainment of the metrics to be verified simply and cost effectively.

C - Publications

1 Cao, G., J. Meng, E. Strain, R. Stones, J. Pettengill, S. Zhao, P. McDermott, E. Brown, M. Allard. 2013. Phylogenetics and Differentiation of Salmonella Newport Lineages by Whole Genome Sequencing. PLoS ONE 8(2): e55687. doi:10.1371/journal.pone.0055687

2 Ju, W., J. Shen, M. Toro, S. Zhao, and J. Meng. 2013. Distribution of Pathogenicity Islands OI-122, OI-43/48, OI-57 and High Pathogenicity Island (HPI) in Shiga Toxin-producing Escherichia coli. Appl. Environ. Microbiol. 79:3406-3412.

3 Kroft BS, Brown EW, Meng J, Gonzalez-Escalona N. 2013. Draft Genome Sequences of Two Salmonella Strains from the SARA Collection, SARA64 (Muenchen) and SARA33 (Heidelberg), Provide Insight into Their Antibiotic Resistance. Genome Announc. 1(5)

4 Nelson, M., Ondov, J., Vanderveer, M., Buchholz, B. Contemporary Fraction of bis(2-ethylhexyl) Phthalate in Stilton Cheese by Accelerator Mass Spectrometry. Radiocarbon, North America, 55, feb. 2013. Available at: <https://journals.uair.arizona.edu/index.php/radiocarbon/article/view/16298>.

5 Shen J, Wang F, Li F, Housley R, Carolan H, Yasuda I, Burrows E, Binet R, Sampath R, Zhang J, Allard MW, Meng J. 2013. Rapid identification and differentiation of non-O157 Shiga toxin-producing Escherichia coli using polymerase chain reaction coupled to electrospray ionization mass spectrometry. Foodborne Pathog Dis. 10(8):737-43.

6 Shen, J., L. Rump, Y. Zhang, Y. Li, X. Wang, and J. Meng. 2013. Molecular subtyping and virulence gene analysis of Listeria monocytogenes isolates from food. Food Microbiol. 35:58-64.

7 Son, I., C. Keys, J. Zheng, S. Zhao, J. Meng, and E. Brown. 2013. Analysis of Pulsed Field Gel Electrophoresis Profiles Using Multiple Enzymes for Predicting Potential Source Reservoirs for Strains of Salmonella Enteritidis and Salmonella Typhimurium Isolated from Humans. Infect, Genetics and Evolution. 16C:226-233.

8 Toro, M., M. B. Najjar, W. Ju, E. Brown, S. Zhao, and J. Meng. 2013. Molecular serogrouping of Shiga toxin-producing Escherichia coli using suspension array. Foodborne Pathogens & Dis. 10:478-480.

9 Wang F, Yang Q, Kase JA, Meng J, Clotilde LM, Lin A, Ge B. 2013. Current trends in detecting non-O157 Shiga toxin-producing Escherichia coli in food. Foodborne Pathogens & Dis. 10(8):665-77.

10 Zhang J, Cao G, Xu X, Jin H, Yang X, Allard M, Brown E, Meng J. 2013. Draft Genome Sequences of Three Salmonella enterica Serotype Agona Strains from China. Genome Announc. 1(1).

11 Zhang J, Cao G, Xu X, Jin H, Zhang Q, Chen J, Yang X, Pan H, Zhang X, Allard M, Brown E, Meng J. 2013. Whole-Genome Sequences of Four Salmonella enterica Serotype Newport Strains from Humans. Genome Announc. 1(3).

12 Zhou, Y. T.; He, W.W.; Wamer, W.G.; Hu, X.; Wu, X.; Yin, J.J. Enzyme-mimetic effects of gold@platinum nanorods on the antioxidant activity of ascorbic acid. Nanosacle. 5(2013): 1583-91

Abstracts at Conferences

1 Hoffmann, M., S. Zhao, J. Pettengill, Y. Luo, T. Muruvanda, J. Abbott, S. Ayers, J. Folster, M. Allard, J. Meng, E. Brown, and P. McDermott. 2013. Differentiation of Closely Related Salmonella enteric Serotype Heildelberg Isolates by Comparative Genomic Analysis. Annual Meeting of International Association for Food Protection, Charlotte, NC.

