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MICROBIAL HAZARDS OF FRUIT CROP PRODUCTION

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ABSTRACT

Microbiological analyses of fruits and vegetables produced by farms in Minnesota and Wisconsin were conducted to determine coliform and Escherichia coli counts, and the presence of E. coli, Salmonella and E. coli O157:H7. E. coli prevalence was linked to certain farm management practices, collected through farmers' surveys at the beginning of each of the two harvest seasons. The E. coli isolates were fingerprinted using pulsed filed gel electrophoresis, and the clonal diversity among isolates obtained from the same farm was determined. Fertilization of produce with animal wastes increased the risk of fecal contamination significantly in both organic and semi-organic produce. Organic farmers who aged their animal manure for less than 6 months had 4-times greater risk of fecal contamination in their produce, compared those that aged for more than 6 months. The risk of contamination from the fecal indicator bacterium was significantly greater in June and July compared to August and September, irrespective of year of sampling, produce types and farm types. These results have been presented at different scientific meetings and the most relevant results of the investigation have been sent to the participating farmers.

- Prevent contamination to protect yourself and your customers from injury and illnesses.
- Risks can be microbial, chemical, and physical.
- All workers should be trained on health and hygiene to minimize potential food contamination.
- Cleaning and sanitizing are not the same thing. You cannot sanitize a dirty surface.
- Food safety practices (cleaning, general maintenance and housekeeping, and pest control) need to be in place to reduce risks.

Keywords: Clonal Diversity, E. coli, Faecal contamination, Microbiological analysis, Organic farmers.

INTRODUCTION

Fresh fruits, including fruit juices are essential components of the regular diet of any human group. The U. S. Department of Agriculture (USDA) has recently emphasized the need for consumption of fresh produce by recommending at least five daily servings in the diet. In recent years, the sales of organic foods have increased at an annual average rate of 20% in the U. S., and most estimates suggest that the market expansion for organic foods will continue at the same rate for the next 5 years. The USDA's Organic Rule implemented in 2002, included the acceptable production practices for foods marketed as "organic" which largely limited the use of fertilizers to animal

and plant wastes for vegetable crop production.

In recent years, the number of foodborne outbreaks caused by contaminated fresh fruits and vegetables increased sharply. Produce accounts for 12% of foodborne illnesses and 6% of foodborne outbreaks today in the U. S., compared to 1% and 0.6%, respectively, in the 1970s.

Because organic growers rely primarily on animal manure for fertilization of their soil, it has been suggested that organically grown foods have a greater risk of pathogenic contamination, compared to their conventional counterparts.

Recently, Ishii et al. and Byappanahalli et al. reported the survival and subsequent naturalization of Escherichia coli in temperate soils of watersheds of various lakes. Both of these reports determined that E. coli can persist in these environmental niches for months, and even for a year, and eventually become a natural habitat of the environment. The persistence of E. coli in an environment such as farms producing fruits and vegetables has not been studies.

OBJECTIVES OF MICROBIAL HAZARD

- Determine the presence of fecal indicator organisms (coliforms, Escherichia coli) and pathogens (E. coli O157:H7, Salmonella) in organic and conventional fruits and vegetables produced by farmers in Minnesota and Wisconsin at the preharvest stage.
- Conduct trace-back investigations in participating organic farms by comparisons of bacterial strains isolated from environmental samples and those isolated from produce.
- Identify potentially high-risk management practices and provide recommendations for improvement.
- Disseminate results and findings among the agricultural community.

BASIC PRINCIPLES OF MICROBIAL HAZARDS

1. Prevention of microbial contamination is strongly favored over reliance on corrective actions once contamination has occurred.
2. Fresh produce, growers, packers, or shippers should use good agricultural & management practices in those areas over which they have control.
3. Fresh produce can become contaminated at any point along the farm-to-table food chain.
4. Minimize the potential of microbial contamination from water used with fresh fruits and vegetables (Crop Production Water and Postharvest Water During Packing).
5. Practices using animal manure or municipal biosolid wastes should be managed closely to minimize the potential for microbial contamination of fresh produce.
6. Worker hygiene and sanitation practices during production, harvesting, sorting, packing, and transporting play a critical role in minimizing the potential for microbial contamination of fresh produce.
7. Follow all applicable local, state, and Federal laws and regulations, or corresponding or similar laws, regulations, or standards for operators outside the U.S., for agricultural practices.
8. Accountability at all levels of the agricultural environment (farm, packing

facility, distribution center, and transport operation) is important to a successful food safety program.

