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Richard C. Whiting, Ph.D.
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Professional Profile

Dr. Richard Whiting is a Senior Managing Scientist in Exponent's Health Sciences Center for Chemical Regulation and Food Safety. Dr. Whiting has over 35 years of experience in food science and technology research with extensive knowledge of microbial food safety issues from production to retail, food service, and consumers. At Exponent, Dr. Whiting has qualitatively and quantitatively evaluated the safety of food processes via hazard analyses, risk profiles, and risk assessments to identify microbial contamination routes, deficient food processing practices and appropriate mitigation steps. He has designed experimental procedures to demonstrate process safety, evaluated HACCP/management systems and microbial sampling plans intended to assure safety, performed root cause analyses to determine the likely cause of product failures, and assisted clients with regulatory issues.

Dr. Whiting is internationally recognized for his research and applications in mathematical modeling of food borne microorganisms to estimate the growth, survival, or inactivation of harmful and spoilage bacteria in foods. He has used these to determine the level of risk that a food has and the reduction in risk that different processing steps could achieve. Dr. Whiting's contributions have been applied by linking this innovative science to individual food processing steps and to entire manufacturing processes to estimate the final quality and safety of foods. He has made major contributions to the development of the Food Safety Objective concept, which links food processing interventions to public health goals, and the use of microbial risk assessments to serve as the science base for the design of Hazard Analysis Critical Control Point (HACCP) systems to ensure food safety.

Prior to joining Exponent, Dr. Whiting was a Senior Scientist with the Food and Drug Administration, Center for Food Safety and Applied Nutrition (FDA, CFSAN). At FDA, he was a technical leader, advising senior managers and shaping the design of microbial risk assessments, including the *Listeria monocytogenes* risk assessment in ready-to-eat foods (2003). In addition, he contributed to developing harmonized international standards for food safety. He was an expert consultant to the Codex Committee for Food Hygiene, Working Group on Standards for *L. monocytogenes* and a member of team that conducted the Codex risk assessment on *L. monocytogenes* (2004). At FDA he also conducted research on microbial modeling and led a research group on microbial threat agents in foods. From 1977 to 1998, Dr. Whiting was a research food technologist at the USDA, Agricultural Research Service, Eastern Regional Research Laboratory. There he conducted research on muscle biochemistry and meat quality and safety, including the functionality and microbial safety of reduced-salt meat products. Shifting to research to microbial pathogens, he advanced the conceptual approaches for modeling growth of foodborne pathogens that became the USDA's Pathogen Modeling Program, including *L. monocytogenes*, *Salmonella*, and *Escherichia coli* O157:H7, and directed research that led to the creation of survival models for *Salmonella* and *E. coli*

O157:H7 and probability-of-growth models for *Clostridium botulinum*. He began his research career as a fellow in the Department of Food Science at the University of British Columbia in Vancouver, Canada.

Dr. Whiting has published over 140 research papers, book chapters, risk assessments and other scientific works. He has lectured extensively in the U.S. and internationally on predictive microbiology and microbial risk assessments, and has participated in numerous workshops/training programs in this area. He has served on the Editorial Boards for *Journal of Food Protection* and the *International Journal of Food Microbiology* and is an Associate Editor for the *Journal of Food Science*. In recognition of his contributions to food science and food microbiology, Dr. Whiting was presented with the Food Safety Award by the National Center for Food Science and Technology and was elected a Fellow of the Institute of Food Technologists in 2006. Dr. Whiting advises clients on issues in food science and technology, microbiological modeling and risk assessment, and consumer product safety.

Academic Credentials and Professional Honors

Ph.D., Food Science, Oregon State University, 1974
M.Sc., Food Science, University of British Columbia, 1970
B.S., Agriculture, Dairy, and Food Industries, University of Wisconsin, Madison, 1968

Food Safety Award by the National Center for Food Science and Technology, 2007
Fellow of the Institute of Food Technologists, 2006
HHS Secretary's Award for Distinguished Service as a member of the FDA Counter / Bioterrorism Preparedness Team, 2003
FDA Group Recognition Award as a member of the *Listeria monocytogenes* Risk Assessment, 2001
USDA Superior Service Award for efforts on the Microbial Food Safety team that developed the microbial pathogen models, 1993
USDA, ARS Edminster Award, for Outstanding Research Associate Proposal in ARS, 1989
Alpha Zeta, Agriculture Honors Fraternity, U. Wisconsin, 1966

Patents

U.S. Patent Number 5,171,591: Control or elimination of undesirable bacteria using parasitic *Bdellovibrio* bacteria, December 15, 1992 (Serial # 07/694,602).

