Safety of Fresh Produce

State of the Science and Research Needs

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Challenges to Data Collection

- Diverse selection of produce
  - (est. >345 items in grocery store)
  - Most highly perishable
- Equally diverse production, harvest, and postharvest systems
  - Within and among produce types
  - Within and among regions of the U.S.
  - Within and among countries
- Multiple pathogens of concern
  - *Salmonella*, *E. coli* O157:H7, *Shigella*, *Cryptosporidium* and *Cyclospora*, Hepatitis A
- Low level contamination
  - percent positive units and numbers per positive unit
- Uneven distribution

Pathogens in the environment

- State of Science
  - Production environment:
    - *E. coli* O157:H7 and *Salmonella* are capable of prolonged survival under some conditions
    - Less clear is their ability to exist in stable, multiplying populations
- Research Needs
  - What are the primary reservoirs for these pathogens?
    - Environmental, domestic or wild animal, human?
  - What are the primary routes of contamination?
  - What is the behavior of the pathogens in the presence of growing crops?
    - What factors influence this behavior?
  - Are some genera, species or strains adapted to these environments or to specific produce types?

Reducing Risks of Contamination

- Basis of Good Agricultural Practices
  - Focus on: Water, Soil Amendments, Adjacent Land Use, Workers, Wildlife
  - Significant data gaps exist for all
    - How do you evaluate the risk? How do you monitor the risk? How do you manage the risk?:
    - Example:
      - Are current composting practices sufficient to eliminate pathogens? How are these practices best validated, monitored, and verified? How significant is recontamination of composted materials?

Preharvest Internalization of Pathogens

- State of science
  - Under some circumstances pathogen uptake into a growing plant or mature fruit has been demonstrated
    - Contamination of soil, water, flowers
- Research needs
  - How likely is internalization in the field?
  - How important are microbial levels and strain?
  - Does seed contamination, variety, maturity, or condition of the plant impact ability or degree of infiltration?
  - Can contaminated insects, other animals play a role?
  - How do the organisms behave (stable, growth, death) post infiltration?
  - How relevant is preharvest internalization to the risk of foodborne illness?

Postharvest: Washing Produce

- State of Science
  - Washing does not eliminate pathogens from produce surfaces
    - Primary purpose of antimicrobials in wash water is to reduce cross contamination
  - Large number of antimicrobial treatments (primarily wash water) evaluated
  - Treatment efficacy
    - 10 to 10,000-fold reduction on unblemished, undamaged, unwaxed skin especially where physical force can be applied
    - 0 to 10 or 100-fold reduction on stem scar, puncture wounds
    - 0 to 1000-fold reduction on complex or delicate surfaces
- Research Needs
  - Are there better approaches that would result in an effective “kill step” (pasteurization) while retaining quality and shelf life?

Postharvest Infiltration of Pathogens

- State of Science
  - Water can be drawn into produce during washing or rehydration steps
  - If water quality isn't maintained and pathogens are present they can be drawn in as well
  - Demonstrated for apples, mango, peppers, tomatoes
  - Critical factors: temperature and pressure differential, depth, water deficit
- Research needs
  - How common or likely is infiltration in absence of water?
    - At cut surfaces, wounds, during vacuum cooling
  - How does the organism behave once internalized?

Survival/Growth of Pathogens in Produce

- State of Science
  - Intact fruit/vegetable
    - Survival variable, growth possible with adequate moisture/temperature
  - Cut/wounded fruit/vegetable
    - Pathogens can be attracted to cut surface
    - Survival and growth potential increases
    - Growth can be rapid in non-acidic products and has been demonstrated under some cases in acidic products (chopped tomatoes)
  - Temperature
    - Growth slowed at lower temperatures
    - SURVIVAL sometimes increases at lower temperatures

Microbiological Methods

- State of the Science
  - Data is influenced by multiple factors
    - Pathogen: strain, culture conditions, pre-stress applied
    - Inoculation method: carrier (organic load), levels of pathogen applied, method of application, temperature
    - Recovery method: ability to identify all viable microbes remaining.
- Research Needs
  - Greater evaluation, validation, and justification of methods used.
    - Where possible, laboratory studies should attempt to mimic appropriate and realistic environmental conditions
  - Better coordination or agreement among researchers regarding standard methods
  - Development of improved methods and sampling strategies for finding and recovering pathogens from environmental samples.