1.0 Introduction

A safe food supply has become one of the critical global issues as identified by the World Health Organization (WHO). Whether the concern is chemical, biological, or physical in nature, no country is exempt from the possibility of exposing its population to contaminated food. Foods contaminated with unacceptable levels of pathogens, chemicals, or other hazards can result in severe health and economic impacts on individuals and society. Many countries have not yet integrated comprehensive food safety programs into their public health strategies. As a result, there is increasing interest in using systematic risk assessments to direct the development of food safety programs in public health strategies.

A 1999 WHO report states that there are approximately 1.5 billion global episodes of diarrhea occurring annually resulting in 3 million deaths among children under five, mainly in developing countries (1). Of these, an estimated 70% are allegedly caused by biologically contaminated food. In many industrialized countries, increased numbers of foodborne diseases such as Salmonellosis and infections caused by *Escherichia coli (*E.coli) have been observed. The Center for Disease Control and Prevention, Atlanta, Georgia has estimated that in the United States, foodborne diseases cause approximately 76 million illnesses, 325,000 hospitalizations and 5,000 deaths each year. Known foodborne pathogens account for an estimated 14 million illnesses, 60,000 hospitalizations, and 1,800 deaths annually (2).

By extrapolating U.S. data to Ontario and using population figures of 267 million for the U.S. and 10 million for Ontario, foodborne diseases cause approximately 2.9 million illnesses, 12,200 hospitalizations, and 185 deaths in Ontario each year. According to the Public Health and Epidemiology Report Ontario (PHERO), there were 1,792 reported outbreaks of foodborne disease in Ontario from 1994 to 1998 (3). A single foodborne outbreak may involve numerous individual cases.

Historically, food safety concerns were frequently associated with the consumption of dairy products or undercooked meats such as chicken and ground beef. In recent years foodborne disease outbreaks have also been associated with fresh fruits, vegetables, and juices (Appendix A: 7.1).

The U.S. National Advisory Committee on Microbiological Criteria for Foods reports a 27% increase in fresh produce consumption in the U.S. from 1973 to 1993 (4). Growing consumer demand for fresh fruit and vegetables and fresh cut or minimally processed food products also increases the potential for exposure to produce related pathogens.

Foodborne diseases are widespread and many vectors for contamination exist. Globalization enables large amounts of food from a single source to reach

consumers in many countries. Unfortunately, these transported foods can be exposed to several sources of contamination, resulting in foodborne disease outbreaks or chemical contamination episodes. There is a growing tendency towards larger, more centralized production facilities, which also increases the potential for larger contamination incidents within the food production and distribution system. Larger contamination events may result in larger foodborne disease outbreaks. One contamination event in the production cycle or distribution system may result in the exposure of many consumers.

Fruit and vegetable production continues to involve a high degree of hand contact that can expose the commodity to potential contamination by infected humans. High levels of human contact with fruits and vegetables increase the risk of contamination. The Ontario Fruit and Vegetable Growers Association estimates that 90,000 people are involved in seasonal horticulture production with approximately 10% of employees from other countries.

Risk Assessments - Horticulture Food Products

With the emergence and recognition of new foodborne pathogens and the awareness that foodborne pathogens can be agents of illness and death, standardized policies and procedures for food safety analysis and risk assessments are being established through the WHO. Systems for monitoring and tracking data for foodborne outbreaks are currently being developed. The emerging importance of food safety has also been recognized in Ontario with the development of the Ontario Food Safety System and the introduction of Bill 87, the new Food Safety and Quality Act. Reduction of risks, in terms of reducing both the probability and the impact of negative events on the quality of life, are important primary objectives of many programs developed by the Ontario Ministry of Agriculture and Food (OMAF). One of the primary objectives is to ensure a safe food supply. A number of food quality and food safety programs in the public and private sectors have been designed and implemented incorporating principles of risk management and risk analysis. Programs such as Good Agricultural Practices (GAPs), Good Manufacturing Practices (GMPs), and Hazard Analysis and Critical Control Points (HACCP) are being developed and utilized.

