Journal of Food Protection, Vol. 77, No. 1, 2014, Pages 6–14
doi:10.4315/0362-028X.JFP-13-249

Quantifying the Sensitivity of Scent Detection Dogs To Identify Fecal Contamination on Raw Produce

MELISSA L. PARTYKA,[1] RONALD F. BOND,[1] JEFF FARRAR,[2] ANDY FALCO,[3] BARBARA CASSENS,[4] ALONZA CRUSE,[5] AND EDWARD R. ATWILL[1]*

[1]*Western Institute for Food Safety and Security, School of Veterinary Medicine, University of California, 1089 Veterinary Medicine Drive, Davis, California 95616;* [2]*U.S. Food and Drug Administration, Office of Food and Veterinary Medicine, Silver Spring, Maryland 20993;* [3]*Falco K-9 Academy, 615 Berry Street, Brea, California 92821;* [4]*U.S. Food and Drug Administration, Office of Partnerships, Rockville, Maryland 20857; and* [5]*U.S. Food and Drug Administration, Office of Regulatory Affairs, Los Angeles District Office, Irvine, California 92620, USA*

MS 13-249: Received 17 June 2013/Accepted 4 September 2013

ABSTRACT

Consumption of raw produce commodities has been associated with foodborne outbreaks in the United States. In a recent Centers for Disease Control and Prevention report outlining the incidence of food-related outbreaks from 1998 to 2008, produce of all kinds were implicated in 46% of illnesses and 23% of deaths. Methods that quickly identify fecal contamination of foods, including produce, will allow prioritization of samples for testing during investigations and perhaps decrease the time required to identify specific brands or lots. We conducted a series of trials to characterize the sensitivity and specificity of scent detection dogs to accurately identify fecal contamination on raw agricultural commodities (romaine lettuce, spinach, cilantro, and roma tomatoes). Both indirect and direct methods of detection were evaluated. For the indirect detection method, two dogs were trained to detect contamination on gauze pads previously exposed to produce contaminated with feces. For the direct detection method, two dogs were trained to identify fecal contamination on fresh produce. The indirect method did not result in acceptable levels of sensitivity except for the highest levels of fecal contamination (25 g of feces). Each dog had more difficulty detecting fecal contamination on cilantro and spinach than on roma tomatoes. For the direct detection method, the dogs exhibited >75% sensitivity for detecting ≥0.25 g of feces on leafy greens (cilantro, romaine lettuce, and spinach) and roma tomatoes, with sensitivity declining as the amount of feces dropped below 0.025 g. We determined that use of a scent detection dog to screen samples for testing can increase the probability of detecting ≥0.025 g of fecal contamination by 500 to 3,000% when samples with fecal contamination are rare (≤1%).

Globalization of the world's food supply, increased demand for fresh and minimally processed produce, and direct marketing of raw agricultural commodities have contributed to new patterns of produce distribution and foodborne illness associated with the consumption of these commodities *(8, 18)*. Consumption of raw or minimally processed produce is increasingly recognized as a vehicle for transmission of foodborne pathogens such as *Escherichia coli* O157:H7, *Salmonella,* and *Listeria (24, 25)*. From 1996 to 2010, approximately 131 outbreaks of foodborne illness were associated with fresh produce commodities; 13 of these outbreaks were linked to tomatoes and 24 were linked to leafy greens such as lettuce and spinach *(8, 31, 32)*. For many of these outbreaks, identification of the originating source(s) of the foodborne pathogen was challenging because of such factors as a short shelf life and growing period, a long time between consumption and identification of the outbreak, and commingled lots of harvested produce. New technologies are needed that can assist outbreak investigators in the rapid and accurate identification of the specific food brands or lots causing the outbreak and the key risk factors and contributing elements that lead to microbial contamination of foods so that effective preventive controls can be implemented.

State and federal agencies such as the California Department of Public Health and the U.S. Food and Drug Administration (FDA) currently use outbreak investigation techniques to determine the microbial source and contributing factors responsible for outbreaks of foodborne illness *(13, 26)*. This process can involve grower and processor interviews, collection of invoices and bills of lading for traceback investigations, in-depth environmental investigations of preharvest and postharvest processing environments, and laboratory analyses of the suspect commodity and associated environmental samples such as irrigation water, animal scat, and soil amendments *(27)*. When rates of contamination are low, hundreds or thousands of samples and resource- and time-intensive microbiological tests may be needed to have a reasonable chance of detecting the contaminated source(s). New tools that would enable a risk-based prioritization of field samples are needed to expedite the identification and confirmation of suspected brands or lots of contaminated produce. The more rapidly the source of contamination and affected commodity is identified, the

* Author for correspondence. Tel: 530-754-2154; Fax: 530-752-7181; E-mail: ratwill@ucdavis.edu.