Summary of Presentation
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Presentation Title: Trends in Food Safety from a California Perspective
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Consumer awareness of food safety issues related to microbial pathogens has increased in the wake of the President's Food Safety Initiative of 1997. Sparked, in part, by broad media coverage of notable outbreaks on fresh and minimally processed fruits and vegetables not commonly associated with severe illness, this initiative drew consumer and produce buyer attention alike. With repeated outbreaks linked to consumption of fresh produce, the apparent prevalence and severity of foodborne illness has largely replaced concern for pesticide residues as the foremost consumer confidence issue facing producers and shippers. Since 1998, the Produce Marketing Association (PMA) Fresh Trends Survey has consistently shown that nearly 60% of consumers say they are more concerned about *Salmonella* and other foodborne pathogens than in prior years.

In part, consumer opinions are one reflection of the impact of premature or inaccurate reporting of outbreak investigations related to fresh produce, which by virtue of forming the basis for purchasing behavior can be economically devastating to a commodity and region. The timing of the reports is often disassociated with the seasonal availability or actual origin of the product. False association of an entire category has resulted in tens of millions of dollars in direct sales losses, as in the case of the California strawberry industry in an outbreak of *Cyclospora* from imported raspberries, and other unaccountable sources of lost revenue from residual concerns. Inaccurate reporting of the source of the product and the ultimate outcome of outbreak investigations related to cantaloupe consumption perpetuates the association of California melons with episodes of *Salmonella* contamination. Careful examination identifies that while illness has been associated with *Salmonella* serotype Saphra and *Salmonella* serotype Poona on cantaloupes within California several times, most recently in 1997, 2000, and 2001, available information clearly places the origin of the consumed melons outside of California. Inaccurate or incomplete reporting by the media also tend to perpetuate false associations of outbreaks with fresh produce that serve to elevate consumer concern. For example, a relatively recent outbreak of *E. coli* O157:H7 in foodservice outlets continues to be cited as evidence for the uncertain safety of watermelon consumption despite the clear outcome of health investigators that determined the cause to be negligent cross-contamination during meat handling in the same facility. However, regardless of the economic impact of false associations, there remain real cases of produce-based contamination, illness, and even death attributable to the consumption of uncooked fruits, vegetables, and other perishable, edible horticultural commodities. Complacency and denial of the role of fresh produce in food safety, at any point in the pipeline to consumers, is not a responsible or acceptable response.

The more common response to these issues and concerns, by those at the forefront of the produce industry, has been to develop and adopt voluntary food safety programs. These are unfortunately but understandably grouped under the banner of Quality Assurance and Grower Certification Programs. These programs are based on various voluntary guidelines, typified by the 1998 *Guide to Minimize Microbial Food Safety*

Hazards for Fresh Fruits and Vegetables released by the Food and Drug Administration. This document provides a framework for the industry to establish its own set of Good Agricultural Practices (GAPs) that are tailored by crop, region, and the specific channels of commerce. The core approach of any GAP or related program is to identify steps to prevent microbial pathogen contamination and to implement multiple, science-based barriers to survival, persistence, dissemination, and multiplication of pathogens. Thus, the GAP Plan is a comprehensive and systematic way to account for all aspects of production and to deal with the potential risks associated with each aspect

California Responds to GAP Initiatives

Since the late 1990's, grower and shipper commodity research boards and commissions, marketing orders, and other grower, shipper, receiver, and fresh cut processor-based associations have taken a proactive position and approach to addressing general concerns prompted by the periodic occurrence of outbreaks due to human pathogens linked to contaminated produce. By a combination of industry initiatives, research support, and cooperative interactions with the University of California, a science-based approach to risk assessment and hazard identification has been undertaken on a commodity, region, and crop management-specific basis. The contamination of produce during production and postharvest handling with human pathogens is, arguably, a rare occurrence. However, producers and handlers of fruits and vegetables have a unique set of challenges in preventing microbial contamination of their products. As with all food products, produce is susceptible to the environment that it is grown or raised in, in addition to its processing environment. The nature of the water, soil, foliar applications and other aspects of production and handling contribute to the overall safety of the food product. Unlike animal-based food products, many fruits and vegetables are consumed in raw form, with little process preparation. Under current consumer behavior or preferences, there is typically no final heat treatment or comparable terminal kill-step to destroy the microorganisms that may have contaminated the product on the way from the farm to the table. As a leading supplier of fresh fruits, vegetables, herbs, and other diverse edible horticultural crops, the California industry deemed it necessary and desirable to develop a specific database at the point of harvest in regional production fields or packinghouses, and to better understand the predicted survival and potential for mitigation of pathogens under current and potential handling practices. The objective is not to detract from the efforts of other domestic or international producers to improve their individual situation relative to microbial food safety. However, as food borne illness and outbreaks associated with produce impacts the entire industry, it is worthwhile for each production region to highlight the risks or documented absence of risks particular to the development of a comprehensive food safety plan The goal of each effort is to contribute to a comprehensive plan to minimize the risk of microbial contamination at every step of production, with data consistent with the environment, practices, varieties, and handling within the California industry. Definitively identifying and addressing potential sources of contamination and risk will be a benefit to all producers, buyers, and consumers, and will go a long way to maintaining and improving confidence in the diverse fresh produce category.