Risk assessment is recognized as a useful tool for identifying potential hazards, determining the likelihood of undesirable events, and the consequences of these events. Everyone faces some level of risk on a daily basis. Risk is a function of both the probability of an undesirable event occurring and the magnitude of the impact of that hazard. Risk assessment as defined by Codex Alimentarius (5) is a scientifically based process consisting of hazard identification and characterization, exposure assessment, and risk characterization. Risk assessment is recognized by Health Canada, the Canadian Food Inspection Agency, and OMAF as a fundamental tool to help prioritize the allocation of food safety resources. Risk assessments are also recognized by the World Trade

Agreement and Codex Alimentarius as a mechanism to facilitate fair and safe trade.

OMAF has established a common framework for conducting risk assessments across programs. These are posted on the OMAF web site at:

www.gov.on.ca/OMAF/english/research/risk/frameworks/index.html

The OMAF risk assessment model is presently aligned with the WHO guidelines on risk assessment. The Ontario Public Service is currently developing a common framework for all risk management activities across all ministries. This framework will use the same principles as those used for the management of risk in international trade of food products, but with terminology more aligned with financial and engineering disciplines.

Risk assessments can be conducted with different levels of detail, ranging from broad-brush qualitative notes, to detailed quantitative mathematical models taking into account all potential hazard-exposure-impact scenarios. As more data becomes available, qualitative assessments may evolve into detailed quantitative models.

Risk assessment is one of the three components of risk analysis, which also includes risk management and risk communication. Food safety risk assessment identifies foodborne hazards that can cause illness or injury and systematically assesses the factors and likelihood of exposure to those hazards through the food chain. Risk assessment also characterizes the negative impacts of those hazards on human health, should significant exposure occur, and describes the uncertainty of the data used to assess the hazard, exposure, likelihood of exposure, and impact components of risk.

The risk assessment model developed by OMAF was used by the Food Inspection Branch as a working template for conducting qualitative risk assessments on fresh foods of plant origin. This document is one of ten risk assessments being conducted. For this risk assessment the biological, chemical, and physical food safety risks from pre-production to sale at retail are identified, assessed, and rated. An introduction and summary of the results is also provided.

The results of the commodity risk assessments allow the Food Inspection Branch to systematically prioritize the allocation of its inspection resources according to food safety risk. Similarly, the Innovation and Risk Management Branch of OMAF would like to prioritize a component of its research investment so as to provide data to increase the certainty of risk assessments. Both initiatives will facilitate the allocation of food inspection resources with greater certainty of their efficiency and effectiveness respecting safe food supplies.

The series of food safety risk assessments completed allows the systematic identification of information needs and themes of common risks for these product types. Many of the production steps and activities of the commodities assessed are common, and expected to be similar to many other fruits and vegetables grown in Ontario. For eight commodities the common production steps and activities are reviewed in the Commodity Comparative Risk Chart (Section 6.1).

Use of the Model and Interpretation of the Risk Assessment Ratings

Please refer to the section entitled "Interpretation of the Commodity Risk Assessment Ratings" (Section 2), for a detailed review of the methodology used in determining the risk assessment ratings. For a quick reference table for interpretation of the ratings refer to Section 2.4.

Risks are characterized by combining the probability or likelihood of a hazard occurring and the impact or consequences this might have. The uncertainty of data used to make these evaluations is also ranked with a summary providing the overall risk of the particular hazard occurring at each production activity. The probability section covers three areas including contamination, consumer exposure, and secondary spread among humans. The impact is also considered in three areas including human health, economics, and the environment. A summary of risks is included with each commodity and summarized in the individual commodity introduction.

In this risk assessment, many of the component ratings have a range, indicating a significant variability with the identified hazard and activity step. The food safety risk assessment process considers all hazards including biological, chemical, and physical hazards. For most commodities**,** specific production steps offer the potential for chemical or biological contamination or both.