College of Applied Medical Sciences

Department of Environmental Health

Introduction to Food Safety and Microbiology

Lecture 2

INTRODUCTION TO FOOD SAFETY

Foodborne illness is nearly 100% preventable if food is handled safely from the time it is received until the time it is served. Restaurant managers can be proactive in preventing foodborne illness by having a food safety plan and training workers their workers to follow the plan.

What is Foodborne illness?

Foodborne illness is caused by eating contaminated food. Each year in the U.S. about 76 million people get foodborne illness and over 5,000 die as a result. This means that this year alone about 1 in every 4 Americans will get foodborne illness.

Economists estimate that foodborne costs the U.S. between $10 billion and $83 billion each year. A foodborne illness outbreak can cost a restaurant about $75,000. Specific costs include lost business, lawsuits, and medical costs. Most reported cases of foodborne illness are still tracked back to restaurants and so not handling food safely can be expensive.

For centuries and till now, food is playing an important role in the distribution of many dangerous human diseases according to the WHO reports about half of human microbial diseases in the under development countries are due to the contamination of food and water with pathogenic microorganisms.

According to health risk, food can be divided into two groups:

1) High risk foods:

Are those foods that most likely to be the vehicles of the food-poisoning and diseases-causing pathogens under favorable conditions support the multiplication of pathogenic bacteria such as:

a) All cooked meat, poultry, fish, eggs and their products.

b) All foods which do not exposed to food treatments.

c) Ready to eat foods "fast foods".

2) Low risk foods:

Such as preserved foods (sterilization, canning, drying ….etc). Acid foods such as vinegar, high acid juices pH<4, foods with high sugars, salt and fat content.

Who Can Get Foodborne Illness?

Anybody can get foodborne illness. However, some people are more susceptible than others. People who are more likely to get foodborne illness are:

• infants and preschool age children;

• pregnant women;

• older adults;

• people who are chronically ill; and

• individuals taking medications.

If these individuals should get sick from eating contaminated food in your restaurant, they could develop very serious complications. Each year over 300,000 people are hospitalized because of complications from foodborne illness.

What Causes Foodborne Illness in a Restaurant?

Foodborne illness occurs when food becomes contaminated. Contaminated food contains hazards that are either naturally present or that were

introduced when a worker does not handle food safely. Divided into causitive categories called “hazards” There are three types of hazards -- biological, chemical, and physical.

• *Biological hazards* -- bacteria, viruses, parasites, fungi, natural occurring toxins, poisonous plants, poisonous mushrooms, and fish that carry harmful poisons.

• *Chemical hazards* – chemicals like petroleum, herbicides, pesticides, heavy metals, food additives, preservatives, cleaning supplies, and toxic metals

• *Physical hazards* – items that accidentally get into food, such as hair, dirt, metal staples, and broken glass, rocks, wood splinters ,as well as naturally occurring objects, such as bones.

Risk Factors

When developing your food safety plan, you will need to address the risk factors that are most commonly associated with foodborne illness. The Centers for Disease Control and Prevention (CDC) have identified five risk factors that cause most foodborne illness. These are:

• ***Food from unapproved and unsafe source*** – not buying food from regulated food suppliers

• ***Improper holding time and temperature*** -- keeping food between 41oF (5oC) and 135oF(57oC) for more than four hours

• ***Poor personal hygiene*** -- workers not washing their hands properly; coughing or sneezing on food; touching or scratching sores, cuts, or boils; and coming to work sick

• ***Improper cooking*** – not cooking food to recommended internal temperatures

• ***Cross-contamination*** - transferring microorganisms from one surface or food to another surface or food

Food Microbiology: is an applied science in which the principle function of food microbiologist's is to make assurance of safety of food that is supplying to the consumer. The relationship between food and microorganisms, Food borne diseases and microbial contamination of food.

Microorganisms: Organisms such as bacteria, parasites, viruses, yeasts, and molds

–Usually too small to be seen by the naked eye

Where are microorganisms?

1-Soil & Water
2-Plants/Products
3-Utensils/Equipment
4-Gastrointestinal Tract
5-Food Handlers
6-Animal Feeds
7-Animal Hides
8-Air & Dust
9-EVERYWHERE!

Microorganisms in Food

Microorganisms are important in many different ways:

• ***Pathogenic,*** or disease causing, microorganisms can cause food borne illness

•***Spoilage*** microorganisms cause a food to smell, taste, and look unacceptable

• ***Fermentation*** microorganisms produce a desired food product

• Other microorganisms do nothing in foods

Microbial contamination of food:

Raw food usually produced contaminated with microorganisms because the plants and animals from which raw food is produced grow in natural environment in contact with soil and water rich in microorganisms in

addition to the microbial flora of plants and animals from which food produced which are considered as natural source of food contamination. Food also gets heavy contamination during handling and processing.

I) Natural sources of food contamination:

1) Water: water is in continuous contact with food from the field of production to the table of foods in the restaurants and houses as:

a- Irrigation water, b- cleaning water, c- processing water, d- cooling water.

