International Journal of Pharmacy and Biological Sciences
ISSN: 2321-3272 (Print), ISSN: 2230-7605 (Online)
IJPBS | Volume 9 | Special Issue 2| ICAM-2019 | 153-161
Proceedings of International Seminar on "Agricultural Microbiome"
Held at Hindustan College of Arts and Science, behind Nava India, Coimbatore, Tamil Nadu 641028, India, 22nd February 2019
| Research Article | Biological Sciences |Open Access |MCI Approved|
|UGC Approved Journal|

Food Safety: Emerging Foodborne Pathogens and Health Implications

R. Rajan
Assistant Professor, Department of Catering Science & Hotel Management, Hindusthan College of Arts & Science, Coimbatore

Received: 25 Feb 2019 / Accepted: 20 Mar 2019 / Published online: 01 Apr 2019

Abstract

The Gastrointestinal Disturbances resulting from the ingestion of food can have a variety of causes. The term "Food Poisoning" is referred to illness caused by bacteria or other toxins in food. Food poisoning can be result of either Intoxication or chemical poisoning. Food safety is a global concern that covers a variety of different areas of everyday life. The principle of food safety is to prevent food from becoming contaminated and causing food poisoning. Safe steps in food handling, proper food quality control, cooking and storage can prevent food-borne illness. The aseptic practices in the preparation, processing & packaging of food products are concerned with the food industry sanitarian. The most common food borne pathogens are Listeria, Staphylococcus, Trichinosis, E. coli, Campylobacter, Clostridium, Salmonella. The HACCP is basically a statement of a preventive system of controls based on the Hazard Analysis of Critical Control Point. The system identifies and measures the specific hazards and ensures the quality of food. Cross contamination is the transfer of harmful bacteria from uncooked food products or unclean people, Countertops and kitchen equipments to ready-to-eat foods. Prevent cross contamination when handling, preparing, and serving food. Cooking food thoroughly and using a thermometer to verify the proper temperature is one of the ways to control food borne illness. Cold temperature slows the growth of harmful bacteria. Refrigerate or freeze meat, poultry, eggs and other perishable as soon as possible after purchasing. Cook food immediately once thawed because some areas of the food may become warm and being to cook during the thawing process. Keeping food at the correct temperature is essential when it comes to food storage. It is advised to keep cold food cold and hot food hot and when possible, foods should always be kept in covered, air-tight containers.

Keywords
Gastrointestinal Disturbances, Cross Contamination, Food Safety, HACCP, Safe Cooking, Storage Procedures, Food Thermometers.

*****

INTRODUCTION TO FOOD-BORNE DISEASES AND FOOD SAFTEY:

The gastrointestinal disturbances resulting from the ingestion of food can have a variety of causes.eg: Eating too much fatty food, poor diet, over dosages, pesticides, overheating, nutritional deficiencies, allergies, toxic plants, infection microorganisms.

The term "food poisoning" as applied to illness caused by bacteria or other toxins in food. Food-borne diseases are subdivided into poisonings and infections. Food poisoning can be result of either Intoxication (ingestion of a toxicant) or chemical poisoning.

Food safety is a global concern that covers a variety of different areas of everyday life. The principles of food safety aim to prevent food from becoming contaminated and causing food poisoning. Safe steps in food handling, cooking and storage can prevent food-borne illness.

A food quality control, Storage of raw products, prevention of contaminated food, supervision of cleanliness & maintenance can eliminate or reduces the food-borne diseases. The aseptic practices in the preparation, processing & packaging of food products are concerned with the food industry sanitarian.

