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Sanitation and HACCP

Steven Pao, Ph.D.
Florida Department of Citrus



DEFINITION OF SANITATION (Marriott, 1994)

- ≠ **Derived from the Latin word *sanita***
 - Which means "health"
- ≠ **The application of a science to provide wholesome food handled in a hygienic environment by healthy food handlers**
 - To prevent microbial contamination that cause foodborne illness
 - To minimize the proliferation of food spoilage microorganisms

SANITATION ISSUES

- ≠ Should citrus fruit be sanitized before consumption?
- ≠ Who cares about fruit and processing sanitation?
- ≠ Could processing contamination be controlled?
- ≠ What are the effective sanitizing treatments?
- ≠ Could contaminated fruit be sanitized?

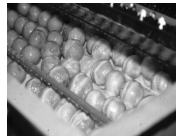
Sources of Microbial Contaminants

- ≠ **Air and Water**
 - Introduced intentionally/unintentionally
- ≠ **Insects and Animals**
 - from wild/domestic origin
- ≠ **Materials and Equipment**
 - for processing/handling
- ≠ **Workers and Consumers**
 - by direct/indirect contact



Importance of Microbial Reduction

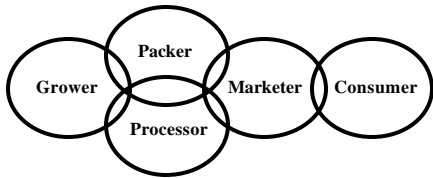
- ≠ **Improve Product Stability**
 - Yeast and molds
 - Aciduric bacteria
- ≠ **Ensure Product Safety**
 - *Salmonella* spp.
 - Pathogenic *Escherichia coli*



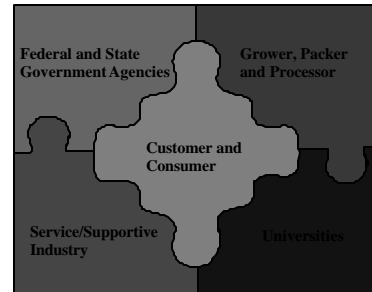
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From Grove to Dinner Table



Cooperative Activity



SANITATION ISSUES

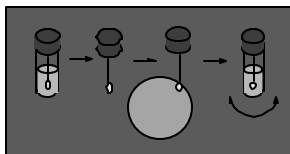
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Prevention

- ⌘ **Plant Sanitation**
 - Adequate cleaning/washing reduces contaminants
- ⌘ **Personal Hygiene**
 - Humans are the major source of food contamination
- ⌘ **Product Packaging**
 - Packaging materials protect the product from contamination

Monitoring

- ⌘ **Check-lists**
- ⌘ **General Inspection**
- ⌘ **Rapid Detection Kits**
 - Chemical residues
 - Microbial loads

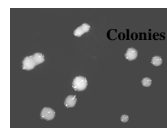
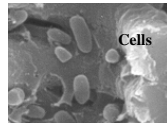
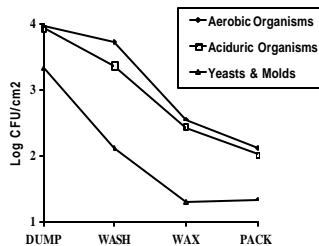


SANITATION ISSUES

- ⌘ Do fruit need to be sanitized before consumption?
- ⌘ Who cares about fruit and processing sanitation?
- ⌘ Could processing contamination be controlled?
- ⌘ What are the effective sanitizing treatments?
- ⌘ Could contaminated fruit be sanitized?

Packinghouse Survey

(Pao and Brown, 1998)

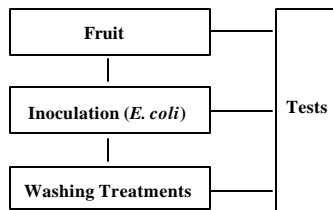


Conclusions of Packinghouse Survey

- Microbial contaminants on fruit surfaces can be reduced by commercial packinghouse operations
 - Washing reduced total aerobic organisms 1.9 Log CFU/cm²
 - Waxing reduced total aerobic organisms 1.1 Log CFU/cm²
- Low levels of coliforms and fecal coliforms were found during the early stages of packinghouse operations
 - No *E. coli* were recovered from fruit at the end of operation
 - No salmonellae were found on fruit during the entire operation

Washing Study

(Pao, Davis, and Kelsey, 2000)



Conclusions of Washing Study

- Washing on roller brushes with fruit cleaners or sanitizers followed by potable water rinse reduced *E. coli* by 1.9-3.5 log cycles
- High pH washing solutions (pH 11.8) applied with an adequate spray volume effectively reduced the surface contamination of the fruit which lowered the microbial loads of the fresh juice as well

