



Food Safety Hazards Associated with Smooth-Textured Leafy Greens Produced in Aquaponic, Hydroponic, and Soil-Based Systems With and Without Roots at Retail

Caitlin Barnhart¹, Laura Hayes², and Danielle Ringle³

¹Food Systems, Dept of Horticultural Science, ²Nutrition and Horticulture, Dept of Horticulture & Department of Food Science and Nutrition, ³Forest and Natural Resource Management, Dept of Forest Resources



Goal of the Project:

The goal of this research is to better understand the varying food safety hazards associated with aquaponic, hydroponic, and soil-grown smooth-textured leafy greens (STLG) available with and without attached roots at grocery stores in Minnesota.

Objectives:

1. Collect STLG samples at grocery stores produced in aquaponic, hydroponic, and soil-based systems with and without attached roots.
2. Quantify and compare bacterial contamination of STLG samples collected in Objective 1.



Overview:

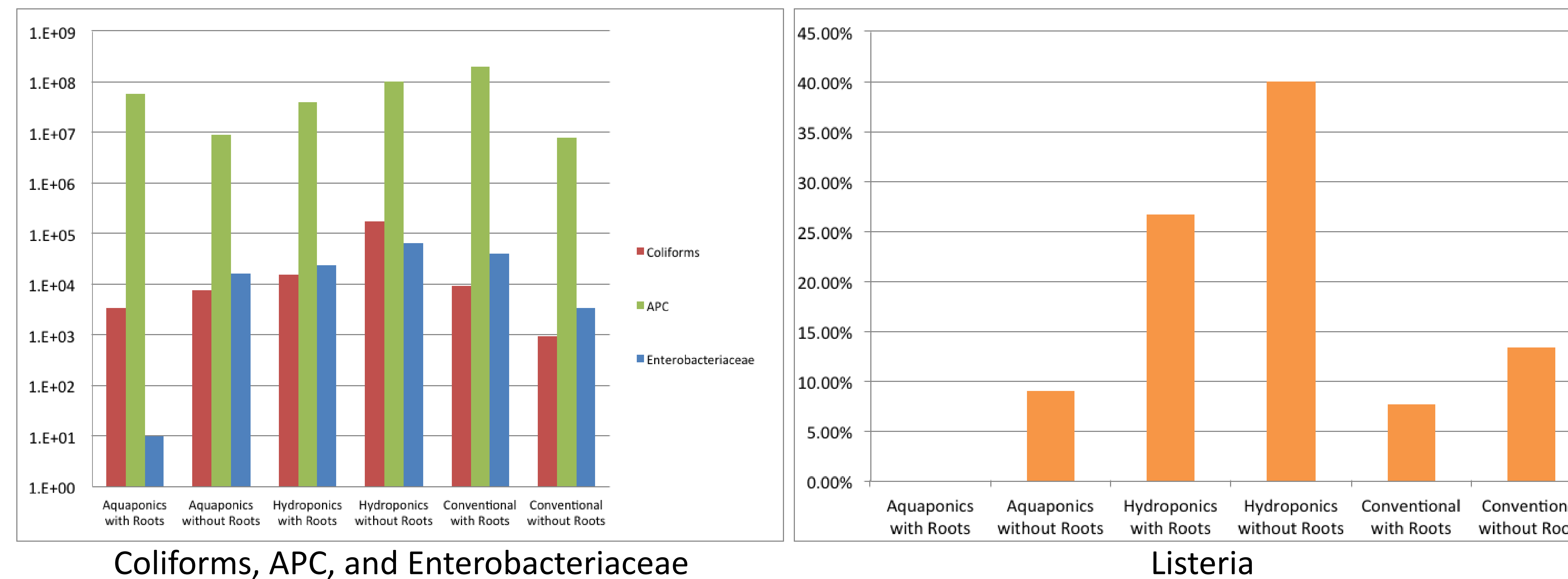
Aquaponics and hydroponics are perceived by many to be a safer alternative to soil-based production in regards to food safety concerns. However, environmental conditions are suitable and contamination risks remain, including untreated water, contaminated growth media, harvesting practices, worker hygiene, processing, etc. One additional risk factor are roots, which have been shown to harbor higher levels of bacteria than the surrounding environment and plant leaves. Despite this risk, roots occasionally remain attached at retail in all production systems. Research is clearly needed to understand the food safety risks between production systems and roots.

Therefore, the goal of this research is to better inform consumers on the varying food safety hazards associated with aquaponic, hydroponic, and soil-grown foods, purchased both in the presence, and absence of an attached root.

Hypotheses Tested:

The hypothesis being tested is that there is no bacterial contamination difference between aquaponic, hydroponic, and soil-based systems at retail. Furthermore, there is no bacterial contamination difference between the smooth leafy greens packaged with or without roots.

Results



Findings

- There is no significant difference between treatments or root presence in Aerobic Plate Count (APC) ($p=0.116$), enterobacteriaceae ($p=0.328$), listeria ($p=0.866$), and non-pathogenic *E. Coli*.
 - This indicates that aquaponic and hydroponic systems have the same hazard potential of soil-based systems.
- Coliform contamination *was* significant ($p=0.015$) between samples, though means were classified in the same group, due to high variance of data.
- Though listeria is not statistically significant, it is biologically significant due to the harm listeria can cause in respect to human health. Hydroponic STLGs, both with and without roots, have the highest probability of listeria contamination, at 27% and 40%, respectively.

Methods

- Sample collection took place in St. Paul, Minneapolis, and Duluth, Minnesota.
- For the six different treatments five different representative samples were chosen that differ either in the store where the smooth-textured greens were purchased, or the location where the smooth-textured greens were produced. Three replications of each representative sample were collected.

Recommendations:

1. Avoid human introduction of pathogens.



2. Inform consumers of the food safety hazard associated with STLG

3. Produce and implement a set of good agricultural practices (GAP's) for both hydroponic and aquaponic systems.



Acknowledgements:

- MnDrive - Global Food Ventures
- Minnesota Agricultural Experiment Station
- College of Food, Agriculture, and Natural Resource Sciences Program for Creation of New or Revised Courses and Programs for Experiential and Interdisciplinary Education.
- University of Minnesota instructors: Nicholas Phelps, Michele Sherman, Neil Anderson, John Erwin, Paul Venturelli, Kristen Nelson, and Jay Maher.

References:

- Wachtel, M. R., Whitehand, L. C., & Mandrell, R. E. (2002). Association of *Escherichia coli* O157:H7 with preharvest leaf lettuce upon exposure to contaminated irrigation water. *Journal of Food Protection*, 65(1), 18–25.
- World Health Organization (WHO). December 2011. Enterohaemorrhagic *Escherichia coli* (EHEC). Retrieved From <http://www.who.int/mediacentre/factsheets/fs125/en/>