FOOD-BORNE DISEASES:

They are commonly called food poisoning caused by gastrointestinal caused by food & beverage that contain harmful bacteria's, ingestion of toxins, and viruses. There are many foodborne illnesses, many are preventable. But preventing food borne infections from resistant bacteria is not so easy. Most common & deadly food borne pathogens are:

Salmonella:

Salmonella enterica is a bacterium that causes salmonellosis – a particularly nasty type of gastroenteritis. Most susceptible to salmonella bacteria are Young children, older adults and people with weak immune system. Food can be contaminated with salmonella in many different ways, some of them are:

- Faecal matter, both human and animal, transferred from unwashed hands, utensils or surfaces
- Handling food after touching small rodents, reptiles and some birds
- From coming into contact with an infected food handler

Beef, dairy, eggs and poultry are foods most likely to be contaminated with salmonella. Some symptoms found are,

- stomach cramps.
- diarrhea.
- fever.
- muscle pains.

Staphylococcus:

Staphylococcus, also known as Staphylococcus aureus, is a common bacterium that lives on the skin, in the mouth and in the nose. The infections often begin with a minor cut that then becomes infected and can vary from a small sore to a flesh-eating infection. The Symptoms are,

- Rashes
- Blisters

Trichinosis

Trichinosis is a roundworm found in meat-eating animals and can spread to humans through the consumption of trichinosis eggs found on raw or undercooked meats infection that lives and reproduces inside a host body.

The worms are usually found in meat products. If the trichinosis eggs are ingested, they can live in the intestines and hatch into adult worms. The adult worms then produce more eggs that can travel to various different types of tissue in the body.

If the infection has progressed to the point that muscle or other tissue has been affected by the worms, then they could also experience:

- Fever
- Swelling
- Muscle pain

E. coli

E.coli, or Escherichia coli, is a bacteria that lives in the digestive systems of humans and animals. Although of the many different types of E. coli, not all are harmful to humans, some can cause severe illness and even lead to death. Humans can develop an E. coli infection when they come into contact with animal or human faeces.

This usually occurs when contaminated water or food is consumed.

E. coli can contaminate food throughout all stages of the food processing supply-chain and is often caused by poor food safety. Particular high-risk foods are meat, poultry, dairy, fruits and vegetables.

Listeria

Listeria monocytogenes is bacteria that can cause acute food poisoning. Most at risk of infection found in Pregnant women, people with a lowered immune system, young children. Some examples of foods with a high risk of contamination are:

- Precooked meats
- Unpasteurised milk & it's by products
- Soft cheeses and ice creams

They could also experience through:

- muscle aches.
- nausea.
- diarrhea.

Campylobacter

The food poisoning caused by Campylobacter bacteria called campylobacteriosis. It is a very common cause mostly found in young adults. It is found on raw or undercooked poultry, is the main cause of campylobacteriosis. The campylobacter bacterium is found inside live poultry is easily transferred during the initial processing stage. Unwashed hands can cause the infection to spread between humans. Milk and water contaminated with campylobacter bacteria can also cause infections. Symptoms are abdominal pain, fever, headache & vomiting.

Clostridium

It is often-called C. diff, is a bacterium that lives in the digestive tract. In small quantities it is often harmless however, if the bacteria overgrow, they can cause the release of a toxin that attacks the host's intestines. This condition is called Clostridium difficilecolitis or C. difficile. The Symptoms are:

- Watery diarrhea 10 to 15 times a day
- Rapid heart rate
- Loss of appetite

Bacteria in food:

Some food borne illness are not caused by bacteria and viruses but result from mycotoxins, worms. Mycotoxins are fungal metabolites which occurs naturally. The moulds grow on foods in cereals, spices, dried fruit & nuts in a humid condition. It causes a variety of health effects including kidney damages, cancer, etc. They are the most harmful than bacteria's since they occur naturally their presence cannot be completely avoided in foods. Appropriate controls can be reasonably achievable. These controls can be ensured during growing, harvesting storing of foods.

Virus in foods:

Most illness are caused by viruses. A survey says that the infections hepatitis viruses are found in shellfish, raw milk, sandwiches and cold meats causes the food borne illness in humans. Poliomyelitis are the viruses found in milk and cream filled pastries. The ornithosis virus produces a respiratory infection in man. A frequently involved virus in recent years has been the 'Norwalk' which is normally found in shellfish.

