SECTION I
THE IMPORTANCE OF TRAINING FOR IMPROVING THE SAFETY AND QUALITY OF FRESH FRUITS AND VEGETABLES

SECTION I

The Importance of Training for Improving the Safety and Quality of Fresh Fruits and Vegetables

Module 1
Safety Hazards in Fresh Produce – Biological, Chemical and Physical*

Learning Outcomes

- ***Participants will gain awareness of the potential biological, chemical and physical hazards associated with the production and distribution of fresh fruits and vegetables.***

- ***Participants will increase their knowledge of the characteristics and growth requirements of microorganisms.***

Practical

- ***Experiment/Demonstration: Water as a Contamination Agent***

Additional Resources

- ***Table 1 – Pathogens Associated with Fresh Fruits and Vegetables***
- ***Table 2 – Outbreaks of Foodborne Disease Associated with Fresh Fruits and Vegetables***

There are many activities that take place as fruits and vegetables move from the farm to the table. These include activities related to production, post-harvest operations, packaging, transportation, and storage. Implementing programs such as the use of Good Agricultural Practices (GAPs) and Good Manufacturing Practices (GMPs) are important steps to reducing possible hazards associated with the produce throughout the production and distribution chain. These will be discussed later in this manual.

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Visual I.1-1

Hazard - something that could cause harm to the consumer.

There are three main types of hazards associated with fresh produce:

- Biological hazards
- Chemical hazards
- Physical hazards

A hazard is something that could cause harm to the consumer. There are three main types of hazards associated with fresh produce:

- Biological hazards
- Chemical hazards
- Physical hazards

Biological Hazards

Foodborne microorganisms such as bacteria, viruses and parasites are often referred to as biological hazards (FAO, 1998). Some fungi are able to produce toxins and also are included in this group of hazards.

Visual I.1-2

Microorganisms

Microorganisms are small organisms that can be observed through a microscope.

In order to facilitate the study of microorganisms they are divided into five major classifications:

- Bacteria
- Yeasts
- Molds
- Parasites
- Viruses

Microorganisms are small organisms that can only be observed through a microscope. Many of these organisms consist of a single cell. They can be found everywhere in the environment. Some have the ability to take up nutrients and metabolize them into a large number of end products. Microorganisms often have the ability to react to changes in their environment and some have been known to adapt to new environments.

Many microorganisms are beneficial to humans. Some are involved in the production of fermented foods such as bread, cheese, wine, beer, and sauerkraut. Other microorganisms are used by industry in the production of such products as some enzymes, antibiotics, and glycerol. Additional microbial functions such as degradation of organic matter and enrichment of soils also benefit mankind. However, some microorganisms have the potential for causing foodborne illnesses.

Microorganisms able to cause human disease may be found on raw produce. Sometimes they are part of the fruit or vegetable microflora as incidental contaminants from the soil, dust and surroundings. In other instances they get introduced onto the food through poor production and handling practices such as the application of untreated manure, the use of contaminated irrigation water or unsanitary handling practices.

Bacterial Hazards

Because bacterial pathogens are part of the environment, they can easily contaminate fruit and vegetables when these commodities are not properly handled prior to consumption. A list of bacterial pathogens that have been isolated from raw produce can be found in Table 1 in the Additional Resources section. A thorough discussion of the pathogenic microorganisms associated with food may be found in the FDA/CFSAN Bad Bug Book (FDA, 2001).

Visual I.1-3

Pathogenic bacteria associated with fruits and vegetables include:

- ***Salmonella***
- ***Shigella***
- ***Escherichia coli*** (pathogenic)
- ***Campylobacter*** species
- ***Yersinia enterocolitica***
- ***Listeria monocytogenes***
- ***Staphylococcus aureus***
- ***Clostridium*** species
- ***Bacillus cereus***
- ***Vibrio*** species

A large number of bacterial pathogens have been implicated in foodborne outbreaks associated with the consumption of fresh fruits and vegetables (Beuchat, 1998). Table 2 in the Additional Resources section provides a list of many of these outbreaks and the organisms associated with them.

