Frequently asked questions

1. **Question:** List out the important microbial genera observed in food.

   Answer: Some of the important genera known to occur in foods are as follows. Some are desirable in certain foods; others bring about spoilage or other complications including gastroenteritis.

   Bacteria

   Acinetobacter, *Erwinia*, *Pediococcus*, *Aeromonas*, *Escherichia*, *Proteus*, *Alcaligenes*, *Flavobacterium*, *Pseudomonas*, *Arcobacter*, *Hafnia*, *Psychrobacter*, *Bacillus*, *Kocuria*, *Salmonella*, *Brochothrix*, *Lactococcus*, *Serratia*, *Campylobacter*, *Lactobacillus*, *Shewanella*, *Carnobacterium*, *Leuconostoc*, *Shigella*, *Citrobacter*, *Listeria*, *Staphylococcus*, *Clostridium*, *Micrococcus*, *Vagococcus*, *Corynebacterium*, *Moraxella*, *Vibrio*, *Enterobacter*, *Paenibacillus*, *Weissella*, *Enterococcus*, *Pantoea*, *Yersinia*, etc.,

   Molds

   Alternaria, *Cladosporium*, *Mucor*, *Aspergillus*, *Colletotrichum*, *Penicillium*, *Aureobasidium*, *Fusarium*, *Rhizopus*, *Botrytis*, *Geotrichum*, *Trichothecium*, *Byssochlamys*, *Monilia*, *Wallemia*, *Xeromyces*.

   Yeasts

   Brettanomyces, *Issatchenkia*, *Schizosaccharomyces*, *Candida*, *Kluyveromyces*, *Torulaspora*, *Cryptococcus*, *Pichia*, *Trichosporon*, *Debaryomyces*, *Rhodotorula*, *Zygosaccharomyces*, *Hanseniaspora Saccharomyces*, etc.,

   Protozoa

   Cryptosporidium parvum, *Entamoeba histolytica*, *Cyclospora cayetanensis*, *Giardia lamblia* and *Toxoplasma gondii*.

2. **Discuss food as a source viral and prion contaminations?**

   Much less is known about the incidence of viruses in foods than about bacteria and fungi, for several reasons, first, being obligate parasites, viruses do not grow on culture media as do bacteria and fungi. The usual methods for their cultivation consist of tissue culture and chick embryo techniques. Second, because viruses do not replicate in

foods, their numbers may be expected to be low relative to bacteria, and extraction and concentration methods are necessary for their recovery.

Few viruses with high potential as food contaminants are

Picornaviruses: Polioviruses, Coxsackievirus A, Coxsackievirus B, Echovirus, Enterovirus, Hepatitis A,

Reoviruses: Reovirus, Rotaviruses,

Parvoviruses: Human gastrointestinal viruses,

Papovaviruses: Human BK and JC viruses

Adenoviruses: Human adenoviruses.

Prions

In recent years, Bovine Spongiform Encephalopathy (BSE) such as mad cow disease has attracted public health attention. The first cases of BSE were reported in Great Britain in November 1986. It appears probable that the disease can be transmitted to humans by food. The prions that cause the disease are resistant to chemical and physical influences, i.e. to heat, UV, ionizing radiations and disinfectants. Prions are sensitive to certain alkaline substances and moist heat under high pressure. An effective disinfectant measure is steam sterilization at 133°C and 3 bar pressure for 20 min. On the basis of current knowledge, the cause of the BSE epidemic was animal feed (meat- and bone-meal) containing brain, eyes or spinal cord of infected animals, and other tissues that had been inadequately heated during the production process.

3. Write a note on sources of microorganisms in food.

There are several sources contributing to contamination of microorganisms in food such as

Soil and water: These two environments are placed together because many of the bacteria and fungi that inhabit both have a lot in common. Soil being a natural media contains wide range of microorganisms which may enter water through atmosphere. These microorganisms contaminate food if care is not taken.

Air and Dust: Most of the microorganisms listed above may at times be found in air and dust in a food-processing operation. Among fungi, a number of molds may be expected to occur in air and dust along with some yeast. In general, the types of organisms in air and dust would be those that are constantly reseeded to the environment.