Most of the shellfish become toxic to humans, symptoms include numbness of lips, fingers tips. Consuming these types of shellfish may result in death if respiratory paralysis found within 12hours.

Many species of fish have been implicated in ciguatera poisoning. The scombroid fish poisoning found in fish product caused seafood toxicants: by ingestion of histamine causes bacterial degradation.

Parasites:

Parasites are small organisms that live inside another organism. Cryptosporidium parvum and Giardia intestinalis are parasites that are spread through water contaminated with the stools of people or animals who are infected. Foods that come into contact with contaminated water during growth or preparation can become contaminated with these parasites.

Food handlers who are infected with these parasites can also contaminate foods if they do not thoroughly wash their hands after using the bathroom and before handling food.

Trichinella spiralis is a type of roundworm parasite. People may be infected with this parasite by consuming raw, undercooked pork & wild game foods.

Chemicals:

It is uncommon and usually characterized by appearance at the symptoms within short time after the poisonous food is consumed. Chemicals such as arsenic, cadmium, copper, cyanide, zinc found in foods are blamed for food poisoning from cheap utensils which are enamelled cheaply containing antimony.

The sodium fluoride is been added to food in place of baking powder, flour, dry milk. The arsenic residues from fruit sprays are most harmful chemicals were not destroyed even after many washes. Leakage of methyl chloride from refrigerator feeds the wrong attributed foods to humans.

SAFETY IN FOOD:

It describes safe steps in handling, preparation & storage of food to prevent the food borne disease. It is

a global concern that covers variety of different areas of everyday life. The four basic steps in handling food are Clean, Separate, Cook & Chill are most important to avoid the spread of bacteria when buying, preparing & storing foods.

Food borne illness can affect anyone who eats contaminated food; however, certain populations are more susceptible to becoming ill when a greater severity of illness. To prevent food borne illness, it is necessary to understand how food becomes unsafe to eat and what proactive measures can be taken to keep food safe. Cross contamination between raw and cooked food is the best way to control the food borne illness.

Role of HACCP in Food Safety:

HACCP is basically a statement of a preventive system of controls based on the Hazard Analysis of Critical Control Point. It involves producing a pronounced effect on food safety. The HACCP concept is really a sophisticated food control option that incorporates many of the traditional approaches that have been attempted over the years. The system identifies and measures the specific hazards and ensures the quality of food.

PREVENTION OF FOODBORNE ILLNESS:

Prevent Cross Contamination:

Separate food products to prevent cross contamination. Cross contamination is the transfer of harmful bacteria from uncooked food products (e.g. raw meat, fish, and poultry) or unclean people, Countertops, and kitchen equipment to ready-to-eat foods (e.g., fruits, vegetables, cheeses and prepared or cooked foods).

WAYS TO PREVENT CROSS CONTAMINATION:

- Segregating raw meat, fish and poultry on one side of the shopping cart.
- Placing raw meat, fish and poultry in separate plastic bags.
- Frequently wash bags. Cloth bags should be washed in a machine and machine dried or air-dried.
- Prevent Cross Contaminating When Storing Food In The Refrigerator
- Use separate cutting boards for cutting meats & vegetables.
- Use a clean serving plate to serve cooked meat. Do not use the plate that held the raw meat, unless it is washed.
- Throw away any sauce or dip that has been used to marinade raw meat, fish, or poultry. Do not use this extra sauce as a dip for cooked food unless it is boiled.

Safe Cooking:

Cooking food thoroughly and using a thermometer to verify the proper temperature is one of the way to control food borne illness.

Cooking foods to the safe minimum internal temperature, as indicated in the table below.

Product	**Minimum Internal Temperature & Rest Time**
Beef, Pork, Veal & Lamb Steaks, chops, roasts	145 °F (62.8 °C) and allow to rest for at least 3 minutes
Ground meats	160 °F (71.1 °C)
Ham, fresh or smoked (uncooked)	145 °F (62.8 °C) and allow to rest for at least 3 minutes
Fully Cooked Ham (to reheat)	Reheat cooked hams packaged in USDA-inspected plants to 140 °F (60 °C) and all others to 165 °F (73.9 °C).