Bacteria such as ***Clostridium botulinum***, ***Bacillus cereus*** and ***Listeria monocytogenes*** can be found in the soil and can easily contaminate produce.

Other bacteria such as ***Salmonella, Shigella,*** pathogenic ***Escherichia coli*** and ***Campylobacter*** reside in the intestinal tract of animals and/or humans. They can contaminate fruit and vegetables through infiltration of sewage waters into fields, irrigation with contaminated water, presence of animals in the field or inappropriate composting. Contamination also can take place during handling at harvest and packaging and in other steps in the distribution and marketing chain.

The number of bacteria that must be present to cause human illness varies with organism type and age and condition of the host. In some instances it is necessary to have over a million pathogenic bacteria per gram or cm^2 of food surface before any illness occurs. However some pathogens are able to cause disease at much lower numbers. For example, ***Shigella spp***. are highly infectious agents with an infective dose of as few as 10 cells.

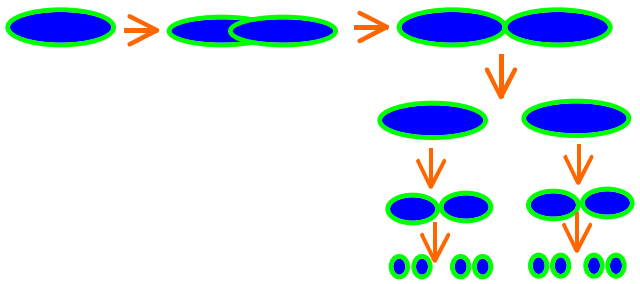
Because some bacteria have such low infective doses, prevention of bacterial contamination is the most important control factor to enhance produce safety. It is also important to take steps to assure that pathogens present cannot reproduce to hazardous levels.

Visual I.1-4

To prevent pathogen reproduction in produce, control:
- Nutrient availability
- Humidity
- Acidity
- Temperature
- Oxygen

In order to reproduce bacteria require adequate nutrients and appropriate environmental conditions such as humidity, oxygen and temperature (FDA, 1998). Each type of bacterium has specific requirements to achieve optimum development, but bacteria can multiply and cause disease outside of these optimum conditions. For example, for most rapid growth, ***E. coli*** requires a temperature of 37°C (98.6 °F). It can, however, multiply in a range of 10^o to 46°C (50^o to 114.8 °F). ***Bacillus cereus*** has an optimal growth temperature of 30°C, but can grow in the temperature range of 10^o to 49°C (50^o to 120.2 °F) (Frazier and Westhoff, 1991).

Visual I.1-5



Bacterial reproduction scheme:
Each bacterial cell divides into two when conditions are appropriate for its growth

Bacteria reproduce through a mechanism referred to as binary fission. During this process, each cell divides in two. These two cells then divide in two and so on. When conditions are appropriate, a bacterial population can grow rapidly in a very short time.

