

Factors that Influence the Introduction, Fate and Mitigation of Foodborne Pathogens on Mangoes Throughout the Production Chain

SUMMARY

Understanding the persistence and mitigation of foodborne pathogens on the surface of mangoes is essential to the establishment of Best Management Practices for the responsible handling, packing, distributing, and importing of mangoes and a fundamental management prerequisite to providing customers with safe mangoes. There is inadequate science-based data to establish management standards and criteria for mangoes to meet pending requirements of the Food Safety Modernization Act. The purpose of this research project is to evaluate the persistence of foodborne pathogens on the surfaces of whole and fresh-cut mangoes, assess potential mitigation strategies for control of pathogens on the surface of mangoes, and appraise the ability of *Salmonella* to infiltrate into mangoes under standard packinghouse conditions and to determine the fate of the internalized cells. The data resulting from the proposed research will specifically address data gaps the National Mango Board currently faces and provide research-based metrics to validate mitigation strategies.

OBJECTIVES

The goal of this collaborative effort is to provide the scientific basis for minimizing pathogen contamination of fresh mangoes during postharvest packing, transportation, and retail, through to the consumer. Because outbreaks associated with mangoes have been linked to *Salmonella* we will focus our studies on this organism, but will also include *L. monocytogenes* for comparison purposes in some of the experiments. The goal of this proposal will be accomplished through three objectives:

1. Evaluating the fate of foodborne pathogens on the surfaces of whole and fresh-cut mangoes.
2. Assessing the risks of contamination with foodborne pathogens from handling practices that are common in mango packinghouses.
3. Evaluating the ability of *Salmonella* spp. to infiltrate into mangoes and to determine the fate of internalized cells after infiltration.

METHODS

Work to date has focused on Objective 1. The primary focus of this objective is to evaluate persistence of *Salmonella* and *L. monocytogenes* on the whole, intact surface of Ataulfo, Kent and Tommy Atkins mangoes, when stored at different temperatures. The temperatures evaluated were 12, 20 and 30 ± 2°C. Whole fruit was inoculated by spotting 100 µl of the inoculum cocktail at 6 log CFU/mango onto the appropriately marked sample area on the smooth mid-section of the fruit. Inoculated intact fruit was dried for 1 h before storage at the appropriate temperature. Bacterial populations were enumerated from samples at different storage temperatures on different days. For whole fruit: 12 ± 2°C, days 0, 1, 3, 5, 7, 10, 14, 21, and 28; 20 ± 2°C, days 0, 1, 3, 7, 10, 14 and 21; 30 ± 2°C, days 0, 1, 3, 5, 7, 10, and 14.

RESULTS TO DATE

Studies to evaluate the effect of inoculum level on the survival of pathogens on whole mangoes have been completed. To compare inoculums, *Salmonella* or *Listeria monocytogenes* were inoculated onto the surface of Tommy Atkins mangoes at either High (6 log) or Low (3 log) concentrations and stored for 14 days at 25 ± 5°C. The initial inoculum concentration did not have an impact on the survival of pathogens on the surface of whole mangoes. Both *Salmonella* and *Listeria monocytogenes* grew on the surface of mangoes, an unexpected result.

Results from ongoing studies evaluating the survival of pathogens (n=6) on the surface of different varieties of whole mangoes at 12, 20, and 30 ± 2°C, are presented in Figures 1-4. Similar to the preliminary experiments, populations of pathogens have increased on the surfaces of all varieties of mangoes at all temperatures.

BENEFITS TO THE INDUSTRY

The Produce Safety Rule (PSR), released as a final rule in November 2015, will impact mango growers, packers and importers. One of the most controversial aspects of the PSR is its requirements on the microbiological quality of water that contacts the harvested surface of the fruit. Alternatives when water does not meet the proposed microbiological quality standards include applying either a postharvest intervention, such as commercial washing, where microbial removal rates have been documented; or a time interval (in days) between harvest and the product reaching a retail location, where microbial reductions over time are known. In both cases, microbial reduction needed during the postharvest intervention or the postharvest storage times are dictated by the initial quality of the water used. Currently, no scientific data exist to support a postharvest intervention or a postharvest storage time for mangoes. The data generated in this proposal specifically address this data gap.