Product	**Minimum Internal Temperature**
All Poultry (breasts, whole bird, legs, thighs, wings, ground poultry, giblets, and stuffing)	165 °F (73.9 °C)
Eggs	160 °F (71.1 °C)
Fish & Shellfish	145 °F (62.8 °C)
Leftovers	165 °F (73.9 °C)
Casseroles	165 °F (73.9 °C)

Chilling Food:

Chill the food promptly. Cold temperature slow the growth of harmful bacteria. Cold air must be circulated to help keep food safe. Maintain the refrigerator temperature at 24°C or below. Maintain the freezer temperature at 0°C or below. Refrigerate and/or freeze meat, poultry, eggs and other perishable as soon as possible after purchasing.

Cleaning & Sanitizing:

Cleaning equipment is primarily to remove as much microorganisms and it is practicable, so the equipment that comes in contact with food is adequately cleaned and sanitized. It may be an important source of contamination of foods with microorganisms.

Maintaining the cooking area clean & tidy helps in minimizing the contact of microorganisms in foods. Wash cutting boards, dishes, and utensils after preparing each food items and before you use it for the next food.

The sanitizing process is an attempt to reduce the number of microorganisms on equipment surfaces, Chloride bleach is a very effective sanitizer, so a mixture of chloride bleach and water are a cost-effective method of sanitation.

Use food thermometers:

Using a thermometer is the only reliable way to ensure that a food is properly cooked. The food has been cooked to the correct temperature to ensure that food borne pathogens, bacteria, viruses are destroyed.

The thermometer may clean with hot, soapy water before and after each use. Pop-up thermometers are reliable, it is often recommended that the temperature be checked in several places with a conventional thermometer to be sure.

Storage:

Storing the food at correct temperature is essential when it comes to food storage. It is advised to keep cold food cold and hot food hot. Foods should always be kept in covered, air-tight containers off the floor. The growth rate of bacteria and other harmful contaminants grows between 5 to 60°C and this is known as the 'Danger-Zone'.

Low-risk foods are foods which carry a reduced risk of becoming contaminated. Some examples of these are dry ingredients, such as rice, flour, cocoa and sugars; and foods that contain little if any protein, such as honey, sauces, oils and some condiments.

High-risk foods are foods that are high in protein, like meat, poultry, seafood, dairy products and eggs, and therefore must be kept below 5°C when chilled. If these foods are frozen they should not be allowed to reach above -15°C.

Perishable food includes fruits and vegetables, fresh meat, foods purchased from chill cabinets, freshly cooked food stored to be used later. It is usually stored in the refrigerator. Some fresh fruits and vegetables, however, will store quite well out of the refrigerator as long as they are stored in a cool place. Tips can be followed from the below chart for the safe storage of food products:

REFRIGERATOR & FREEZER STORAGE CHART

These short but safe time limits will help keep refrigerated food 40° F (4° C) from spoiling or becoming dangerous. Since product dates aren't a guide for safe use of a product, consult this chart and follow these tips.

- Purchase the product before "sell-by" or expiration dates.
- Follow handling recommendations on product.
- Keep meat and poultry in its package until just before using.
- If freezing meat and poultry in its original package longer than 2 months, overwrap these packages with airtight heavy-duty.

