University: Basrah
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Topic: Food safety and microbiological quality control
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Food Safety & Microbiological Quality Control

Food: Any substance that can be consumed to obtain energy and contains nutritional for all forms of a living creature to survive and reproduce on the planet earth.

Food Security: Food security is defined as "when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life". Thus food security not only assures a sufficient quantity of food but also the quality of food.

Food Safety: Food Safety defines as the "assurance that food is acceptable for human consumption according to its intended use".

Food Safety& Microbiology: The greatest challenge to food safety is microorganisms that account for more than 200 diseases caused by bacteria, viruses, protozoa, and fungi. Recent-time statistics have shown that nearly 420,000 people die every year due to foodborne illnesses. The case is even severe in children, especially those who are below 5 years, which alone counts for 40% of the total burden caused by foodborne diseases. Foodborne illnesses are primarily classified as food infection and food intoxication. While in the first case, live microorganism enters the body, multiplies and damages host tissue, the later can cause damage by the production of toxin in food, despite being absent in the body.

The Economics of Food Borne Diseases: The loss of productivity due to foodborne illness is estimated to 95.2 billion USD per year in the low and middle-income countries while the annual cost of treatment was estimated at 15 billion USD, as presented in the annual report of the World Bank in 2018.

Quality Management System: Quality Management System is a strategic direction improving the overall quality of food safety & hygiene in compliance with the regulatory standards. Thus the targets of QMS include the productions of 'zero risk food', otherwise known as 'safe food' for its customers.

Health Hazards Associated with Food: Three major hazards may contaminate food and lead to a breach of food safety; these are:

1. **Physical Hazard:** Presence of dirt, dust, metal, hair, etc. that contaminate food
2. **Chemical Hazard:** Presence of pesticides, heavy metals, and allergens, etc.
3. **Biological Hazard:** Presence of microorganisms (mainly)

Among the three, the first two (i.e. Physical and Chemical) hazards can be eliminated during the stages of raw material screening and processing. However, controlling microorganisms is difficult as food serves as nutritional supports for the organisms and helps them to grow. As a result, most of the food spoilages are also attributed to microbial spoilages.

Quality Control: The food produced in an industry must be safe and free of any of the hazards mentioned earlier. Quality Control (QC) is a part of the **Quality Management System** and it is a reactive process aiming to identify and rectify defects in food products, in terms of hazards. The QC team of the food and beverage industry has skilled microbiologists and chemists to perform the analyses of food products and adhering to the Quality Assurance (QA) parameters and the regulatory guidelines.

Roles of the Microbiologist: Microbiologists play vital roles in the food industry, especially in controlling the quality (QC) of food products. The job responsibilities of a Microbiologist include:

1. **Routine Quality Control:** Regular monitoring of the raw materials, process intermediates as well as the finished products in terms of microbiological quality.
2. **Risk Analysis, Assessment, Communication & Management:** Any substance, action, and method that increases the probability of adverse effects on the health of the consumers or leads to food hazards are termed as risk. The scientific process of analyzing risk using tools like Hazard Analysis and Critical Control Point (HACCP) followed by an assessment of the grade of risk with proper communication, to manage the process through scientific intervention, is one of the major job-roles of the microbiologists working in the food industry.

3. **Environmental Monitoring:** The safety of the food largely depends on the environment of food production and subsequent packaging. Therefore, a safe environment is a prerequisite to maintain the sterility of food products or at least a safe level for ensuring food safety. Environmental monitoring of the storage area, production area, instruments and packaging area, etc. are carried out to determine the microbial load, adhering to the policy and regulatory guidelines.
4. **Food Hygiene:** The roles of microbiologists also include the maintenance of all conditions and necessary measures to ensure the safety and suitability of food at all stages of the food production and supply; commonly referred to as food hygiene.
5. **Food Inspection & Surveillance:** Microbiologists are required to conduct routine examinations to confirm the regulatory compliance and adhere to the norms associated with food safety. This functionality is known as food inspection while continuous monitoring is termed as food surveillance.
6. **Quality Management System (QMS):** Microbiologists, as part of the entire management, are involved in designing the process and formulating the 'Quality Policy Document' to be followed. Routine monitoring of quality and survey based on HACCP are important job roles.
7. **Food Regulatory Compliance:** Microbiologists are involved in regulatory affairs in maintaining the safety of food, adhering to the regulatory guidelines.

Analytical Skill-Sets required for getting QC-Jobs include:

1. **Basic Microbiological Skills:** Media Preparation, Sterilization, Maintenance of Aseptic Condition, Strain Maintenance, Pure Culture Techniques, Staining Techniques, etc.
2. **Applied Microbiological Skills:** Environmental Monitoring, Isolation and Enumeration of Bacteria, Identification of Microorganisms.
3. **Analytical Instrumentation usage:** High-Performance Liquid Chromatography (HPLC), Gas Chromatography (GC), Atomic Adsorption Spectroscopy (AAS), Enzyme-Linked Immunosorbent Assay (ELISA), etc.
4. **Quality Management:** QMS, Food Audit, Regulatory Aspects, and Food Laws.

Regulatory Aspect of Food: Several food regulatory systems enforce Quality Assurance Plan for food safety. A few of them are:

1. Good Agricultural Practices (GAP)
2. Good Manufacturing Practices (GMP)
3. Good Hygienic Practices (GHP)
4. Good Laboratory Practices (GLP)
5. Hazard Analysis and Critical Control Point (HACCP)
6. International Standard Organization (ISO)