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Foodborne Diseases and Public Health Issue

Major foodborne illnesses and causes

Foodborne illnesses are usually infectious or toxic in nature and caused by bacteria, viruses, parasites or chemical substances entering the body through contaminated food. Chemical contamination can lead to acute poisoning or long-term diseases, such as cancer. Many foodborne diseases may lead to long-lasting disability and death.

Illness due to contaminated food are perhaps the most widespread health problems in developed and developing countries and important of reduced economic productivity. There have been devastating outbreaks of diseases caused by many and lead to diarrhoeal diseases and transmit from water or food to people or through person-to-person contact. Some examples are below:

Bacteria

- *Salmonella*, *Campylobacter* and enterohaemorrhagic *Escherichia coli* are some of the most common foodborne pathogens that affect millions of people annually, sometimes with severe and fatal outcomes. Symptoms can be fever, headache, nausea, vomiting, abdominal pain and diarrhoea. Foods involved in outbreaks of Salmonellosis include eggs, poultry and other products of animal

origin. Foodborne cases with *Campylobacter* are mainly caused by raw milk, raw or undercooked poultry and drinking water. Enterohaemorrhagic *Escherichia coli* is associated with unpasteurized milk, undercooked meat and contaminated fresh fruits and vegetables.

- *Listeria* infections can lead to miscarriage in pregnant women or death of newborn babies. Although disease occurrence is relatively low, *Listeria* cause severe and sometimes fatal health consequences, particularly among infants, children and the elderly, count them among the most serious foodborne infections. *Listeria* is found in unpasteurised dairy products and various ready-to-eat foods and can grow at refrigeration temperatures.
- *Vibrio cholerae* can infect people through contaminated water or food. Symptoms may include abdominal pain, vomiting and profuse watery diarrhoea, which quickly lead to severe dehydration and possibly death. Rice, vegetables, millet gruel and various types of seafood have been implicated in cholera outbreaks.

Viruses

Some viruses can be transmitted by food consumption. Norovirus is a common cause of foodborne infections that is characterized by nausea, explosive vomiting, watery diarrhoea and abdominal pain. Hepatitis A virus can also be transmitted by food and can cause long-lasting liver disease and spreads typically through raw or undercooked seafood or contaminated raw produce.

Parasites

Some parasites, such as fish-borne trematodes (*Clonorchis* spp., *Metagonimus* spp., and *Echinostoma* spp.) are only transmitted through food. Others, for example tapeworms like *Echinococcus* spp, or *Taenia* spp, may infect people through food or direct contact with animals. Other parasites, such

as *Ascaris*, *Cryptosporidium*, *Entamoeba histolytica* or *Giardia*, enter the food chain via water or soil and can contaminate fresh produce.

Prions

Prions, infectious agents composed of protein, are unique in that they are associated with specific forms of neurodegenerative disease. Bovine spongiform encephalopathy (BSE, or so-called mad cow disease) is a prion disease in cattle, associated with the variant Creutzfeldt-Jakob disease (vCJD) in humans. Consuming meat products containing specified risk material, such as brain tissue, is the most likely route of transmission of the prion agent to humans.

Chemicals

- **Naturally occurring toxins** include mycotoxins (fungi), marine biotoxins, cyanogenic glycosides and toxins occurring in poisonous mushrooms. Staple foods like corn or cereals can contain high levels of mycotoxins, such as aflatoxin and ochratoxin, produced by mould on grain. A long-term exposure can affect the immune system and normal development, or cause cancer.
- **Persistent organic pollutants (POPs)** are compounds that accumulate in the environment and human body. Known examples are dioxins and polychlorinated biphenyls (PCBs), which are unwanted by-products of industrial processes and waste incineration. They are found worldwide in the environment and accumulate in animal food chains. Dioxins are highly toxic and can cause reproductive and developmental problems, damage the immune system, interfere with hormones and cause cancer.
- **Heavy metals** such as lead, cadmium and mercury cause neurological and kidney damage. Contamination by heavy metal in food occurs mainly through pollution of water and soil.
- **Other chemical hazards** in food can include radioactive nucleotides that can be discharged into the environment from industries and from civil or

military nuclear operations, food allergens, residues of drugs and other contaminants incorporated in the food during the process.