2 Ju, W., S. Shen, L. Rump, M. Toro, S. Zhao and J. Meng. 2013. Pathogenicity Islands in Shiga Toxin-producing Escherichia coli O26, O103 and O111 Isolates from Humans and Animals. Annual Meeting of International Association for Food Protection, Charlotte, NC.

3 Rump, L.V. N. Gonzalez-Escalona, W. Ju, G. Cao and J. Meng. 2013. Virulence plasmid distribution and their potential role in pathogenesis in non-O157 Shiga toxin-producing Escherichia coli (STEC). ASM Annual Meeting, Denver, CO.

4 Toro, M., R. Timme, W. Ju, G. Cao, M. Allard and J. Meng. 2013. Shiga Toxin-producing Escherichia coli H Antigen Clustering Evidenced by CRISPR (Clustered Regularly Interspaced Short Palindromic Repeats) Array. Annual Meeting of International Association for Food Protection, Charlotte, NC.

5 Wang, F., Q. Yang, K. Jones, J. Meng, and B. Ge. 2013. Evaluation of a Suite of Loop-medicated Isothermal Amplification Assays for Rapid, Reliable, and Robust Detection of Shiga toxin-producing Escherichia coli in Produce. Annual Meeting of International Association for Food Protection, Charlotte, NC.

6 Yang, Q., F. Wang, K. Jones, J. Meng, W. Prinyawiwatul, and B. Ge. 2013. Evaluation of Loop-medicated Isothermal Amplification Assays for Rapid, Reliable, and Robust Detection of Salmonella in Produce. Annual Meeting of International Association for Food Protection, Charlotte, NC.

D - International Trainings

Good Agricultural Practices (GAP)

January 14-19, 2013. Quito, Ecuador. The JIFSAN GAP Train the Trainers course was conducted in cooperation with the US-FDA and the Instituto Internacional de Cooperación para Agricultura (IICA) with 30 participants. The course included lectures, case studies with discussion sessions and a field trip to a broccoli production and processing company.

February 11-15, 2013. Kingston, Jamaica. The JIFSAN GAP Train the Trainers was conducted in cooperation with the Jamaican Ministry of Agriculture and Fisheries, the Rural Economic Development Initiative, Jamaica Social Investment Fund, and The World Bank with 54 participants formally enrolled. The program was well supported by the collaborating organizations and approximately 75 people attended the formal opening and closing ceremonies. The field trip included visits to tropical vegetable farms and packing facilities.

July 22-26, 2013, Mexico City, Mexico. The JIFSAN GAP Train the Trainers course was conducted in cooperation with the US-FDA, the Servicio Nacional de Sanidad, Inocuidad y Calidad Agroalimentaria (SENASICA), and the Comité Estatal de Sanidad Vegetal del Distrito Federal México (CESAVEDF) in México City, México at the meeting facilities of the SENASICA headquarters. The program was structured a bit differently than previous GAP courses in that Day 1 was dedicated to the subject of outbreak investigations and related topics. Presentation materials for this day were largely developed by members of the CORE group at FDA and the audience was made up almost entirely of employees of SENASICA with responsibilities for work in food safety. The remainder of the week was dedicated to a somewhat abbreviated (4-day) standard GAP program for 80 participants. The field trip included a visit to a vegetable production and field packing operation.

Good Aquacultural Practices (GAqP)

Two GAqP Training Programs were conducted in India in successive weeks during the Month of March. These were conducted in collaboration with the FDA and Marine Export Development Association (MPEDA) and the Export Inspections Council (EIC). Participants who met the requirements were awarded HACCP Certification from the Association of Food and

Drug Officials (AFDO). In the two locations (see following) participants were able to observe harvesting and processing practices on a field trip.

March 4-8, 2013. Cochin, India. The first of the two programs was in southwestern Cochin. There were 28 participants, 15, from the seafood processing industry, 9 from MPEDA), and 3 from the EIC.

March 11-15, 2013. Nellore, India. For the second program there were 29 participants, 20 from the seafood processing industry, 7 from MPEDA and 2 from EIC.

May 20-24, 2013. Bhubaneswar, India. A third program was held in India in May. There were 27 participants, 14, from the seafood processing industry, 2 from the Marine Export Development Association (MPEDA), 9 participants from the Export Inspections Council (EIC), and 1 in-country FDA/HHS personnel.