Publications

Chen Y, Ross WH, Whiting RC, Van Stelten A, Nightingale KK, Wiedmann M, Scott VN. Variation in *Listeria monocytogenes* dose response in relation to subtypes encoding a full-Length or truncated Internalin A. App. Environ. Microbiol 2011; 77:1171–1180.

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Whiting RC. Risk management—Factoring in different interventions and estimating total benefit. International Sprout Growers Association. 20th Annual convention, Chicago, IL, 2010.

Whiting RC, Buchanan RL. Microbiological modeling. NASA, Jet Propulsion Lab, Pasadena, CA, 2010.

Whiting RC. Use of risk assessment modeling as a tool in developing sound food safety programs for microbial control. Using a Risk Based Approach, Performance Criteria and

Defined Food Safety Objectives to Determine The "Right" Amount of Lethality for Your Process, IFT Annual Meeting, Chicago, IL, 2010.

Whiting RC. Use of the *Salmonella* on almonds risk assessment to guide food safety decisions. Session S7, Government, Academic and Industry Collaborations to Advance the Development and Use of Microbiological Risk Assessments, IAFP Annual Meeting, Anaheim, CA, 2010.

Whiting RC. Use of risk assessments to guide food safety decisions and determine HACCP plans. Food Industry Microbiology Round Table, Plymouth, MN, 2010.

Whiting RC, Smith MA, Havelaar A, Buchanan RL, Julien E. Thresholds in the dose-response relationship for bacterial pathogens. International Life Science Institute Annual Meeting, Tucson AZ, 2009.

Whiting RC. What risk assessment can tell us about setting criteria. Controlling Listeria in ready-to-eat foods: Working towards global scientific consensus and harmonization. Amsterdam, The Netherlands, 2009.

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Whiting RC. Opportunities and challenges for industry and government to utilize risk assessments for making food safety risk management decisions. Proceedings, Effective Use of Microbial Risk Assessment Food Safety Risk Management Decisions Symposium, Society for Risk Analysis Annual Meeting, Baltimore, MD, 2009.

Whiting RC. Hands-on workshop on microbial risk assessment modeling and interpretation. International Association of Food Protection Annual Meeting, Columbus, OH, 2008.

Whiting RC. Regulatory perspectives to drive risk management options. In: New and Innovative Ways to Drive Risk-Based Management. International Association of Food Protection Annual Meeting, Symposium Session S6, Columbus, OH, 2008.

Buchanan RL, Whiting RC. International microbiological criteria for foods: The emergence of risk-based standards and related metrics. U. Georgia, Center for Food Safety 2008 Annual Meeting, Atlanta, GA, 2008.

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Whiting RC. Fundamentals of predictive microbiology and risk assessment. Korean FDA, Seoul, Korea, October 26, 2007.

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Whiting RC. Microbial risk assessment in CCFH: Experience and perspectives. Workshop—National and International Activity for the Containment of Antimicrobial Resistance, First Session on Codex Intergovernmental Task Force on Antimicrobial Resistance, Seoul, Korea, October 22, 2007.

Whiting RC. Fundamentals of predictive microbiology. Workshop 3, Predictive Microbiology as a HACCP Validation and Support Tool. Part of International Association of Food Protection Annual Meeting, Orlando, FL, July 7, 2007.

Whiting RC. Regulatory perspective on the use of predictive microbiology—FDA perspective. Workshop 3, Predictive Microbiology as a HACCP Validation and Support Tool. Part of International Association of Food Protection Annual Meeting, Orlando, FL, July 7, 2007.

Whiting RC. Case Study, Example 3: Use of predictive models in *L. monocytogenes* smoked finfish risk assessment. Workshop 3, Predictive Microbiology as a HACCP Validation and Support Tool. Part of International Association of Food Protection Annual Meeting, Orlando, FL, July 7, 2007.

Whiting RC. Factors influencing the performance of sampling plans, microbiological criterion. Workshop on the Role of Testing in the Safety of Fresh Produce, NCFST, Oak Lawn, IL, May 30, 2007.