Visual I.1-6

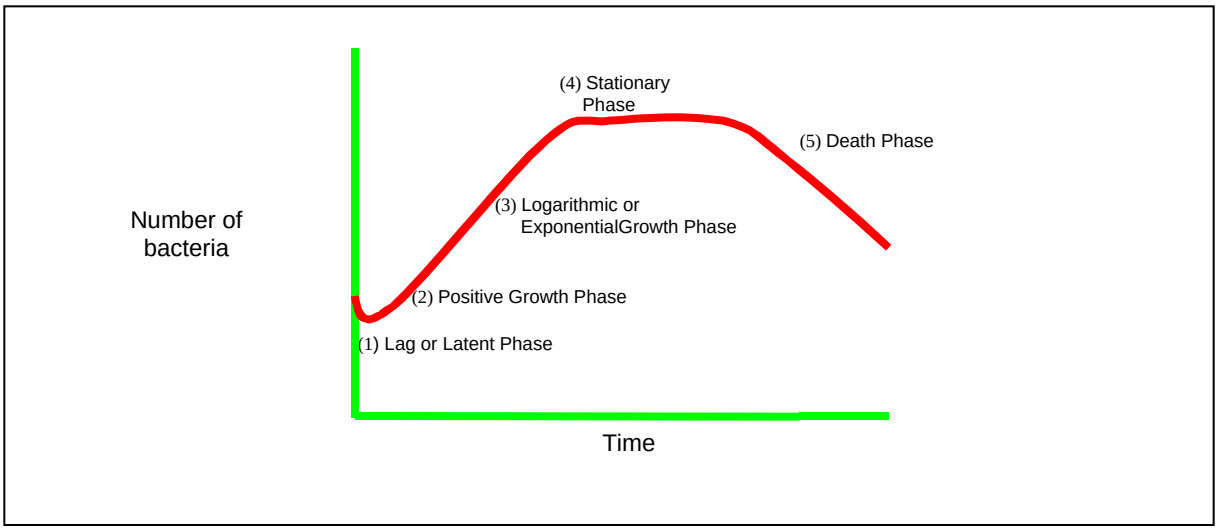
Time (hrs)	# of bacteria
0	1
1	8
2	32
3	256
4	2,048
5	16,384
6	131,072
7	1,048,576
8	16,777,216
9	134,217,728
10	1,073,741,824

In 7 hours one bacteria cell can generate over a million bacteria cells

The time needed for a cell to divide (or a population to duplicate) is known as generation time. Generation times vary for different types of bacteria. Bacterial generation times depend to a large extent on nutrient availability and environmental conditions such as humidity, oxygen availability, acidity and temperature. Consider ***E. coli*** which has a generation time that ranges between 15 and 20 minutes. Under optimum conditions, in 10 hours a single cell could produce over a million cells.

When conditions for reproduction are favorable, bacterial cells start their multiplication process. This process usually takes place in a series of steps or phases. In general, the bacterial reproduction process for a given population of cells follows a pattern similar to that illustrated in Visual I.1-7.

Visual I.1-7



Knowledge of the population growth process provides insight into opportunities for prevention and control of bacterial growth. In order to keep bacterial numbers from reaching levels that can be a threat to human health, it is necessary to keep the initial numbers low and to assure that organisms that reach the product are not allowed to grow beyond the lag phase.

Some of the control strategies that will be discussed in this course are preventive and attempt to maintain low initial numbers of microorganisms. These include Good Agricultural Practices like controlling microbial hazards from water, proper use of manure and biosolids, appropriate worker hygiene and provision of worker sanitation facilities, and proper sanitation during product handling and transportation. Other recommendations such as temperature control and some of the more novel technologies are used to slow bacterial growth.

A processing step which can lower initial bacterial numbers is washing, provided wash water is of good quality and is not allowed to accumulate dirt and contaminants. The surface of a well-washed tomato may have less than 1000 microorganisms per square centimeter, while an unwashed one may have a several thousand. Before washing, the number of microorganisms on the external tissue of cabbage could be as high as one or two million per gram. Washing decreases this number to the range of 200,000 to 500,000 (Frazier and Westhoff, 1991).

Visual I.1-8

The surface of fruits and vegetables can be contaminated with pathogenic microorganisms due to contact with:

- soil
- water
- manure
- sewage fluids
- air
- humans
- animals

Pathogens can be found among the microflora of fruits and vegetables because it is fairly easy for external surfaces of these commodities to come in contact with soil, water, sewage fluids, air, humans and animals. When conditions become favorable for the natural flora to reproduce, these pathogens reproduce.

Parasitic Hazards

Visual I.1-9

Parasites most commonly associated with human infections include:

- ***Cryptosporidium***
- ***Cyclospora***
- ***Giardia***
- ***Entamoeba***
- ***Toxoplasma***
- ***Sarcocystis***
- ***Isospora***
- Helminthes:
  - Nematodes (i.e. ***Ascaris lumbricoides***, ***Thricuris trichiura***)
  - Plathelminthes (i.e. ***Fasciola hepatica*** and Cysticercus spp.)