September 16-20, 2013. Goa, India. This was a Good Fisheries Vessel Practices. Twenty six participants attended the workshop in Goa, representing the Export Inspections Council (EIC, the largest group represented), the Central Institute of Fisheries Technology, the Kerala State Co-op Federation for Fisheries Development Ltd., and a few members of the seafood processing industry.

Commercially Sterile Packaged Foods (CSPF)

November 4-9, 2013. Bangkok, Thailand. The JIFSAN Train the Trainers course for CSPF was offered in collaboration with the Department of Food Engineering at King Mongkutt's University of Technology Thonburi (KMUTT) and the National Food Institute (NFI) Thailand. There were 40 participants, with 21 from Universities, 13 from government, 2 from industry and 4 others. Many of the students had previously attended Better Process Control School and were knowledgeable of thermal processing. This program represented Phase I of an effort to establish a CSPF Collaborative Training Center with Thailand. Definitive plans for Phase II in 2014 have been made.

Food Inspector Training (FIT)

September 30-August 1, 2013. Klang, Selangor (near Kuala Lumpur), Malaysia. The JIFSAN FIT program was planned and delivered in collaboration with the International Food Safety Training Center (IFSTC) of the Food Safety and Quality Division of the Ministry of Health – Malaysia to about 30 participants who were mostly early-career food inspectors. In addition to classroom sessions the participants conducted mock inspections of two facilities, one for frozen aquacultural products and the other for processed juice drinks.

October 9-14, 2013. Shenzhen, China. The JIFSAN FIT program was conducted in Shenzhen, Guangdong, China October 9 - 14, 2013. The program was planned and delivered in collaboration with China Inspection and Quarantine Association (CIQA) and the Certification and Accreditation Administration (CNCA) based in Beijing, China. There were 70 participants, 40 of whom were bona fide food inspectors and the remaining 30 from industry with food safety responsibilities. In addition to classroom sessions the group conducted a mock inspection of an infant formula manufacturing facility.

Supply Chain Management for Spices and Botanical Ingredients (SCMSBI)

March 25-April 5, 2013. College Park, MD and Oxford, MS. See page 5.

E - IFSTL Courses

Course	Date	Outcome	Impact
Food Microbiology for Industry Analysts	1/15/13	1) Five laboratory analysts were trained. 2) The Malaysian government has established a cadre of in-country trainers, who have already delivered a reproduction of this course for 24 analysts from their provincial and federal laboratories.	The individuals trained at JIFSAN's train-the-trainer programs as well as those trained by these trainers in their country will provide more reliable laboratory data to the Malaysian Competent Authority allowing for an improved food safety system for both the domestic and export markets.
Listeria in Food	5/3/13	1) Trained 9: 2 from Rep. of Korea (government), 1 from FDA CFSAN and 5 UMD students (future TAs). 2) Pre and post-course factual tests were administered and the average score for the group went from 30% pre-course to 73% post-course.	The participant from FDA CFSAN reported he was now better prepared to take on his new project on *Listeria* in food and for which he had no prior work experience. The analysts from Korea (who work on samples from the import, export and local markets) will provide more reliable laboratory data to the Korean Competent Authority allowing for an improved food safety system for both the domestic and export markets.

Pesticide Residue Analysis and Introduction to Risk Analysis.	6/12/13	1) Trained 7: 1 from Costa Rica (University Researcher), 2 from Indonesia (government), 4 from Malaysia (3 national government and 1 city health authority) 2)The trainee from Costa Rica has implemented the method in her research laboratory (academia) 3) The Ministry of Health of Malaysia has schedule the delivery of this training to provincial lab analysts in Sept. 2014 and 4) the trainee from Indonesia has planned to propagate the training among national and provincial laboratories in Indonesia.	The person trained from Indonesia will propagate the training to analysts in Indonesia who work on samples from the import, export and local markets, and all will provide more reliable laboratory data to the Indonesian Competent Authority, allowing for an improved food safety system for both the domestic and export markets. The persons trained in the JIFSAN training, as well as during the repetition in country (who work on samples from the import, export and local markets) will provide more reliable laboratory data to the Malaysian Competent Authority allowing for an improved food safety system for both the domestic and export markets.
Salmonella for food company	9/13/13	Trained 18 people from the Mars company's sites in Egypt, Russia, USA, Saudi Arabia, Australia, China, France, on methods of analysis for Salmonella.	This training gave a better understanding of requirements for these methods for persons responsible for auditing contract labs in preparation for the demonstration of supply chain verification as will be required by FSMA.