Whiting RC. Application of risk assessment to inform risk management and food process control. Johns Hopkins Bloomberg School of Public Health, February 26, 2007.

Whiting RC. Setting ALOPs, food safety objectives and performance objectives. Commercial Sterility Working Group, NCFST, February 5, 2007.

Whiting RC. Setting performance objectives and food safety objectives. P-OCRA Workshop, Bilthoven, The Netherlands, November 27–December 1, 2006.

Whiting RC. Microbiological modeling. FPA Internet Workshop, Washington, DC, July 20, 2006.

Whiting RC. Food safety objectives. Session 059. Symposium on Conceptual and Mathematical Description of the Food Safety Objectives, IFT Annual Meeting, Orlando, FL, June 27, 2006.

Whiting RC. Microbial dose-response. Session: Microorganism Thresholds: Presentations and Panel Discussion. FDA Office of Food Additive Safety Grand Rounds on Crossing the Thresholds of Tomorrow, June 8, 2006.

Whiting RC. *Listeria* risk assessment. Lecture for JIFSAN Distant Learning Course in Risk Assessment, June 5, 2006.

Whiting RC. *Clostridium botulinum* research at FDA, CFSAN. Briefing for the National Counterterrorism Center Working Group on *C. botulinum*, NCTC, McLean, VA, March 15, 2006.

Whiting RC. Approaches for deriving performance objectives and performance criteria from a food safety objective. Symposium on Relating Microbiological Testing and Microbiological Criteria to Public Health Goals. ICMSF, RAC, ILSI, IAFP and IFT, Gallaudet University, Washington, DC, October 31–November 1, 2005.

Whiting RC. Risk-based approach to microbial food safety. Illinois Institute of Technology-NCFST Graduate Seminar, Summit Agro, IL September 16, 2008.

Whiting RC. Critique of the food handling practices model. RAC Workshop, College Park, MD, August 18, 2005.

Whiting RC, Schaffner D. Basic statistical concepts. IAFP workshop on Statistics as a tool for the microbial evaluation of foods, Baltimore, MD, August 12, 2005.

Whiting RC. Risk-based approach to establishing microbiological criteria. JIFSAN Telecommunication Course on Risk Assessment (by Internet), June 6, 2005.

Whiting RC. Microbial risk assessment process. National Trends in Food Safety and Quality. University of Florida (by telephone), May 17, 2005.

Whiting RC. Application of risk assessment in RTE foods. Process validation and process control for RTE foods workshop. Alkar-RapidPak, Lodi, WI, May 3–4, 2005.

Whiting RC, Buchanan RL. Setting a microbiological criteria. CCFH Working Group on control of *Listeria monocytogenes*, Berlin, Germany, September 21, 2004.

Whiting RC. How risk assessors and risk managers have utilized available data to support decision making, *Listria* and *Vibrio* risk assessment examples. Presented at RAC Symposium, College Park, MD, September 14, 2004.

Whiting RC. Toward a classification of ready-to-eat foods according to risk or other uses of risk assessment in managing risk. *Listeria monocytogenes* and Risk Analysis, ASEPT, Laval, France, March 17–18, 2004.

Whiting RC. The US FDA/FSIS quantitative risk assessment of *Listeria monocytogenes* in ready-to-eat foods. *Listeria monocytogenes* and Risk Analysis, ASEPT, Laval, France, March 17–18, 2004.

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Whiting RC, Raybourne R. Assessment of *Listeria monocytogenes* virulence variability using animal models and its use in dose-response relationships. *Listeria monocytogenes* and Risk Analysis, ASEPT, Laval, France, March 17–18, 2004.

Whiting RC. Perspectives on pathogen performance standards. Society for Risk Analysis Annual Meeting, Baltimore, MD, December 10, 2003.

Whiting RC. Data and modeling requirements for foodborne microbial risk assessments. AIChE Annual Meeting, San Francisco, CA, November 20, 2003.

Whiting RC. Quantitative assessment of the relative risk to public health from foodborne *Listeria monocytogenes* among selected categories of ready-to-eat foods. HHS/FDA National Public Affairs Conference, Nashville, TN, November 19, 2003.

Whiting RC. Relative risk ranking assessment for *L. monocytogenes*. IFT International Food Safety and Quality Conference, Orlando, FL, November 5–7, 2003.

Whiting RC. Risk assessment. Seafood Science and Technological Society Meeting, Biloxi, MS, November 3–6, 2003.