Parasites are organisms that live in another living organism, called the host. They are only able to grow in a host, however, they may be passed from one host to another through some non-host vehicle. Parasites most commonly associated with human infections include ***Cryptosporidium, Cyclospora, Giardia, Entamoeba, Toxoplasma, Sarcocystis, Isospora,*** and Nematodes.

Because produce is often eaten raw, it can serve as a vehicle to pass a parasite from one host organism to another (Beuchat, 1998 and Murray et al., 1995). Water contaminated with fecal material, infected food handlers, and animals in the field may be vehicles for contamination of produce with parasites that may then be passed on to humans consuming the raw produce.

Viral Hazards

Visual I.1-10

Viruses that have been reported as transmitted by foods include:
- Hepatitis A
- Norwalk virus and Norwalk-like virus
- Rotaviruses, astroviruses, enteroviruses (polioviruses, echoviruses and coxsackie viruses), parvoviruses, adenoviruses and coronaviruses.

Viruses are very small and unable to reproduce outside of a living cell. Therefore they do not grow in or on foods. However, raw fruits and vegetables may become contaminated by exposure to contaminated water or during handling by infected people. The viruses infect susceptible persons consuming the raw produce. Since an infective dose of most viruses is extremely small, sometimes as few as 10 virus particles, prevention of produce contamination is critical to controlling viral disease.

Sources of Biological Hazards

Characteristics of some of the microorganisms causing disease in humans are described in Table 1 in the Additional Resources section. Also presented are examples of sources of contamination and symptoms associated with the illnesses they cause. Diagnosis of these illnesses requires clinical testing, however, recognizing the symptoms associated with various forms of contamination can aid in preventing contamination by providing a means of identifying potentially infected handlers so that their contact with fresh produce can be avoided.

Many of the diseases caused by pathogenic bacteria, parasites, and viruses that have been linked to fruits and vegetables can be transmitted when human feces contaminate the produce. It is important that individuals handling produce at every stage, from field to table have a good understanding of proper hygiene practices to prevent contamination. Training of workers at every level of the production chain and education of consumers have been identified as key elements to reduce foodborne illnesses associated with fresh fruits and vegetables (Beuchat, 1998).

Chemical Hazards

Chemical contaminants in raw fruits and vegetables may be naturally occurring or may be added during agricultural production, post-harvest handling and other unit operations (FAO, 1998). Harmful chemicals at high levels have been associated with acute toxic responses and with chronic illnesses.

Visual I.1-11

Some Naturally Occurring Chemicals Hazards

- Allergens (e.g. weeds)
- Mycotoxins (e.g. aflatoxin)
- Mushroom toxins
- Phytohaemagglutinin
- Alkaloids

Visual I.1-12

Added Chemical Hazards

Polychlorinated biphenyls (PCBs)

Agricultural chemicals

- Pesticides
- Fertilizers
- Antibiotics

Prohibited substances

- Direct
- Indirect

Toxic elements and compounds

- Lead
- Zinc
- Cadmium
- Mercury
- Arsenic
- Cyanide

Contaminants

- Lubricants
- Cleaners
- Sanitizers
- Coatings
- Paints
- Refrigerants
- Water or steam treatment chemicals
- Pest control chemicals

From packaging materials

- Plasticizers
- Vinyl chloride
- Painting/coding inks
- Adhesives
- Lead
- Tin

Data collected by the WHO Food Contamination Monitoring and Assessment Program (GEMS/Food) indicate that, in many countries, chemical contamination levels are tending to decline. This is due, in large part, to increased restriction on the use of toxic chemicals and pesticides that persist in the environment and to improved control of environmental pollution.

Physical Hazards

Physical hazards may be introduced into fresh fruit and vegetable products at numerous points in the production chain.