Food safety should be integrated along with entire food chain, from farm to table, with three sectors included government, industry and consumers. They should share responsibility with other disciplines such agriculture, health and trades.

Factors of significant for food safety

1. Health and demographics

The world population is expected to grow up 9 billion by the year 2050, and significant growth will be noticed in developing countries. Increase human populations is causing serious problem of food security and safety, environmental degradation, large migration scale to cities and change in the ecosystem. Foodborne diseases have been reported frequently in the vulnerable unite of population, especially in elderly and children who have lower resistance to diseases infection.

2. Food supply system

Under the pressure of the growing human population, food production must increase substantially with likely increase in agro-chemical inputs. Intensified animal production system leads to the further spread of zoonotic microorganisms, both resulting in increased opportunities for food contamination. The world meat consumption is expected to increase to double rate and this may take place in developing countries. Climate changes and increase trade globally contribute to survive the pathogens and record new outbreaks.

3. Health system and infrastructure

Adequate supply of safe water and sanitation facilities is one of the essential prerequisites for hygienic food production, processing and preparation. People in many developing countries lack acceptable sources of drinking water and

sanitation. Weakness in investigation, surveillance, monitoring of foodborne hazards, biological or chemicals, is responsible for series problem: difficulties in formulating food safety, evaluating economic impacts, allocating resources on priorities food safety problem.

4.Social situation, behaviour and life style

Behaviour and lifestyle strongly influence the foodborne diseases. Consumers in affluent countries are demanding foods that are minimally processed, without preservative, with long shelf life. Long storage of food may result in the growth of pathogens to infective doses, even at refrigeration temperatures, thus increasing the risk of disease. Poverty and inequity two most important contributor factors to poor health, because absence of sufficient fuels for preparation food for eating. Lack of education is another prime factor in maintain hygienic condition to prevent foodborne hazard acquired. Traveling is also a cause for transmission of pathogens from visiting an endemic area.

5.Environmental condition

Global warming is also anticipated to increase foodborne diseases and its surviving. The most virulent and opportunistic bacteria prevail during extreme weather include *E. coli*, *Salmonella*, *Campylobacter*, and *Vibrio*, causing outbreak from oral transmission. Water and food are considered the main vehicle for carries pathogens to humans and animals.

Variation in temperature and humidity influence the continuation of mycotoxins contamination in food commodities and crop field. Warmer temperature combined with heavy rainfall leads to increase plant stress and therefore predisposing crop to intrusion by mould. Mycotoxins are chemical metabolic particles synthesised by fungi during growth while it is refereed has a serious problem to human health and agriculture practices.

Stress weather condition, heat and drought, have direct effect on microorganisms surviving despite some of them can remain active for a period of time. For example, some *Bacillus* species were isolated soybean (*Glycine max*) as attribution to producing this bacterium to exopolysaccharide during drought period. Increased temperature aid to increase the pathogens population and occurrence. *Salmonella*, as one of important food pathogens, were found to be responsible for 93.8 million human cases with gastroenteritis.

Emerging pathogens

Many pathogens and new strains have been emerged or appeared in the last decades and cause public health concerns. These pathogens have been reported around the world for certain of reasons including:

1. Drug resistant strains of several enteric pathogens such as *Salmonella typhimurium* DT 104.
2. *Mycobacterium avium paratuberculosis* (MAP) causes Johne's disease in livestock, horses and deer, and Crohn's disease in man. This bacteriae cause pulmonary infection and digestive disorders in humans, found in fresh and salty water and isolated from soil.
3. Prion the etiological cause for bovine spongiform encephalopathy (BSE) in n cattle and Creutzfeldt-Jacob disease in humans. Prion is not affected by the food processing, including cooking.
4. Genetically modified food (GMF) is also known as genetically engineered foods (GE foods), or bioengineered foods. This modern technique has been used for two reasons: addressing the need to produce sufficient quantity as growing of populations, secondly products like soybean and maize have been engineered for resistance to pathogens and herbicides, as well as resist to sever climate changes.
5. Food irradiation that helps in reducing pathogens in food, it is an application utilizing gamma rays which believed to physically harm.