HAZARD CONTROL POINTS FOR SELECTED FRUITS

The natural ecosystem is an uncontrolled and wild environment that includes organic debris and microorganisms. An analysis of common operations used to harvest and prepare fruits for market can identify steps in the process where pathogens might be introduced, controlled, or eliminated. Despite the variability of production practices within the U.S. geographical area. The production practices for the fruits and vegetables listed below are described in the flow charts to follow. Hazard control points during harvest and postharvest operations are indicated on these fruits.

- Strawberries
- Apples
- pears
- citrus fruits
- kiwi fruit

Relevant hazard control points include: field worker hygiene, field sanitation, equipment sanitation, container sanitation, water sanitation, truck sanitation, and temperature control. Field worker hygiene is an important consideration in the harvest and postharvest processing of fruits due to the widespread use of human hands as part of the process. Direct hand contact is also used to trim extraneous matter or defects, sort (for grade, color, size, defects, or maturity), tie or bind, transfer, pack or repack. It is common for human hands to make contact with fruits and vegetables during harvest and postharvest operations. Hand contact during food-related operations is of particular importance to food safety due to the potential for an infected worker to transfer feces to hands and then to food. In theory, it should be easy to control the cleanliness of a workers' hands by requiring proper washing or wearing of gloves, but it has been extraordinarily difficult in the foodservice industry to achieve this goal. A practice of potential public health concern is infield packing of produce. The additional handling step in the field has the potential of pathogen contamination if control measures are not taken. Most, but not all, fruits are exposed to water during harvest or postharvest operations. Among the examples, kiwi and strawberries generally are not exposed to water. Fruit (for example, citrus fruits) have contact with water only for the purposes of washing. In the United States, water used for packing fruits is treated with a disinfectant 62% and 51% of the time, respectively (USDA 2001). Fruits routinely come into contact with harvesting equipment (knives, machetes, clippers, and scissors) and containers (bags, bins, boxes, buckets, pans, trailers and trucks). Equipment and containers in the United States are washed in about 75% of the operations and sanitized about a third of the time (USDA 2001). Equipment such as tables, conveyor belts, flumes, washing or cooling bins and additional containers is used during postharvest operations and is washed by about 75% of the packers and sanitized by about 50% of the packers (USDA 2001). Commodities such as berries or apples that receive minimal handling may be exposed only to a container or to a few pieces of equipment. The disturbance of the fruitsphysical barrier would greatly increase the opportunities for pathogen survival and growth, if contamination occurs. Equipment and containers may retain pathogenic microorganisms. Much of the equipment and

containers used during harvest and postharvest operations are made of materials that are difficult to clean—for example, wood. The soil typically found in a field will encrust equipment and containers. While this soil buildup may introduce pathogens, it also may deter their survival due to the presence of other microbial competitors and predators. If soil adheres to equipment used for washing and disinfecting produce, however, the organic components of the soil may affect the pH and disinfecting capacity of the water and limit the effectiveness of the disinfectant. Controlling the cleanliness and sanitation of equipment and containers is likely to be difficult due not only to their frequent exposure to dirt, but also to the materials with which they are made. Also, waxy bloom on fruit surfaces can contaminate pickers' hands and contact surfaces. Truck sanitation faces challenges similar to those confronted in attempting sanitation of equipment and containers. In some instances, commodities are protected from the sanitary conditions of the truck by the containers in which they are packed. In other instances, items like melons may be loaded directly into the truck. All commodities are loaded into vehicles of some kind for transportation from the field to the market. The temperature range at which fruits are stored is narrow; temperatures that are too high or too low will impair their quality. The cool temperatures at which produce is stored inhibit the growth of some pathogenic bacteria but permit others to thrive. Cool temperatures also tend to preserve viruses and parasites. Although temperature control contributes to the safety of fruits especially those that are cut, its effectiveness in controlling hazard will be less significant than the hazard reduction achieved by refrigerating raw animal products.

CORRECTIVE ACTIONS ARE NEEDED WHEN

- Pest infestation occurs
- The packing line is contaminated by blood (cut finger on a sharp metal edge, etc.
- A drain backs up into the produce handling area
- Other situations posing immediate risk of produce becoming contaminated occur

CORRECTIVE ACTIONS

If a food safety risk is identified in the produce packing, storage, or transportation vehicles:

- Immediately assess the situation.
- Has produce been affected?
- Can it still be sold, or does it need to be thrown away?
- Determine the cause of the problem.
- What needs to be done to correct it?
- Put corrective actions in place, keep records, and monitor to make sure the corrective actions have fixed the problem.

CONCLUSION

Protecting the U.S. food supply requires a comprehensive and coordinated effort throughout the food production & transportation system. Implement good agricultural & manufacturing practices. Operator must ensure that process is working correctly.

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