Visual I.1-13

Material	Injury potential	Sources
Glass	Cuts, bleeding; may require surgery to find or remove	Bottles, jars, light, fixtures, utensils, gauge, covers, etc.
Wood	Cuts, infection, choking; may require surgery to remove	Field sources, pallets, boxes, building materials
Stones	Choking, broken teeth	Fields, buildings
Insulation	Choking long-term if asbestos	Building materials
Plastic	Choking, cuts, infection; may require surgery to remove	Packaging, pallets, equipment
Personal effects, i.e. jewelry, hair clips, pens	Choking, cuts, broken teeth; may require surgery to remove	Employees

Illness and serious injuries can result from foreign material in produce. These physical hazards can result from poor practices during harvesting, washing, sorting and packaging operations (FAO, 1998). Filth and foreign matter in fruit and vegetables are listed, in many instances, among the main barriers for international trade.

Summary

1. A hazard is something that could cause harm to the consumer. There are three main types of hazards associated with fresh produce:
   - Biological hazards
   - Chemical hazards
   - Physical hazards

2. Foodborne microorganisms such as bacteria, viruses and parasites are often referred to as biological hazards. Some fungi are able to produce toxins and also cause a hazard.

3. Microorganisms able to cause human disease may be found on raw produce. Sometimes they are part of the fruit or vegetable microflora as incidental

contaminants from the soil, dust and surroundings. In other instances they get introduced into the food through poor production and handling practices such as the application of untreated manure, the use of contaminated irrigation water or unsanitary handling practices.

4. Fresh fruits and vegetables may be vehicles for the transmission of parasites and viruses.

5. Training of workers at every level of the production chain and education of consumers have been identified as key elements to reduce microbial hazards associated with fresh fruits and vegetables.

6. Chemical contaminants in raw fruits and vegetables may be naturally occurring or may be added during agricultural production, post-harvest handling and other unit operations.

7. Illness and serious injuries can result from foreign material in produce. These physical hazards can result from poor practices during harvesting, washing, sorting and packaging operations.

Module 2
Fresh Produce Safety and Consumer Health*

Learning Outcome

- ***Participants will gain greater awareness of the consequences of foodborne disease.***

Practical

- ***Discussion Question 2***

In 1983, the Expert Committee on Food Safety convened jointly by the World Health Organization (WHO) and Food and Agricultural Organization (FAO) of the U.N. concluded that illness due to contaminated food is "the most widespread health problem in the contemporary world" (FAO/WHO, 1984).

Despite efforts to reduce foodborne illnesses, there are still significant health hazards associated with food.

Visual I.2-1

Sources of Foodborne Disease Outbreaks in Latin America and the Caribbean – 1995-1997

Agent	% Cases
Bacteria	46.3
Viruses	1.8
Parasites	1.8
Total Microbial	49.9
Marine Toxins	44.2
Plant Toxins	0.4
Chemicals	5.4

The relative importance of these hazards can be determined by studying disease surveillance data. Data from Latin America and the Caribbean reveal that almost half of all foodborne diseases with identifiable sources were caused by microbial sources and bacterial pathogens represented the largest single share of all known sources (PAHO/WHO, 1998). In the U.S during 1993-1997, a total of

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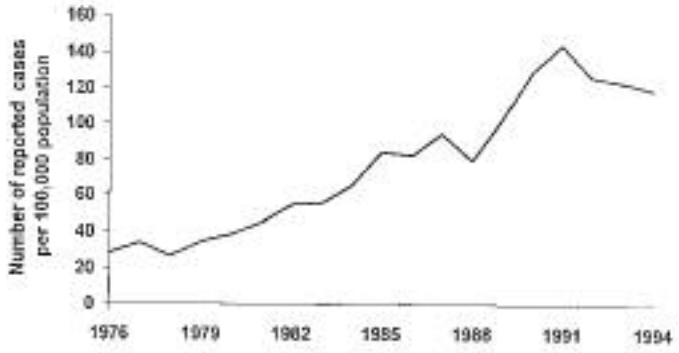
2,751 outbreaks of foodborne disease (two or more cases of a similar illness resulting from the ingestion of a common food) were reported (Olsen et al., 2000). These outbreaks caused a reported 86,058 persons to become ill. Among outbreaks for which the cause was determined, the largest percentage of both outbreaks (75%) and cases (86%) were caused by bacterial pathogens. Chemical agents caused 17% of outbreaks and 1% of cases; viruses, 6% of outbreaks and 8% of cases; and parasites, 2% of outbreaks and 5% of cases.