Product Refrigerat Freezer	Product Refrigerator Freezer
Eggs	**Soups & Stews**
Fresh, in shell 3 - 5 weeks Don't freeze Raw yolks, whites 2 - 4 days 1 year Hard cooked 1 week Don't freeze Liquid pasteurized eggs or egg substitutes, opened 3 days Don't freeze unopened 10 days 1 year	Vegetable or meat-added & mixtures of them 3 - 4 days 2 - 3 months **Bacon & Sausage** Bacon 7 days 1 month Sausage, raw from pork, beef, chicken or turkey 1 - 2 days 1 - 2 months Smoked breakfast links, patties 7 days 1 - 2 months **Fresh Meat (Beef, Veal, Lamb, & Pork)**
TV Dinners, Frozen Casseroles	Steaks
Keep frozen until ready to heat 3 - 4 months	3 - 5 days 6 - 12 months Chops
Deli & Vacuum-Packed Products	3 - 5 days
Store-prepared (or homemade) egg, chicken, tuna, ham, macaroni salads 3 - 5 days Don't freeze Pre-stuffed pork & lamb chops, chicken breasts stuffed w/dressing 1 day	4 - 6 months Roasts 3 - 5 days 4 - 12 months Variety meats (tongue, kidneys, liver, heart, chitterlings) 1 - 2 days 3 - 4 months

Don't freeze Store-cooked convenience meals

3 - 4 days

Don't freeze Commercial brand vacuum-packed dinners with USDA seal, unopened

2 weeks

Don't freeze

Raw Hamburger, Ground & Stew Meat

Hamburger & stew meats

1 - 2 days

3 - 4 months Ground turkey, veal, pork, lamb

1 - 2 days

3 - 4 months

Ham, Corned Beef

Corned beef in pouch with pickling juices

5 - 7 days

Drained, 1 month Ham, canned, labeled "Keep Refrigerated," unopened

6 - 9 months

Don't freeze opened

3 - 5 days

1 - 2 months Ham, fully cooked, whole 7 days

1 - 2 months Ham, fully cooked, half

Meat Leftovers

Cooked meat & meat dishes 3 - 4 days

2 - 3 months Gravy & meat broth

1 - 2 days

2 - 3 months

Fresh Poultry

Chicken or turkey, whole

1 - 2 days

1 year Chicken or turkey, parts

1 - 2 days

9 months Giblets

1 - 2 days

3 - 4 months

Cooked Poultry, Leftover

Fried chicken

3 - 4 days

4 months Cooked poultry dishes

3 - 4 days

4 - 6 months Pieces, plain

3 - 4 days

3 - 5 days 1 - 2 months Ham, fully cooked, slices 3 - 4 days 1 - 2 months **Hot Dogs & Lunch Meats** (in freezer wrap) Hot dogs, opened package 1 week 1 - 2 months unopened package 2 weeks 1 - 2 months	4 months Pieces covered with broth, gravy 3 - 4 days 6 months Chicken nuggets, patties 3 - 4 days 1 - 3 months **Fish & Shellfish** Lean fish 1 - 2 days 6 - 8 months Fatty fish 1 - 2 days 2 - 3 months Cooked fish 3 - 4 days 4 - 6 months Smoked fish 14 days 2 months Fresh shrimp, scallops, crawfish, squid 1 - 2 days 3 - 6 months Canned seafood after opening out of can (Pantry, 5 years) 3 - 4 days 2 months

CONCLUSION:

The Microorganisms can be an important source of foodborne pathogens. The presence of foodborne pathogens in foods can be due to the direct contact with contaminated sources in the working environment. Every food industry should be concerned about the food safety because outbreaks of disease in humans have been traced to the consumption of unsafe foods.

The challenges to providing a safe and nutritious food supply are complex because all aspects of food production from land to fork need to be considered. As the system of food production changes, the food safety system needs to change with it. A strong science-based approach that addresses all the complex issues involved in continuing to improve food safety and public health is necessary to prevent foodborne illnesses.

References:

William C. Frazier, Dennis C. Westhoff-Food Microbiology-4th Edition-Tata McGraw Hill.

https://www.fda.gov/downloads/food/resourcesforyou/healtheducators/ucm109315.pdf

https://www.foodsafety.com.au/resources/articles/what-is-food-safety

https://www.csiro.au/en/Research/Health/Food-safety/Refrigerating-foods