Figure 1. Survival of a 5-strain *Salmonella* cocktail on the surface of Kent mangoes stored at 12 ± 2°C for 28 days, 20 ± 2°C for 21 days, and 30 ± 2°C for 14 days. Values represent the average and standard deviations of three replications with duplicate samples (n=6).

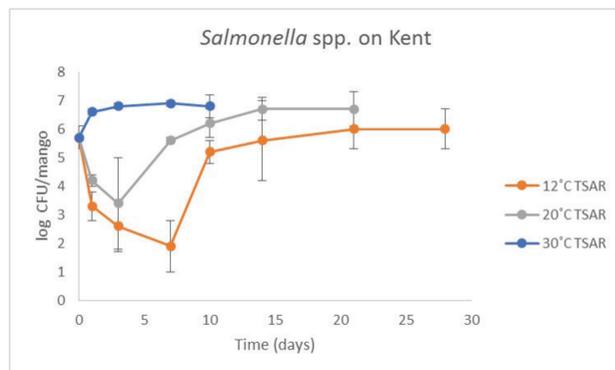


Figure 2. Survival of a 5-strain *Salmonella* cocktail on the surface of Tommy Atkins mangoes stored at 12, 20, and 30 ± 2°C for 14 days. Values represent the average and standard deviations of three replications with duplicate samples (n=6).

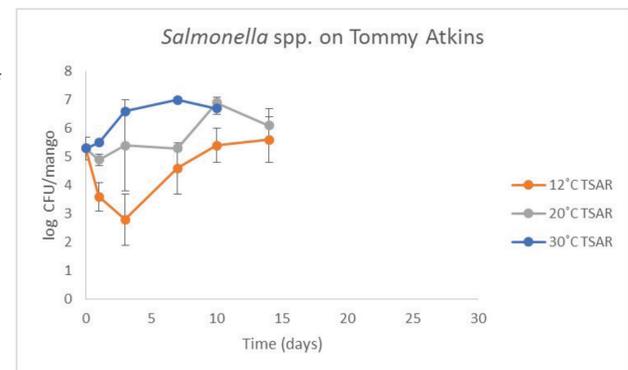


Figure 3. Survival of a 5-strain *Salmonella* cocktail on the surface of Ataulfo mangoes stored at 12, 20, and 30 ± 2°C for 7 days. Values represent the average and standard deviations of three replications with duplicate samples (n=6).

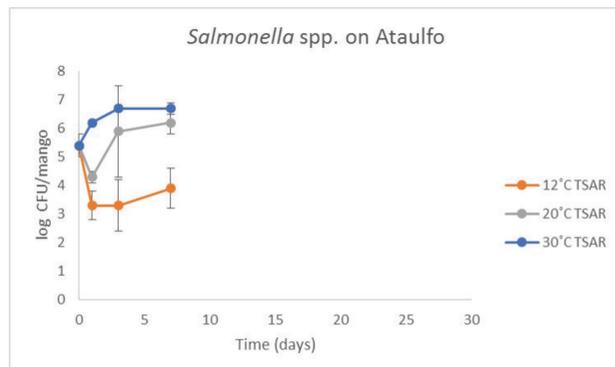
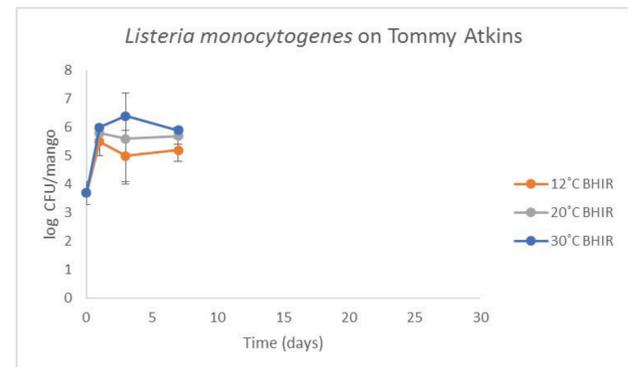


Figure 4. Survival of a 5-strain *Listeria monocytogenes* cocktail on the surface of Tommy Atkins mangoes stored at 12, 20, and 30 ± 2°C for 7 days. Values represent the average and standard deviations of three replications with duplicate samples (n=6).



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