Tomato Safety Research Needs Workshop
February 21-22, 2007
Wiley Building, College Park, Maryland

High Priority Research Needs

Are there alternate processing technologies (particularly 'dry' processing systems that can be used to reduce either the presence or spread of microbiological contamination?

- Use of dump tanks, flume systems and "wet" packing of tomatoes represent unique challenges in terms of potential cross contamination of both product and the packing environment, potential infiltration of the tomatoes, and the need to maintain careful control of water temperature and antimicrobial levels. Lessons learned from other foods, including other fruits and vegetable, show that reducing the exposure of foods to excess amounts of water can be an effective means of reducing contamination. Additionally, reduced use of water provides a means for reducing concerns associated with water supply and disposal issues. The research is needed to determine if moving to less water-intensive packing procedures for tomatoes is feasible and could lead to reduced risk of contamination.

Are specific seasons, microclimates, or weather events associated with contamination of tomatoes in the field?

- Preliminary epidemiological and field investigations suggest that specific seasonal and microclimate environmental conditions, as well as weather events, can lead to increased risk of contamination of tomatoes with human pathogens. However, these observations have not been verified systematically, nor have the mechanisms by which these factors contribute to susceptibility to contamination been established. Potentially, the identification of such risk factors could lead to practical guidance in terms of harvest procedures, planting location, and post-harvest packing/processing. Such knowledge would be an important determinant in the development and implementation of different intervention strategies.

What vectors and vehicles are important in transmitting pathogens to tomato plants and fruits? What are the mechanisms of pathogen movement?

- A number of potential scenarios have been proposed by which tomatoes become contaminated either in the field or during subsequent harvesting and packing; however, to date the relative importance of these vectors and vehicles have not been established. Without such knowledge, the science-based selection of risk mitigation strategies and intervention sites and technologies is not possible and the industry and FDA are forced to use much less focused and cost effective umbrella approaches to hazard control.

How long can pathogens persist in tomato fields, in plant waste, chemical sprays, etc.?

- Critical to making informed decisions regarding commodity specific good agricultural practices that will lead to improved microbiological safety of

tomatoes is an improved understanding of the microbial ecology of the farm environment. In particular, an improved understanding of survival and persistence in the farm environment is critical to the assessment of a particular farm for risk, the persistence of *Salmonella* in adjacent environmental or animal reservoirs, and the development and timing of on-farm interventions.

Are bodies of water in close proximity to tomato fields significant reservoirs for pathogen contamination of tomatoes? How are the populations of pathogens in the soil and water related?

- A series of initial studies have suggested that water in the primary agricultural environment may be an important source of *Salmonella* for tomatoes. However, these studies have not established the relative importance of the water sources, the effective physical separation distances needed to prevent the transfer of Salmonella from the bodies of water in the environment, and potential means for preventing those transfers. This information is critical for developing potential intervention technologies and the implementation of improved tomato-specific GAPs.

What are the cooling and cold chain requirements (aka temperature management) that are needed to prevent growth of pathogens on tomatoes?

- Past research has clearly identified the potential of tomatoes to support the growth of *Salmonella* in the pulp if the fruit is held at temperatures that support growth. This is particularly true when tomatoes are sliced. However, there is little information available to assess what portion of the microbiological food safety risks associated with tomatoes is attributable to inappropriate temperature management (both too warm and too cold). This information is critical to developing reasonable product pathway risk assessments for tomato and tomato products, the articulation of enhanced GAPs and GMPs, and the development of "secondary barriers to growth" of *Salmonella* in tomato products at increased risk (due to the ability of tomatoes to support the growth of the pathogen).

What proportion of tomato producers have implemented GAPs, and to what extent? What are the barriers to GAPs implementation?

- Reduction in the risk of a food serving as a vehicle for *Salmonella* infections is dependent not only on the identification of effective mitigation strategies but also on the extent to which these strategies are consistently implemented. In the case of tomato production, this reflects the extent to which producers and packers are adhering to recommended GAPs and related GMPs. At this stage, it is difficult to determine whether ongoing tomato outbreaks are due to non-adherence to existing GAPs or whether these GAPs are insufficient to control key risk factors. Determining the adequacy and adherence to GAPs and GMPs, and differentiating between them, is critical to making decisions on future food safety strategies, and the need for more research and more oversight. The ability to measure the adherence to GAPs and GMPs is critical to effective priority setting, risk assessments, education programs, and consumer outreach initiatives. This information can lead to development of more effective interventions.

What is the relative importance of internalization vs. surface contamination of tomatoes in the field?

- The selection of effective post-harvest interventions to reduce *Salmonella* associated with tomatoes and tomato products is dependent on understanding the location of the microorganisms on or in the fruit. Most antimicrobial treatments based on surface application are ineffective for internalized microorganisms. Thus, if contamination is largely limited to the surface of the fruit, surface treatment may be sufficient as an intervention technology. Conversely, extensive internalization will require the development of alternative technologies. This information is needed to determine which interventions are likely to be effective and is thus critical to the direction of future research efforts.

Are there specific microbial serotypes or genotypes associated with tomatoes? Are certain varieties of tomato more likely to carry pathogens?

- Initial studies have suggested that there may be substantial differences in the ability of different *Salmonella* strains to contaminate, survive and growth on tomatoes. The identification of the factors contributing to this differential response will provide information needed for assessing the risk of tomatoes serving as a vehicle for *Salmonella* and possibly lead to targeted interventions strategies.

Are there effective approaches that can be used to inactive internalized or attached pathogens? What interventions will reduce the risk of contamination?

- Current approaches for reducing the presence of *Salmonella* on tomatoes are largely restricted to those capable of reducing the pathogen on the surface of the fruit. Most of these treatments are not effective against internalized *Salmonella* and they are likely to be less effective against the pathogen if embedded in a biofilm.