According to the U.S. Centers for Disease Control and Prevention (CDC), produce-associated foodborne disease outbreaks are a relatively small percentage of all foodborne disease. However, the number of cases is increasing. In 1973-1979, only 2% of U.S. foodborne disease outbreaks were associated with fresh produce. In 1990-1997, this had increased to 6%. Of these produce-related outbreaks, 50% were attributed to bacterial contamination, 7% to viruses, 6% to parasites, and 35 % to unidentified causes (Liang, 2000).

Visual I.2-2

Incidences of Foodborne Diseases in Venezuela



Despite efforts to decrease the occurrence of these diseases, it is estimated that 5 to 10% of the populations in developed countries suffer from foodborne illness each year and the numbers are even higher in less developed areas (Kaferstein, et al. 1997). Since many of these illnesses are not reported to public health officials, it is difficult to get an exact count on actual numbers. However, statistics from both developed and developing countries show a trend toward more foodborne illnesses in recent years. In part, this trend may be due to improvements in disease reporting systems in some countries. However, most authorities agree that there also is an increase in the actual number of cases.

Health Effects of Foodborne Disease

Visual I.2-3

Some Effects of Foodborne Disease

- Vomiting
- Gastroenteritis
- Diarrheal disease
- Non-intestinal disease, i.e. neurological conditions, pre-mature labor, and still-births

For most adults in the industrialized world, incidents of foodborne disease are unpleasant but are generally mild and self-limiting (WHO, 1999a). Symptoms are generally restricted to gastroenteritis and are not usually life-threatening. However, for susceptible individuals, such as the elderly, pregnant women, the very young, and those with compromised immune systems, foodborne illness may lead to serious consequences including death.

In developing countries, diarrheal diseases, particularly infant diarrhea, are a major public health problem. It has been estimated that annually over 1,500 million children under the age of five years suffer from diarrhea and over 3 million die as a result (WHO, 1999a). Diarrhea may also lead to malnutrition that can make children more susceptible to longer periods of diarrhea and to infections. These occurrences can lead to a downward spiral of poor health and, eventually, to premature death.

Not all foodborne disease results in intestinal illnesses (WHO, 1999a). The WHO estimated that 2-3% of the cases of foodborne illness lead to other conditions, which may result in chronic diseases having long-term effects on those afflicted and/or death. ***Clostridium botulinum*** causes a severe neuroparalytic disease that is often fatal. Effects of ***Listeria monocytogenes*** can vary from mild flu-like symptoms to meningitis and meningoencephalitis. This organism is especially serious for pregnant women since infection may result in abortion, stillbirth, or premature labor. For persons with compromised immune systems, infections may result in serious illness and even death.

Costs of Foodborne Disease

Visual I.2-4

Costs of Foodborne Disease

Costs for Individuals	Cost to Society
✓ Medical costs	✓ Loss of productivity
✓ Missed work and lost wages	✓ Cost of disease investigation
✓ Travel to get care	✓ Loss of revenue due to business closure and product avoidance
✓ Expenses for care taker	✓ Chronic disease
✓ Chronic disease	

Although the difficulty in identifying the actual number of cases of foodborne illness makes it hard to estimate the cost of these diseases, no one can dispute that foodborne illness is very expensive. The economic impacts affect not only the individuals and families involved but also the communities, industries, and nations (Doores, 1999). The most obvious costs are those associated with health care for the afflicted individuals. Additional costs related to caring for those who are ill, absenteeism from work and school, and travel costs to seek medical care add to the financial burden. Costs to society include lost worker productivity, the costs of investigating and controlling outbreaks, lost revenue due to business closure and product avoidance, legal costs for litigations related to the illnesses, and costs related to public services for those suffering from chronic disease.