Irrigation water is highly loaded with microorganisms because its raw water rich in inorganic matter, moreover in the fields this water gains more organic residues from plant, sewage, manure and soil, so this water converted to the optimum medium for microbial growth which contaminates the raw food with two groups of microorganisms:

a- Psychrophilic normal bacterial flora of water which will be responsible for food spoilage during refrigeration.

b- Mesophilic contaminating flora which reached the water from soil, sewage, animals, humans. Which will be responsible for food-borne diseases and poisoning.

Cleaning, processing and cooling water as they are not disinfected also contribute in the food contamination.

2) Soil, manure and sewage:

The soil is rich in microbial spores and continuously contaminates the raw food with bacterial and fungal spores, particularly heat resistant spores that resist the heat treatment of food. Sewage and animal manure used as fertilizers contaminate the food with very dangerous bacteria, viruses and parasites.

3) Animals and plants:

The plants, particularly leafy vegetables loaded with microorganisms because of the contact with sources of contamination such as: soil, sewage, water, manure, rodents ….etc. These microorganisms reach the food produced from raw plants.

Animals carry many microorganisms causing dangerous diseases to the human such as: **brucellosis, tuberculosis, anthrax**…..etc. The food gains these microorganisms through: meat, milk, eggs …etc.

Generally the animal-origin foods more dangerous than plant-origin foods because:

a- There are hundreds of microbial diseases associated between animals and humans. So these microbes transferred to the human through food.

b- Microbial spoilage of animal-origin foods leads to production of chemical compounds toxic to the human such as toxic polypeptide, fatty acids, ketones, aldehydes… etc.

4) Air:

The air of open production field usually poor in microorganisms and not suitable for growth of microorganisms because:

1. Poor in organic matter.
2. Low moisture because of the sun-heat.
3. Bactericidal effect of sun-UV light.
4. Continuously removing of microorganisms by wind current.

However, the air of closed food-plants, restaurants, food stores loaded with microorganisms and may be served as a source of contamination of food and prepared meals. In such case it is necessary to disinfect the air of closed buildings by bactericidal chemicals or bactericidal UV-lamps and using special cooling systems and other sanitary practices.

II) Food contamination during handling and processing:

In addition to the natural sources of contamination, the food exposed to the heavy contamination during a long way from the field of production to the table of eating through the following stages:

a) Harvesting or collection of raw foods in the farms:

The raw food may be contaminated from the soil of field, manures, insects, rodents, birds, collectors, containers, equipments…..etc.

b) Transportation:

The food contaminates from the boxes, bags, trucks, cars particularly from permanent societies of contamination which formed from food-residues in the boxes, containers or cars. As the raw food maybe contaminated with toxic chemicals if the same car or container used for transportation of fertilizers, pesticides, fuels….etc.

c) Manufacturing in the food plants.

d) Marketing and distribution.

The most important stage of these four stages is the stage of food processing in the food-plant, for this reason a strict constructions and rules of food plant sanitation was issued for long time.

Food plant sanitation

Food exposed to all sources of contamination in the food plant, air, water, soil, sewage, rodents, insects, food handlers, surfaces, equipments, containers…etc

So plant manager hold a big responsibility for production a food with following characteristics:

1. Clean food. **2. Fresh food.**

3. Pure food. **4. Safe food.**

5. Normal food with character. **6. High nutritive food with value.**

In order to achieve these goals, there are many quality control sections established in each plant:

1. Pest control section.
2. Chemicals control section.
3. Cleaning and sanitizing control section.
4. Microorganisms control section.
5. Food-handlers, employees, workers health section.

Microbiology quality control in food plant

Microbiological section of quality control responsible for microbiological examinations of the following items:

1) Sites and materials of food plant:

a- Microbiology of processing water and drinking water. In addition to pathogenic microorganisms, it‟s necessary to examine slime-producing bacteria and other undesirable bacteria.

b- Microbiology of products, raw materials, ingredients, additives, packaging materials ….etc.

c- Microbiology of sewage and waste treatments units.

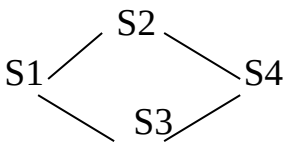
d- Microbiology of food plant and equipments: floors, walls, windows, doors, sinks, air……etc.

e- Microbiology of food stores, cartons, bags, containers, cars…..etc

2) Microbiological examination of food handlers, workers, employees:

Food handlers are very dangerous source of food contamination especially in our country because they are closely contact with food from the field of production to the consumer.

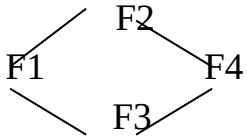
Food handlers contaminate foods and prepared meals with respiratory system pathogens through **(4S)**:



S1: Saliva
S2: *Staphylococcus aureus*
S3: *Streptococcus pyogenes*

S4: Sickness from contaminated food

Also foods contaminate with enteric pathogens through **(4F)**:



F1: Feces
F2: Food handler fingers
F3: Flies
F4: Food contamination (meals)

For these reasons a special care must be taken with food handlers from the health view points. So they must wear a special head cover, mask, cloves, work coat, shoes….etc.

Food handlers external feature must be similar to the heart surgeon, more over food handlers is more dangerous than surgeon because if he contaminates the food may be hundred of consumers killed, while the surgeon killed only one person in such case.