## QUALITY ASSURANCE

### Block 3

#### UNIT 8

**Introduction to Hygiene, Food Safety and Quality Assurance**

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#### UNIT 9

**Plant Sanitation and Meat Regulations**

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#### UNIT 10

**Carcass/Product Sanitation**

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In this block, you will learn about the ‘Quality assurance’, which is a holistic approach to ensure that good quality wholesome meat is produced from disease-free animals in such a manner that it remains free from any contamination during the different stages of processing, handling and storage, and poses no risk to human health.

The content of the block is detailed under following 3 units:

**Unit-8** will introduce you to different terminology related to food quality viz., hygiene, food safety and quality assurance. Generally, hygiene means cleanliness and our subject of concern is the food hygiene which is aimed at the clean and safe production, preparation, handling and presentation of food items. In this unit you will know about the role of hygiene in the production of clean and safe meat and also different steps involved in food safety. This unit deals with the importance of quality assurance in production, processing and distribution of meat and meat products. You will learn about different quality assurance practices which are applied at farm, meat plant, retail outlet and kitchen level for the production of safe meat and meat products.

**Unit-9** will help you to know how meat plant is cleaned and sanitized for the production of hygienic meat and meat products. To ensure the production of wholesome meat, good manufacturing practices, sanitation standard operating procedure and hazard analysis and critical control point etc. should be followed in a meat plant. You will be able to enrich your knowledge with these principles and procedures from this unit. Functions of different cleaning and sanitizing agents which are generally used for meat plants are discussed here. There are many rules, regulations and standards for meat and meat products which are applied at national, international and state level. In this unit, you will learn about these along with the regulatory agencies working at different level of meat production.

In **Unit-10**, you will learn about the sanitation of large and small animal carcass, chicken and eggs. Food spoilage may be caused by insect, physical injury, indigenous enzymes, chemical changes and microorganisms, particularly bacteria, yeasts and moulds. As you know that meat and eggs are ideal environment for the growth of microorganisms, spoilage can be minimized by several preservation techniques and by reducing the microbial load by proper sanitizing systems. You will know how different factors affect the microbiological quality of meat at different stages of production and handling. This unit deals with the different types of spoilages of meat and eggs and the different methods used for sanitization of large and small animal carcasses, egg and chicken.
UNIT 8 INTRODUCTION TO HYGIENE, FOOD SAFETY AND QUALITY ASSURANCE

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8.0 OBJECTIVES

After reading this unit, you will be able to:

- define hygiene, food safety and quality assurance;
- state the role of hygiene in production of clean and safe meat and meat products;
- list the steps to food safety related with meat and meat products;
- narrate the importance of quality assurance in production, processing and distribution of meat;
- describe different quality assurance practices at different level of production, processing and distribution viz., at farm, meat plant, retail outlet and kitchen level; and
- define hazard analysis and critical control point (HACCP).

8.1 INTRODUCTION

There are many opportunities for food to be contaminated between production and consumption. Food can be contaminated at farm, food-processing plants and during transport to food establishments. Finally, food can be contaminated during the last stages of production, at retail establishments, and by consumers in their homes. Even when food is purchased from inspected and approved sources, ingredients may be contaminated when they arrive at the food establishment. It is important to know, how to handle these ingredients safely and how to prepare food in such manner that reduces the risk of contaminated food being served. Food safety in retail food establishments begins with managers who are knowledgeable about food hazards and who are committed to implementing proper food handling practices in their facility. It continues with properly trained food workers who understands the essentials of food safety and sanitation and who will not take shortcuts when it comes to food safety. In this context, knowledge regarding food borne illness assumes great significance.
Quality assurance systems enable the application and verification of control measures intended to assure the quality and safety of food. They are required at each step in the food production chain to ensure safe food and to show compliance with regulatory and customer requirements. The systems are a set of controls implemented and verified by the responsible person(s) at each step in the chain (e.g., producers, farmers, fishermen, food processors, retailers, distributors, storage and transport personnel, etc.). Governments have an important role in providing policy guidance on the most appropriate quality assurance systems and verifying/auditing their implementation as a means of regulatory compliance. The selection and application of quality assurance systems can vary depending on the steps in the food production chain, size/capacity of the food business, type of product produced, etc. and may include Good Hygiene Practices (GHPs), Hazard Analysis and Critical Control Point (HACCP) systems and HACCP-based systems.

8.2 ROLE OF HYGIENE IN PRODUCTION OF ‘CLEAN AND SAFE’ MEAT

The term ‘Hygiene’ refers to the ‘cleanliness’ in general. Hygiene is one of the keys to reduce the levels of disease transmission in a production facility and beyond as it is the science dealing with the preservation of health through the practice or principles of cleanliness. When hygienic measures are applied to achieve the ‘clean’ production, preparation, handling and presentation of food item(s), it is known as ‘Food Hygiene’. It is a continuous process of maintaining hygiene throughout the ‘food-chain’ right from the starting point i.e., raising of healthy and disease-free livestock or poultry at production site i.e., farm, up to the last point of food consumption by the consumers. In other words, the term ‘Food Hygiene’ refers to the methods employed for production, preparation, and presentation of food that is ‘safe’ for consumption and of ‘good keeping quality’. It covers not only the proper handling of every variety of food stuff and drink, and all the utensils and apparatus used in their preparation, service, and consumption, but also the care and treatment of foods known to be contaminated with food-poisoning bacteria which have originated from the animal host supplying the food. Therefore, it becomes clear that the ‘clean food’ should be regarded as a prerequisite for the production of ‘safe food’.