One study estimated that, in the U.S., the cost of foodborne disease caused by seven common pathogens was US$ 5.6 to 9.4 billion (WHO, 1999b). The estimated cost of salmonellosis in England and Wales in 1992 was placed at US$560 to 800 million.

Fresh produce is a particular food safety concern since it is generally eaten without any processing to eliminate or reduce the number of microorganisms present. In addition, since the 1980's, several foodborne infectious agents have been either newly described or newly associated with fruits and vegetables (Tauxe, 1997). For example ***E. coli*** O157:H7 was first identified as a pathogen associated with hamburger in 1982. In 1993, an outbreak of disease caused by this organism in unpasteurized apple juice demonstrated that it could survive in a low acid environment.

Summary

1. A majority of foodborne illness for which causes have been identified have been associated with biological hazards.

2. Produce-associated foodborne disease outbreaks are a relatively small percentage of all foodborne disease however, the number of cases is increasing.

3. For susceptible individuals, such as the elderly, pregnant women, the very young, and those with compromised immune systems, foodborne illness may lead to serious consequences including death. It has been estimated that annually over 1,500 million children under the age of five years suffer from diarrhea and over 3 million die as a result.

4. Costs related to foodborne illness include caring for those who are ill, absenteeism from work and school, travel costs to seek medical care, lost worker productivity, the costs of investigating and controlling outbreaks, lost revenue due to business closure and product avoidance, legal costs for litigations related to the illnesses, and public services for those suffering from chronic disease.

Module 3
Impact of Produce Safety on Trade*

LEARNING OUTCOME

- ***Participants will increase their knowledge of the impact of produce safety on a country's economy.***

PRACTICAL

- ***Discussion Question 1.***

The effects of unsafe fruits and vegetables on health are important reasons for studying produce safety but they are only part of the cause for concern about the safety of these products.

Visual I.3-1

Economic Impact of Agriculture

Country	1999 GDP* (billion$)	GDP - agriculture	Employment in agriculture
Belize	0.74	22%	38%
Brazil	1,057.00	14%	31%
Chile	185.10	6%	14%
Costa Rica	26.00	14%	20%
Dominican Republic	43.70	14%	17%
Guatemala	47.90	23%	50%
Mexico	865.50	5%	24%
Nicaragua	12.50	34%	42%
Trinidad & Tobago	9.41	2%	10%

* GDP = Gross Domestic Product

Food and agricultural production plays an important role in the economy of many countries, especially those of Latin America and the Caribbean. 1999 figures indicated that, depending on the country, total agriculture (production of both food and non-food crops of plant and animal origin) contributed from as little as 2% to over 34% of the gross domestic product (FAOSTAT, 2000). These figures represented not only the value of products but also income generated by persons

* Prepared by: Pamela Brady, Ph.D., IFSE, University of Arkansas

employed in the agricultural sector. For many countries in the region a significant proportion of the population is employed in agriculture.

Trade is an important part of the economy of most countries and agricultural products make up a significant portion of this trade. According to the World Trade Organization (WTO), total world trade in 1999 was valued at $5,473 billion with approximately 10% of this total, or $544 billion, in agricultural products (WTO, 2000).

Visual I.3-2

1999 Export Values from Selected Countries (1000$ U.S.)

Country	Total Agriculture	Produce	
		Total	% Agriculture
Belize	108,299	59,007	54%
Brazil	13,824,401	1,690,870	11%
Chile	2,966,674	1,804,797	52%
Costa Rica	1,802,773	927,902	51%
Dominican Republic	332,094	66,155	20%
Guatemala	1,431,210	276,827	19%
Mexico	7,006,363	3,213,241	46%
Nicaragua	312,854	34,109	11%
Trinidad & Tobago	221,261	20,400	9%

In 1999, exports of agricultural products from countries in Latin America and the Caribbean were valued at over $36 billion (WTO, 2000). For some countries, exports of fruits and vegetables made up close to half of the total agricultural exports. Thus, assuring the acceptability of these products to importing countries is a major economic consideration. In addition, it is important keep in mind that fruits and vegetables are produced for domestic consumption as well as for export. Therefore, the production of safe products is important for the health and welfare of the people within a country as well as for potential export revenue.