6. Using pesticides and veterinary drugs have short term or long-term effects on human body.

Prevention and control of foodborne diseases

There are three lines of defense for prevention and control of biological hazards

- 1- The first line of defense aims at improving the hygienic quality of raw food stuffs at the agri/aqua-culture level. Certain zoonotic diseases, such as brucellosis and tuberculosis can be eradicated in animals. The resulting food (meat and milk free from pathogens).
- 2- The second lines of defense utilised food processing technologies. For example, pasteurization, fermentation, and irradiation can increase the availability of foods by extending their shelf life and contribute to their safety by reducing or eliminating.
- 3- The third lines of defense can be achieved by education of food handlers in the principles of safe food preparation. The term food handlers include a good storage conditions, cleaning, and professional cooking.

Pathogens associated with the meat processing

A number of significant numbers of foodborne pathogens such as *Salmonella* and *E. coli* 0157:H7 can exist over period of time on farm environment cycling and recycling through acutely or latently infected individual and herds, contaminated feed, water, pasture, equipment. Such bacteria pathogens can exist for several months or years in biosphere environment. Even though *E. coli* exist in cattle at lower frequency, it can pose serious hazard to human health.

Sources of carcass contamination

Animals entering the slaughter process carry *Salmonella* or *E. coli* or a range of other zoonotic pathogens. These pathogens may contaminate slaughter environment, equipment and meat. Bovine gut is the primary reservoir of enteropathogenic infection in humans consuming beef and beef products, and

Salmonella is isolated from rumen, cecum, rectum, colon, rectum. From these locations, organisms are frequently transferred to hides, hooves etc, and can contaminate carcass during dehiding and other dressing activities.

Factors influencing pathogens distribution in cattle on farms

- 1- Farm location
- 2- Specific husbandry practices
- 3- Herd size (proportion of mature and immature animals)
- 4- Herd/lot mingling
- 5- Drinking water system
- 6- Feeding regimes
- 7- Intensive management procedures
- 8- Contact with vermin, wild or other farm animals
- 9- Concurrent viral or parasite infections
- 10- Transport conditions and duration
- 11- Aspects lairage practices

Slaughter and decontamination systems

At slaughter house, the proportion of pathogens occur in carcass influenced by some factors including:

- 1- Differences on slaughter/dressing hygiene practices may also influence the proportion of pathogens on carcass.
- 2- The application of antimicrobial interventions
- 3- Steam vacuum and chemical rinsing
- 4- Drinking water before slaughtering process
- 5- Abattoir hygienic condition

Important of chilling process to inhibit the growth of pathogens in animal carcasses

Normally, the surface of temperature of beef carcasses ranges from 25 to 32°C. the rate at which beef carcasses cool are most significantly dictate by two factors, weight and fat cover. Heavier carcasses contain more heat but do not have an equivalently larger surface area, through which to lose their greater heat content. Thus, cool much more slowly than smaller carcasses. While pathogens are operating at carcass surface temperature, where the differences between the absolute fat and lean carcasses are likely to be less extreme, are likely to have important effects on the extent and significance of pathogens survival during chilling. So chilling is important to reduce carcass surface temperature as rapidly as possible to prevent microbial growth, and in particular, the growth of significant pathogens, such as *Salmonella*. The growth of pathogens is again influenced by temperature and carcass lean/fat composition. However, even at carcass temperature of 15 to 20°C, *Salmonella* has relatively short generation times, of the order of 0.99 to 2.14 hours. At the higher temperature, i.e: 25-30°C, generation times as low as 0.56 and 0.58 have been reported for a range of beef tissues.