SANITATION ISSUES

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Infiltration Study

(Pao, Davis, and Parish 2000)

- Assumption
 - The fruit peel serves as a natural protective barrier that prevents the internalization of human pathogens under normal conditions
 - Unadulterated fresh fruit and juice products would be produced after adequate fruit surface sanitizing treatments
- Challenge (Buchanan et al. 1999)
 - Infiltration of *E. coli* O157:H7 via open channels leading from the blossom end into the core region of intact apples were reported
 - The uptake of a dye solution was subsequently utilized to indicate the frequency and extent of pathogen internalization in fruits

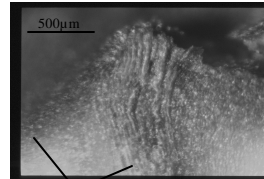
De-calyxed oranges inoculated with dye solution and *S. rubislaw* expressing green fluorescent protein

Brilliant Blue dye solution and *S. rubislaw* (10^7 CFU/100 μ l)

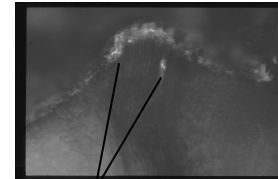


Fluorescent Microscopic Images

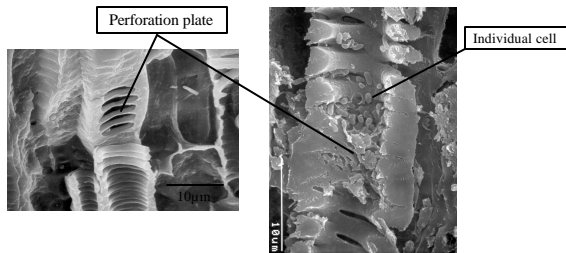
Bright Field



Dark Field



Scanning Electron Microscopic Images of Vascular Bundle



Conclusion of Infiltration Study

- ⚡ Dye is not a reliable indicator for bacterial infiltration
 - Dye solution penetrates deeper and spreads laterally
 - Bacteria were not observed in every dye-infiltrated vascular bundle
- ⚡ Natural sieving effect limited the spread of bacteria in tissues
 - Reticulated vessel walls and perforation plates in fruit could confine and entrap bacteria at surface or near surface areas
- ⚡ Surface sanitizing treatments can be a means to achieve desired fruit de-contamination

DEFINITION OF HACCP (Marriott, 1994)

- ⚡ Hazard Analysis Critical Control Point
- ⚡ A rational approach to process control for food products was developed by the Pillsbury company, NASA and U.S. Army Natick Laboratories in 1971 for use in the food processing industry
- ⚡ An attempt to apply a zero defects program to food processing

HACCP Terms (Marriott, 1994)

- ⚡ Hazard
 - The potential to cause harm to the consumer
 - » Microbial hazards
 - » Chemical hazards
 - » Physical hazards
- ⚡ Critical control point (CCP)
 - An operation or step by which preventive or control measures can be exercised that will eliminate, prevent, or minimize a hazard (hazards) that has (have) occurred prior to this point

HACCP Implementation (NFPA, 1993)

- ⚡ Gain management commitment
- ⚡ Identify the HACCP team
- ⚡ Provide the HACCP training to workers
- ⚡ Follow HACCP implementation guidelines



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- ⚡ Marriott, N.G., 1994, Principles of Food Sanitation, 3rd edition, Chapman & Hall Inc., New York.
- ⚡ National Food Processors Association, 1993, Implementation of HACCP in a food processing plant, Journal of Food Protection, 56:548-554.
- ⚡ Pao, S. and G. E. Brown, 1998, Reduction of microorganisms on citrus fruit surfaces during packinghouse processing, Journal of Food Protection, 61:903-906.
- ⚡ Pao, S., C. L. Davis, D. F. Kelsey, and P. D. Petracek, 1999, Sanitizing effect of fruit waxes at high pH and temperature on orange surfaces inoculated with *Escherichia coli*, Journal of Food Science, 64:359-362.
- ⚡ Pao, S. and C. L. Davis, 1999, Enhancing microbiological safety of fresh orange juice by fruit immersion in hot water and chemical sanitizers, Journal of Food Protection, 62:756-760.
- ⚡ Pao, S., C. L. Davis, and M.E. Parish, 2000, Microscopic observation and processing validation of fruit sanitizing treatments for the enhanced microbiological safety of fresh orange juice, Journal of Food Protection, In review.

Thank You for Your Attention