Veterinary Drug Residues in Aquaculture, Meat and Poultry.	9/25/13	1) Trained 10: 1 Sudan (University PhD student), 1 Kenya (government), 1 Iraq (government), 3 Egypt (government), 1 Indonesia (government), 3 Chile (1 academia, 2 government). 2) Reproduction of this training in Chile for 20 people is scheduled for April 2014, targeting over multiple repetitions of this course to extend to all government labs and government-certified labs doing regulatory samples. 3) The participant from Kenya will use the new knowledge on the US regulations in his work on the development of regulations for Kenya. 4) The participant from Iraq intends to implement ELISA as a screening tool in her regulatory laboratory	The persons trained in the JIFSAN training as well as during the repetition in country (who work on samples from the export and local markets) will provide more reliable laboratory data to the Chilean Competent Authority allowing for an improved food safety system for both the domestic and export markets. New regulations in Kenya may better align with US regulations. The implementation of screening in Iraq could contribute to improved public health.
Salmonella and *Campylobacter*	10/11/13	1) Trained 10: 4 Malaysia (government), 1 Barbados (government), 1 Saint-Lucia (government), 1 Honduras (government), 3 Chile (government). 2) The Malaysian government has established a cadre of in-country trainers, who will reproduce this training for provincial and national laboratory analysts	Each participant was asked how many laboratories they have to either train, influence or inspect. It added up to 135 laboratories for the 10 participants. So the training of these 10 people could impact the activities of up to 135 laboratories.

Shiga-toxin producing E. coli	10/17/13	1) Trained 4 from Ministry of Health in Malaysia. 2) The Malaysian government has established a cadre of in-country trainers, who will reproduce this training for provincial and national laboratory analysts.	It is anticipated that the persons trained in the JIFSAN training as well as during the repetition in country (who work on samples from the export and local markets) will provide more reliable laboratory data to the Malaysian Competent Authority allowing for an improved food safety system for both the domestic and export markets.
Pesticide Residue Analysis and Introduction to ISO17025	11/22/13	1) Trained 6: 1 China (academia), 1 Saudi Arabia (academia), 3 Korea (government), 1 India (industry). 2) A regional workshop is being organized for September 2014 in China to propagate some of the learning from this course.	The participation from China will contribute to local investments in laboratory capacity building initiatives to meet the requirement of export markets. The participant from India works for a private industry; his laboratory just acquired LC-MS/MS instrumentation to expand their capacity for pesticide residues (only had GC-MS/MS) and having learned the requirements for the US market, intends to apply methods for the commodities aimed at the US market that meet the recommendations of the US FDA. Previously, they were predominantly adopting EU methods because they are imposed.
Microbiology for Food Safety in Malaysia	11/17/13	Trained 20 analysts from the State laboratories in Malaysia	Adoption of FDA-recommended methods for *Salmonella* as well as progressive adoption of rapid techniques by the reference labs in the States. The portion of the course on Good Laboratory Practices was particularly interesting to the participants as they felt this was a topic where they could individually

			make changes. It is expected that some of the laboratories will re-work their floor plans to improve their workflow to minimize the risk of cross-contamination, especially as new rapid techniques get brought in.

2014 course schedule is available online: http://ifstl.jifsan.umd.edu/upcomingClasses/

Appendix F – Undergraduate Internship/Graduate Assistantship

Undergraduate Internships (Ending in May 2013)				
Last Name	First Name	Project ID	Project	Mentor
Anders	Stephen	JIP-223	Food Irradiation: Chemical Changes in Food and Food Contact Substances due to the Absorption of Ionizing Radiation	Kim Morehouse
Chase	Hannah	JIP-237	Investigating the Global Genomic Diversity and Evolution of *Cronobacter* spp. using a Next-Gen DNA Microarray technology for inclusion into the Pathogen-annotated Tracking Resource Network (PATRN) via NCTR's ArrayTrack for technology transfer to FDA Field and FERN laboratories.	Ben Tall
Chou	Luoth	JIP-219	Adaptation of Listeria monocytogenes in high osmolarity and refrigeration temperature.	Atin Datta
Do	Andrew	JIP-218	To identify allergenic proteins of the major food allergens and to determine their digestibility and IgE immunoreactivity.	Ondulla Foye-Jackson
Flamer	Marie-Laure	JIP-229	Identification and Characterization of Salmonella enterica from Spices	Junia Jean-Giles
Forster	Jacqueline	JIP-232	Rapid Detection and Quantitation of Gluten Using Hand-Held Diagnostic Devices	Eric Garber
Gladding	Anne	JIP-239	Ensuring Fresh Produce Safety: Susceptibility of Fresh-Cut Produce to Microbial Invasion;	Joy Johanson