Whiting RC, Eblen S. USFDA "New" risk assessment. Refrigerated Foods Association Technical Seminar, Crystal City, VA, September 9, 2003.

Whiting RC. Principles for determining if a product requires shelf life dating. Invited presentation in ILSI Symposium at the IAFP Annual Meeting, Symposium on Science-based

Shelf Life Dating of Ready-to-Eat Refrigerated Foods. International Association for Food Protection Annual Meeting, New Orleans, LA, August 13, 2003.

Whiting RC, Schaffner D. A hands-on course in quantitative microbial risk assessment. Workshop II. International Association for Food Protection, Annual Meeting, New Orleans, LA, August 8–9, 2003.

Whiting RC. Analysis of *Clostridium botulinum* toxin in food matrices using ELISA technology. Bilateral U.S.-Israel Conference of Science and Technology Based Countermeasures to Foodborne Terrorism, Shepherdstown, WV, July 2, 2003.

Whiting RC, Bagi L. Time-temperature controls: Scientific Status. Lag phase of *Listeria monocytogenes*. Atlantic Fisheries Technology Society and Seafood Science and Technology Society of the Americas, Orlando, FL, October 10, 2002.

Whiting RC, Eblen S. Risk assessment for *Listeria monocytogenes*. Refrigerated Foods Association, Crystal City, VA, September 5, 2002.

Whiting RC. Ranking of microbiological risks. In Symposium on Customized Approaches to Microbiological Risk Assessment, International Association of Food Protection, San Diego, CA, July 3, 2002.

Whiting RC, Buchanan RL, Lindqvist, R. Hazard characterization of *Listeria monocytogenes*. Society for Risk Analysis Workshop, Seattle, WA, December 3, 2001.

Whiting RC. Data modeling tools used in the FDA/FSIS *L. monocytogenes* risk assessment. Society for Risk Analysis Workshop, Seattle, WA, December 2, 2001.

Whiting RC. FDA *Listeria monocytogenes* risk assessment. In: Session on Risk Assessment, Fourth World Fish Inspection & Quality Control Congress, Vancouver, BC, October 25, 2001.

Whiting RC. Microbial risk assessmentBFDA/FSIS *Listeria monocytogenes*. Food Science Department, University of British Columbia, Vancouver, BC, October 23, 2001.

Whiting RC. Microbial food safety risk assessment. Information Resources for Policy Analysis, Economic Research Service, Washington, DC, October 17, 2001.

Whiting RC. Current FDA CFSAN approaches to susceptibility in microbial risk assessment. George Washington University Medical Center, Center for Risk Science and Public Health, Washington, DC, July 26–27, 2001.

Whiting RC. Draft risk assessment for *Listeria monocytogenes* in RTE foods. EU-US Food Safety Research Workshop, Brussels, Belgium, July 19, 2001.

Whiting RC. Draft risk assessment for *Listeria monocytogenes* in RTE foods. Second ARS-BBSRC Workshop on Food Safety, Norwich, UK, July 16, 2001.

Whiting RC. FDA/FSIS *L. monocytogenes* risk assessment. Food Research Institute, University of Wisconsin, Madison, WI, May 16, 2001.

Whiting RC. Microbial risk assessment, Cornell University, Department of Food Science, Ithaca, NY, April 17, 2001.

Whiting RC, Gombas K. FDA & FSIS *Listeria* risk assessment and action plan. Washington State Food Safety Advisory Committee, Olympia, WA, March 22, 2001.

Whiting RC. FDA risk assessment for *Listeria monocytogenes*. Presentation and panel discussions. 21st Annual Conference and Exhibition, Refrigerated Foods Association, Nashville, TN, March 2, 2001.

Whiting RC. Dose-response in microbial risk assessment. 2001 ILSI Annual Meeting, Montego Bay, Jamaica, January 22, 2001.

Whiting RC. Experiences with microbial risk assessments. USDA Graduate School, Risk Assessment Course, January 19, 2001.

Whiting RC, Miliotis MM. FDA/FSIS *Listeria monocytogenes* Risk Assessment. The Ninth International Symposium of Toxic Micro-organisms. Tokyo, Japan. March 12–13, 2002.

Whiting RC. *Listeria monocytogenes* risk assessment. American Refrigerated Foods Association, Crystal City, VA, September 21, 2000.