Plants and Plant Products: It may be assumed that many or most soil and water organisms contaminate plants. However, only a relatively small number find the plant environment suitable to their overall well-being. Those that persist on plant products do so by virtue of a capacity to adhere to plant surfaces so that they are not easily washed away and because they are able to obtain their nutritional requirements.

Food Utensils: When vegetables are harvested in containers and utensils, one would expect to find some or all of the surface organisms on the products to contaminate contact surfaces. As more and more vegetables are placed in the same containers, a normalization of the microbiota would be expected to occur. In a similar way, the cutting block in a meat market along with cutting knives and grinders are contaminated from initial samples, and this process leads to a buildup of organisms, thus ensuring a fairly constant level of contamination of meat borne organisms.

Gastrointestinal Tract: The intestinal biota consists of many organisms that do not persist as long in waters as do others, and notable among these are pathogens such as salmonellae. Any or all of the Enterobacteriaceae may be expected in fecal wastes, along with intestinal pathogens, including the protozoal species.

Food Handlers: The microbiota on the hands and outer garments of handlers generally reflect the environment and habits of individuals, and the organisms in question may be those from soils, waters, dust, and other environmental sources. Additional important sources are those that are common in nasal cavities and the mouth and on the skin, and those from the gastrointestinal tract that may enter foods through poor personal hygienic practices.

Animal Feeds: This is a source of salmonellae to poultry and other farm animals. In the case of some silage, it is a known source of *Listeria monocytogenes* to dairy and meat animals. The organisms in dry animal feed are spread throughout the animal environment and may be expected to occur on animal hides.

Animal Hides: In the case of milk cows, the types of organisms found in raw milk can be a reflection of the biota of the udder when proper procedures are not followed in milking and of the general environment of such animals. From both the udder and the hide, organisms can contaminate the general environment, milk containers, and the hands of handlers.

4. What is food poisoning? Discuss the major microorganisms involved in it.

At least three Gram-positive spore forming rods are known to cause bacterial food poisoning: *Clostridium perfringens (welchii), C. botulinum* and *Bacillus cereus.* The incidence of food poisoning caused by each of these organisms is related to certain specific foods, as is food poisoning in general.

***Clostridium perfringens* food poisoning**

The causative organism of this syndrome is a Gram-positive, anaerobic spore-forming rod widely distributed in soils, water, foods, dust, spices, and the intestinal tract of humans and other animals. Based on their ability to produce certain exotoxins, five types are recognized: types A, B, C, D, and E. The food poisoning strains belong to type A, as do the classic gas gangrene strains, but unlike the latter, the food-poisoning strains are generally heat resistant and produce only traces of alpha toxin. Some type C strains produce enterotoxin and may cause a food-poisoning syndrome.

The causative factor of *Cl. perfringens* food poisoning is an enterotoxin. It is unusual in that it is a spore-specific protein; its production occurs together with that of sporulation. All known food-poisoning cases by this organism are caused by type A strains. An unrelated disease, necrotic enteritis, is caused by beta toxin produced by type C strains and is only rarely reported outside New Guinea. Although necrotic enteritis due to type C has been associated with a high mortality rate, food poisoning due to type A strains has been fatal only in elderly or otherwise debilitated persons. Some type C strains have been shown to produce enterotoxin, but its role in disease is unclear.

Botulism

Unlike *Cl. perfringens* food poisoning, in which large numbers of viable cells must be ingested, the symptoms of botulism are caused by the ingestion of a highly toxic, soluble exotoxin produced by *Cl. botulinum* while growing in foods. It is produced by cells growing under optimal conditions, although resting cells have been reported to form toxin as well. The Botulinal Neurotoxins (BoNT) are the most toxic substances known; with purified type A reported to contain about 30 million mouse LD_{50}/mg. The neurotoxins are formed within the organism and released upon autolysis.

