Baseline Microbial Assessment of Fresh Produce

M.E. Hummerick[1] R.M. Wheeler[2], G.D. Massa[2], C.M. Johnson[3] , L. Spencer[4]

[1.]Vencore [2.]NASA Kennedy Space Center [3.]Miami University [4.]Craig Technologies

Abstract

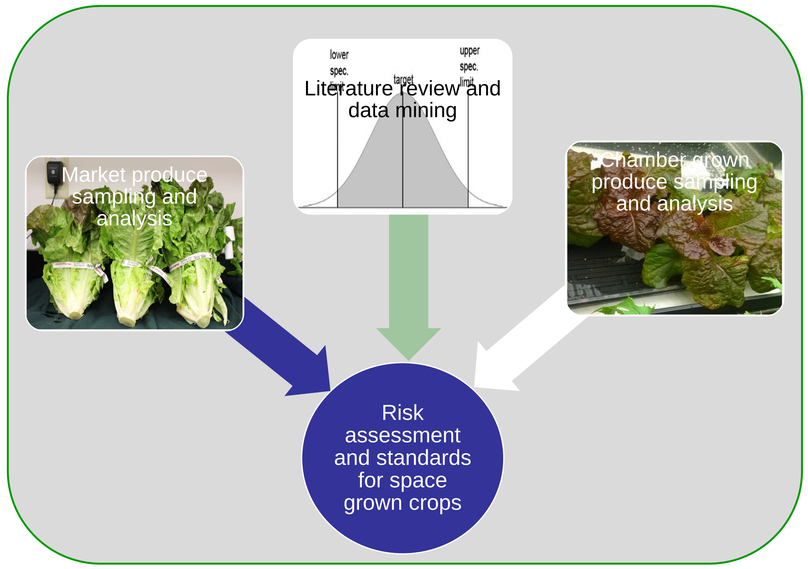
Currently no standards or requirements exist for microbial food safety for space grown produce (fresh plant foods). Without standards it is difficult to assess produce handling and sanitization options for the ISS and future exploration missions. We are conducting a literature review of microbial levels on fresh food and then carrying out measurements (microbial counts) of grocery store purchased and controlled environment-grown crops. Testing will include lettuce, mizuna, cherry tomato, pepper, and radish, all candidate crops for pick-and-eat testing on ISS and near term exploration missions. Growth chamber conditions will be set to mimic an ISS or spacecraft environment. Assays will include specific pathogens (Enterobacteriacea, *Salmonella* sp., and *Aspergillus flavus*) and total culturable microorganisms using aerobic plate counts, and total yeast and mold counts. Analyses will follow the FDA Bacteriological Analytical Manual methods. The goal of the project is to establish a baseline for expected microbial levels found on fresh plant foods that might be grown on ISS and near term missions, and develop risk assessment and microbial safety recommendations for these types of fresh foods.

Introduction and Goals

- Determining the microbial load of produce grown in spaceflight is important for crew health to avoid foodborne illness.
- At present, no standards specifically apply to fresh plant foods grown in space in small chambers like Veggie for crew consumption.
- Currently, microbiological standards set by NASA for non-thermostabilized foods are used as a reference for acceptable levels of bacteria and fungi in fresh produce grown on ISS.
- Other government agencies and vegetable producers have addressed microbiological limits of minimally processed fresh vegetables to assure a safe supply and could be used as a guideline for assessing risk of ISS grown produce.

Figure 1. Veggie chamber on ISS and first crew consumption of Outredgeous romaine lettuce after harvest from Veggie. (Photo Credit NASA)

Project Plan



Methods

Market produce.

- Three of each type of produce was purchased from three different grocery store chains. Selection criteria included similar varieties as those grown in chambers and consistency between stores in brands and quality. Sampling from the same markets will be repeated approximately 30 days after initial sample collection.

Chamber grown produce.

- Red romaine lettuce (Outredgeous), cherry tomato (Red Robin), Green pepper (Pompei), radish (Cherry Belle) and mustard green (Mizuna) were grown in controlled environment chambers under ISS like conditions, 45% RH, 3000 ppm CO_2, 23 ° C and 300 umol.

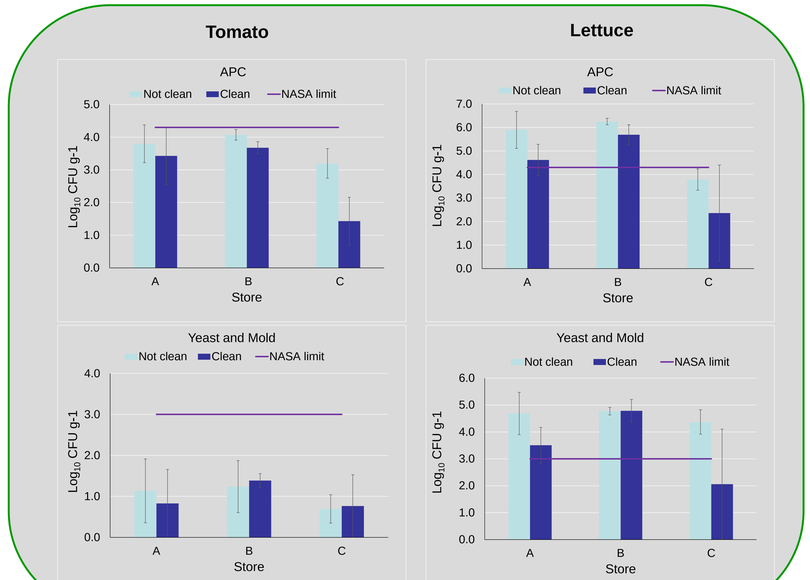
Microbiological sampling and analysis.

- Both washed and unwashed samples were tested. Washed samples were rinsed twice in sterile de-ionized water and dried.
- 25 gram samples were placed in sterile bags and macerated in buffered peptone water.
- Microbiological analysis included:
  - Total Culturable Microorganisms
    - Aerobic Plate Counts
    - Total Yeast and Mold Count
  - Specific pathogens:
    - Enterobacteriaceae (Petrifilm)
    - Generic *E. coli* (Petrifilm)
    - *Salmonella* sp.(enrichment/selective media)
    - *Aspergillus flavus (selective media)*

Preliminary Results and Discussion

Market produce.

- None of the targeted pathogens were detected in tomato and lettuce. sampled from 3 markets.
- While aerobic bacteria and yeast and mold counts for lettuce exceeded NASA standards for thermostabilized food, they were in the range of those reported in the literature for similar products.



Chamber grown produce.

- Crops are currently being grown for repeated sampling for this study.
- Data from previous chamber studies (Table 1) under different conditions can be used to complete statistical analysis to determine acceptable ranges of indigenous bacteria and fungi for a variety of fresh produce.

Table 1.

Crop	APC CFU/gfw	Yeast and Mold CFU/gfw
Tomato	10^4	10^3
Lettuce (Flandria)	10^4-10^5	10^2
Romain/Red Leaf	10^3	10^2-10^3
Mizuna	10^3-10^6	10^2-10^3
Radish	10^6-10^8	10^2-10^6
Onion	10^7-10^8	10^2
Chinese Cabbage	10^5-10^6	10^2-10^6
Peppers	10^4	10^3-10^4