Whiting RC, Bagi L. Modeling the lag phase of *Listeria monocytogenes*. Third International Conference on Predictive Modeling, Leuven, Belgium, September 13, 2000.

Whiting RC. Lessons for the *Listeria monocytogenes* risk assessment. Third International Conference on Predictive Modeling, Leuven, Belgium, September 13, 2000.

Whiting RC. *Listeria monocytogenes* risk assessment. American Dairy Science Association, Baltimore, MD, July 24, 2000.

Whiting RC. Microbial modeling/risk assessment. Food-Borne Pathogens 2000: Perspectives & Interventions, SIM, Crystal City, VA, April 16–19, 2000.

Whiting RC. *Listeria monocytogenes* risk assessment. American Frozen Foods Institute, Washington, DC, March 22, 2000.

Whiting RC. Listeria risk assessment. FDA Science Forum 2000, Washington, DC, February 15, 2000.

Prior Experience

Senior Scientist, U.S. Food and Drug Administration, 1998–2008
Research Food Technologist, U.S. Department of Agriculture, 1977–1998
Research Fellow, Food Science Department, University of British Columbia, 1974–1977
Graduate Student, Food Science Department, Oregon State University, 1970–1974
Graduate Student, Food Science Department, University of British Columbia, 1969–1970
Plant Quality Control Manager, Oconomowoc Canning Co., 1967, 1968

Project Experience

Co-lead for the USDA Food Safety and Inspection Service risk assessment on *Salmonella* Enteritidis in shell eggs. This was the first risk assessment on foodborne microbial pathogens. Among many objectives, it evaluated the relative importance of different storage temperatures on egg safety. Publically presented and defended the risk assessment.

Technical leader for the FDA risk assessment that estimated the relative importance of different ready-to-eat foods in leading to listeriosis. It clarified the importance of *L. monocytogenes* growth in the foods and evaluated the susceptibilities of different consumer populations. This risk assessment provided the scientific basis for the current FDA Compliance Policy Guide proposal. Presented risk assessment to Agency officials, industry representatives, and the public.

Served on Joint FAO/WHO Expert Committee on Microbial Risk Assessment. This committee planned, conducted, and published the FAO/WHO risk assessment on *L. monoctyogenes* that evaluated the consequences of whether a food that did or did not support growth and determined the numbers of the pathogen likely to lead to listeriosis.

Was a member of the U.S. Delegation to the Codex Committee on Food Hygiene. Focused on developing concepts in microbial risk assessment and regulation of *L. monocytogenes*.

Was the technical lead for FDA risk assessment on hot- and cold-smoked seafood that evaluated the impact of different processing steps and potential mitigations on the risk of listeriosis. To be released in 2009, this risk assessment modeled product pathways and estimated the improvement in the risk per serving to consumers that would result from various processing changes.

Developed the microbiological modeling for FDA risk assessment on soft cheeses (Brie, Camembert). This ongoing risk assessment is evaluating the impact that changes in the processing and storage would have on public health from *L. monocytogenes*.

Participated in the USDA/FSIS NACMCF Committee (National Advisory Committee for Microbiological Criteria for Foods) that evaluated the impact of date marking on microbiological safety.

Editorships and Editorial Review Boards

- Associate Editor for Reviews and New Concepts, J. Food Science, 2000–present
- Editorial Board for J. Food Protection, 1999–present
- Advisory Committee for J. Food Protection, 1998–2002
- Editorial Board for International J. Food Microbiology, 1996–2008

Peer Reviewer

- *International J. Food Microbiology*
- *J. Food Protection*
- *J. Food Science*
- *Applied and Environmental Microbiology*

Professional Affiliations

- Institute of Food Technologists, 1969–present
  Philadelphia Section: Section newsletter editor, 1983–1987; elected to National Council, 1985–1989; elected Secretary, 1987, 1988; elected Section Chairman, 1993–1994
  National: Elected Muscle Food Division Director, 1992–1994; Nomination Committee for Food Microbiology Division, 1992; Research Committee, 1998; Associate Editor for Reviews and New Concepts, J Food Science, 2000–present; Elected Fellow, 2006
- International Association for Food Protection (formerly IAMFES), 1997–present
- Editorial Board for J. Food Protection
- Chair, Risk Analysis Professional Development Group, 2002–2004
- Society for Risk Analysis, 1998–present