***Bacillus cereus* gastroenteritis**

Bacillus cereus is an aerobic, spore-forming rod normally present in soil, dust, and water. It has been associated with food poisoning in Europe since at least 1906. Among the first to report this syndrome with precision was Plazikowski. His findings were confirmed by several other European workers in the early 1950s. The first documented outbreak in the United States occurred in 1969, and the first in Great Britain occurred in 1971.

B. cereus and *B. mycoides* strains from milk have been shown to produce diarrheagenic enterotoxin in 9 days at temperatures between 6°C and 21°C. Varying numbers of isolates of the following species were found also to be enterotoxin producers: *B. circulans, B. lentus, B. thuringiensis, B. pumilus, B. polymyxa, B. carotarum,* and *B. pasteurii. B. thuringiensis* has been isolated from foods, and it apparently produces a Vero-cell active toxin.

B. cereus produces a wide variety of extracellular toxins and enzymes, including lecithinase, proteases, β-lactamase, sphingomyelinase, cereolysin (mouse lethal toxin, hemolysin I), and hemolysin BL. The diarrheagenic syndrome appears to be produced by a tripartite complex composed of components B, L1, and L2 and designated Hemolysin BL (HBL). Together, this complex exhibits hemolysis, cytolysis, dermonecrosis, vascular permeability, and enterotoxic activity.

5. Name mycotoxins observed in food?

A very large number of molds produce toxic substances designated mycotoxins. Some are mutagenic and carcinogenic, some display specific organ toxicity, and some are toxic by other mechanisms. While the clear-cut toxicity of many mycotoxins for humans has not been demonstrated, the effect of these compounds on experimental animals and their effect in in vitro assay systems leave little doubt about their real and potential toxicity for humans. At least 14 mycotoxins are carcinogens, with the aflatoxins being the most potent. It is generally accepted that about 93% of mutagenic compounds are carcinogens. With mycotoxins, microbial assay systems reveal an 85% level of correlation between carcinogenicity and mutagenesis.

Few mycotoxins detected in food are aflatoxin produced by *Aspergillus flavus, Alternaria* toxins produced by *A. citri, A. alternata, A. solani* and *A. tenuissima,* citrinin mycotoxin produced by *Penicillium citrinum* and other fungi, ochratoxins produced by a

large number of storage fungi, including *Aspergillus ochraceus, A. alliaceus, A. ostianus, A. mellus,* and other species of *Aspergilli* and among penicillia that produce ochratoxins are *P. viridicatum, P. cyclopium, P. variable,* and others.

Along with these patulin produced by *P. claviforme, P. expansum, P. patulum;* by some aspergilli *(A. clavatus, A. terreus*), Penicillic acid produced by a large number of fungi, including many penicillia (*P. puberulum*) as well as members of the *A. ochraceus* group, sterignatocystin produced by *Aspergillus versicolor, A. nidulans, A. rugulosus* and others, fumonisins produced by *Fusarium* species such as *F. anthophilum, F. dlamini, F. napiforme, F. nygami, F. moniforme,* and *F. proliferation,* sambutoxin (*Fusarium sambucinum* and *F. oxysporum*) and zearalenone (*F. graminearum* and *F. tricinctum*) are of real serious concern in food intoxication.

6. What are the components of chemical poisoning in food?

Several pesticides are in use to manage pre and post harvest diseases associated with plants. Pesticides are also used as a preservative for long term seed storage and transport (to avoid biodeterioration by microorganisms). Among the unintended consequences of chemical pesticides for crop protection, it is the residue that remains on various crops leads to chemical poisoning. This, of course, is cause for concern as pesticides are by their very nature designed to kill pests. It is known to be associated with several ailments in human after consuming pesticides laced food. The amount of pesticide residues present on fruit and vegetables at harvest are creating a residual toxicity among the consumers. Risk assessment relating to pesticide residues in food has been tackled by the Codex Alimentarius with the special Joint FAO/WHO Expert Committee on Pesticide Residues (JMPR) made up of groups of independent experts. This commission carries out toxicological assessments on pesticides, estimating an ADI value, and proposing MRLs and models to be used to assess the population exposure.