Current Activities

A key concern in the preharvest and postharvest microbial food safety management of fresh, edible horticultural commodities is the potential for contaminated water to establish persistent pathogen populations on harvested crops. Potential points of

produce contamination include irrigation water and water used for foliar applications. Prevention of contamination of produce is preferable to mitigation after the event, as it can be difficult to remove pathogenic organisms from produce. Washing can remove microorganisms from produce, but the amount removed depends on the initial microbial load and the method of washing. Disinfectant dips or sprays can be used to reduce levels of bacteria on produce but do not ensure complete pathogen removal.

The application of contaminated water during irrigation, or other crop management practices that involve water, has the uncharacterized potential to result in broad distribution and, at least temporary, establishment of undesirable levels of indicators of fecal contamination or the documented presence of a variety of known pathogens. As the natural presence of pathogens is accepted to be low and unpredictable, in the absence of irrigation with effluent or other contaminated source, indicators a widely used to identify potentially contaminated source water. Fecal indicators (i.e. *E. coli*, enterococci, thermotolerant coliforms) are not pathogens and their presence on plants is not an immediate health concern. Some fecal indicators, generally categories of bacteria identified by diagnostic reactions on certain nutrient media, may be found in recreational and agricultural water, including groundwater influenced by surface events. For plant surfaces, fecal indicators have not proven to be a reliable measure of recent fecal contamination but remain a standard tool for food assessments. In a random microbial screening of either water or produce, these bacteria may be inappropriately used as a basis for rejection by the market. In addition, some of these strains are falsely identified, in random public health sampling programs of produce in retail display, as recognized pathogens, due to limitations of specificity of commonly used microbial diagnostic tests. These 'false positive' identifications have resulted in detrimental impacts and economic losses for the industry at large and specifically to California-based fresh cut processors.

Until a suitable indicator or group of indicator bacteria are identified, nonpathogenic *Escherichia coli* (*E. coli*) remain the practical indicator of microbial water quality in produce production systems. Despite the functional significance of *E. coli* as an indicator of agricultural water quality, there is no established or recognized limits or standards, at this time. The best available standards that might be applied to irrigation water quality are those established by the U.S. Environmental Protection Agency (U.S. EPA Ambient Water Quality Criteria for Bacteria EPA-440/5-84/002 revised July 2001). In recreational water with allowed full body contact, the single sample maximum allowable density must be less than 235 *E. coli* per 100 ml of water sample. Industry funded projects are in progress to develop baseline documentation of the regional presence and persistence of *E. coli* in on-farm reservoirs intended for irrigation or foliar applications. This data will be useful in defining future research directions in microbial food safety, environmental sources of potential contaminant indicators, and the development of Recommended Management Practices.

In close relation to source water quality, the application of foliar treatments; virtually all contact sprays on aboveground plant parts including fertility management, pest and disease control, plant growth regulators, or microenvironment modification, is an area of primary concern for the potential to contaminate fresh produce with infectious pathogens. Several interacting factors determine the relative risk of persistence of diverse pathogens known to be associated, at least transiently, with fruits and vegetables at production or during harvest and postharvest handling operations (Beuchat 1998, Suslow 2002). Plant anatomical traits, macro and microclimatic effects, solar irradiance, the composition of the contaminant-carrying matrix, other crop

management practices, the pre-existing plant microflora, and the preharvest interval of treatment are among these influential factors.

Foliar treatments are important and common crop management activities for both conventional and organic producers and handlers However, the nature of organic crop management practices, particularly with regard to the use of foliar treatments consisting of both simple and complex organic matrices, may predispose certain fruits and vegetables to a higher risk of persistent contamination, if human pathogens are present. Contamination may derive directly from the source material or may occur through secondary sources such as the use of contaminated diluent water. The assessment of the validity of this perceived risk has been identified as a priority for California food safety management. Conversely, the general increase in microbial diversity associated with organic crop management may provide the basis for competitive and antagonistic exclusion of human pathogens from persistent contamination of foliar materials or establishment on or within plant surfaces. These two perspectives are currently under investigation.