The safety of foods has a wide reaching effect on world trade. The World Health Organization estimated that in 1993, foodborne diseases produced worldwide losses in international food trade of approximately US$380 million (PAHO/WHO, 1998). In addition to the economic burden on those afflicted with disease, foodborne illness also led to economic effects on industry and healthcare systems.

Countries importing product have strong economic reasons for demanding safe product. Unsafe imports may pose a threat to the health and safety of consumers. Detention and/or rejection of unsafe product and decreased

consumer confidence in a product or in a country's ability to produce safe product can lead to major losses of revenue for both exporting and importing countries. These lost markets and decreased revenues can translate to reduced community services, lower wages, and lost jobs. An example of this was seen with the 1996 U.S. outbreak of ***Cyclospora.*** Preliminary investigation identified domestic strawberries as the vehicle for this outbreak. Although further investigation proved the source of the outbreak was imported raspberries, the California Strawberry Commission reported that decreased consumer confidence in product safety resulted in over $40 million in lost revenue, 5,000 lost jobs, and a 10% reduction in crop acreage the following year (CDFA, 1997).

In the U.S., consumers are demanding year-round access to fresh fruits and vegetables. Produce from Latin America and the Caribbean helps meet this demand since much of it arrives when cold weather prevents the production of produce domestically (Zepp, et al., 1998). In 1998, U.S. fresh produce imports reached record levels with values totaling over $2.7 billion for fresh fruits and $2.1 billion for fresh vegetables (FASonline, 1999). Countries in Latin America and the Caribbean supplied over 80 percent of the U.S. imported fruits and over 70 percent of the imported vegetables.

Visual I.3-3

Examples of Recent U.S. Multistate Foodborne Disease Outbreaks Associated with Fresh Produce

Year	# of States	# of Cases	Pathogen	Associated food
2001	6	>40	***Salmonella***	Cantaloupe
2000	8	86	***Salmonella***	Tomatoes
1998	3	>400	***Shigella***	Parsley
1997	14	864	***Cyclospora***	Berries
1997	3	305	***Cyclospora***	Basil
1996	2	49	***E.coli O157:H7***	Leaf lettuce
1996	2	72	***Shigella***	Scallions
1996	20	1,500	***Cyclospora***	Raspberries
1993	3	84	***Salmonella***	Tomatoes
1991	23	400	***Salmonella***	Cantaloupe

Although the number of foodborne illness outbreaks associated with fresh produce is still relatively low, as produce consumption has increased, there has been a greater incidence of foodborne illness outbreaks associated with fresh fruits and vegetables (Guzewich and Salsbury, 2000). Some of these outbreaks have been associated with imported produce. However, the proportion of foodborne illness associated with imported produce is no greater than that from produce grown in the U.S.

When looking at the safety record of produce exported to the U.S., it is important to consider that although disease outbreaks may have been associated with produce from another country, the actual site of contamination may never be determined. This is because product contamination can occur anywhere in the production and marketing chain (Zepp et al., 1998). Furthermore, by the time an outbreak is traced to a farm, packinghouse or other site, the actual source of contamination may no longer be there. An example of this problem was seen in a 1991 Hepatitis A outbreak associated with frozen strawberries. The berries were grown in Mexico and processed and distributed in the United States. Outbreak investigators were unable to determine if the contamination occurred before the berries entered the U.S. or during processing and distribution (See Table 2 in Additional Resources section for a list of produce-related outbreaks in the U.S.).

Summary

1. Food and agricultural production plays an important role in the economy of many countries.

2. Exports of fruits and vegetables make up a large percentage of the export income of many countries in Latin America and the Caribbean.

3. Unsafe imports may pose a threat to the health of the people consuming them and result in significant economic loss for the exporting country.

4. Foodborne disease outbreaks in the U.S. have been associated with produce from both domestic and imported sources. The proportion of foodborne illnesses associated with imported produce is no greater than that from produce grown in the U.S.

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