			and Produce Safety Practices at Foreign Farms	
Hahn	Justin	JIP-226/233	Identification of virulence factors that contribute to the enterotoxicity of Vibrio parahaemolyticus.	Augusto Franco-Mora
Kanyuck	Kelsey	JIP-225	Method Validation for Seafood Toxin Biosensors	Betsy Yakes
Kuo	Jennifer	JIP-210	Establish methodology for assessing inflammatory cytokine expression (mRNA and protein) in infectious and inflammatory models of foodborne pathogens	Mohammad Samiul Alam
Lee	Nathan	JIP-215	Analysis of Chemical Contaminants in Foods	Jon Wong
Lopez	Joanna	JIP-147	Food Safety Risk Analysis: Quantitative Risk Assessments	Yuhuan Chen/Sheri Dennis
Meltsner	Juliet	JIP-213	Assessment of pathology and immunological biomarker expression in mice following exposure to STEC-associated Shiga Toxin 2.	Lisa Plemons
Moore	Amanda	JIP-228	Use and Applicability of Human Clinical Studies in the Generally Recognized As Safe (GRAS) Program	Timothy Twaroski
Pahlavan	Autusa	JIP-236	Screening of polyclonal antibodies against gluten from specific grain and develop enzyme linked immunosorbent assay (ELISA) for grain specific gluten detection	Girdhari Sharma
Park	Hoon Yong	JIP-	Analysis of Chemical Contaminants in Foods	Jon Wong

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Park	Joseph	JIP-224	Analyzing Food Safety Practices Related to Fresh Produce	Joy Johanson
Partan	Elizabeth	JIF-230	MassCode PCR spectroscopy liquid array as a tool for genetic Listeria spp	Sufian Alkhaldi
Same	Mary	JIF-231	Food Safety Risk Analysis: Quantitative Risk Assessments	Sherri Denis
Saunders	Cameron	JIF-227	Isolation and identification of yeasts with antagonistic activities against Penicillium expansum, the main cause of postharvest spoilage and patulin production in apples	Valerie Tournas
Thole	Joseph	JIF-231	Rapid Methods for the Detection of Food Allergens and Toxins	Eric Garber
Trach	Larisa	JIP-235	Testing a multiplex real-time PCR method for simultaneous detection of Salmonella spp., *Escherichia coli 0157*, and *Listeria monocytogenes* in FDA regulated foods	Venugopal Sathyamoorthy
Yang	Kwon	JIP-147	Food Safety Risk Analysis: Quantitative Risk Assessments	Jane Van Doren/Sheri Dennis
Graduate Assistantship				

Li	Jinxi		Development of Methods for the Characterization of Protein Allergens	John Callahan (CFSAN) / Catherine Fenselau (UM)
Cao	Guojie		Whole Genome Sequencing of Salmonella Newport	Marc Allard (CFSAN) / J. Meng (UM)

G – Symposia/Conferences

JIFSAN Advisory Council Symposium: The 2013 Annual JIFSAN Advisory Council Spring Symposium: Conundrum of Defining Food Safety - The Case of the Moving Zero was held on April 18th-19th, 2013, at the Greenbelt Marriott Hotel, Greenbelt, MD. The symposium examined the conundrum of defining food safety and how the definition has changed with time. It provided a better understanding of the issues contributing to the conundrum of defining safety, how perceptions are influenced, and how expectations of safety are being met. Over 100 people attended the symposium.

The 2013 Annual Fera (CSL)/JIFSAN Joint Symposium on Food Safety and Applied Nutrition (June 12th-13th, 2013) addressed "Analytical Methods and Laboratory Practices for International Food Safety", and was held at the Food and Drug Administration, Harvey W. Wiley Building, College Park, MD. The aims of the symposium are to fill the gap in between by providing an overview on current methods and validation process, laboratory accreditation, and trainings on analytical methods through international partnership. Invited speakers were drawn from regulatory agencies, public interest groups, international organizations, and academic and research institutions in Asia, Europe and North America.