A well-planned, well-executed and controlled cleaning and sanitation programme for rooms, machines and equipment is very important to achieve a hygienic standard. However, cleaning and sanitation alone will not assure a hygienic standard in production where process hygiene as well as personal hygiene are important factors.

It is impossible to give an adequate definition of process hygiene because the critical points affecting the level of hygiene in a process will vary, depending on several factors. These factors include:

- The type of processing
- Processing buildings (site, size, buildings)
- Equipment available
- Permanent or non-permanent personnel (working routines, training)
- Climatic conditions
- Sanitary facilities,
- Water and energy supplies and
- Liquid and solid waste disposal.
Nevertheless, better cleaning standard during processing of meat can be achieved by observing well-planned working routines. For example, cleaning during processing, removal of solid waste and sufficient space in processing rooms are factors which facilitate cleaning.

Despite the good product- and process-hygiene, deterioration in the cleaning standard may occur if microorganisms are transmitted to well-cleaned surfaces from unwashed hands before processing starts. Therefore, adequate personal hygiene of human workers and visitors assures the overall cleaning process, and it remains an important component in the control of pathogen introduction and transmission.

However, it must be borne in mind that neither the process hygiene, personal hygiene nor the cleaning and sanitation alone can assure a sufficient hygienic standard but together, if carried out in an optimal manner, they will guarantee a complete hygienic standard (Fig. 8.1).

8.3 FOOD SAFETY

There has been a lot of recent concern about the safety of the food we eat and for good reason. Nothing seems to be immune from the problem: red meats, chicken, eggs, milk and their products. What’s worse, nobody seems to have a convincing answer to solve the problems. That is because everyone is trying to work within the system. The problem is not the food, it is the system — the methods we use to raise, process, transport, and store our food. There is nothing new about the food-borne diseases but they are appearing in increasing numbers, the bad animal health as the main problems in the meat industry.

Industrialization of animal production such as for pigs and poultry will produce factors that may increase the risk of new diseases outbreaks. Increased risks includes changes in the ecology of the animal, housing environment, increasing population (stocking) density, and demographic factors such as: close proximity to human populations (urban spread) and/or wildlife, habitat, introduction of animals from other geographical regions, a greater opportunity for evolution of viral and microbial variants, and drug resistance. Therefore, good hygienic practices must be followed throughout the production process, just as a chef works in a hygienic way from the beginning to the end and does not only rely on cooking to make the food safe. Moreover, it is desired that handling information such as “Keep Refrigerated” and “Use-By” dates on labels are observed and put to practice. In view of above facts, it is important for the public health and the long-term security of the animal production industry that farmers and food processors take every practical step to deliver pathogen-free meat to the consumers.

Following simple steps can be followed for food safety:

Cleaning: Wash hands and surfaces often.
Quality Assurance

- Wash your cutting boards, dishes, utensils and counter tops with hot soapy water after preparing each food item and before you go on to the next food.
- Use plastic or other non-porous cutting boards.
- Consider using paper towels to clean up kitchen surfaces

Separation:
- Don’t cross-contaminate i.e., don’t touch the finished/cooked meat after handling the raw material, as it would transfer the pathogen to the cooked meat.
- This is especially true when handling raw meat, poultry, and seafood.
- Never place cooked food on a plate that previously held raw meat, poultry, or seafood.

Cooking:
- Cook to proper temperatures
  - Use a clean thermometer that measures the internal temperatures of cooked foods to make sure meat, poultry, casseroles, and other foods are cooked all the way through.
  - Cook roasts and steaks to at least 63°C (145°F). Whole poultry should be cooked to 82°C (180°F) for doneness.
  - Cook ground beef, where bacteria can spread during processing, to at least 72°C (160°F).
  - Don’t use recipes in which eggs remain or used as raw or only partially cooked.

Chilling:
- Refrigerate promptly
  - Refrigerate or freeze perishables, prepared foods and leftovers within two hours or sooner.
  - Avoid defrost food at room temperatures. Thaw food in the refrigerator, under cold running water or in the microwave. Marinate foods in the refrigerator.
  - Divide large amounts of leftovers into small, shallow containers for quick cooling in the refrigerator.

Check Your Progress 1

1) What do you understand by hygiene? What is its role in clean meat production?

2) Enumerate the factors that may affect the efficacy of process hygiene in a meat plant.
3) What should be the temperature of cooking poultry and ground beef for safe food production?

8.4 QUALITY ASSURANCE IN MEAT AND MEAT PRODUCTS

In our day-to-day life, we frequently use and listen to the term ‘Quality’ for indicating the attributes of a branded or standard product. The ‘Quality’ refers to a combination of characteristics that enhance the acceptability of a product. In fact, the ‘Quality’ is a broad term, which relates to the chemical, physical, technological, bacteriological and aesthetic characteristics of products. Accordingly, the ‘Quality Control’ of foods including meat and meat products is related to the testing of the finished products, or say, ‘End product analysis’ for the desired properties or traits. On other hand, the ‘Quality Assurance’ is related with the activity or procedure (method or programme) that ensures the maintenance and continuity of the specifications and standards of the products within the prescribed tolerance limits during all stages of handling, processing, preparation, packaging, presentation, storage and distribution. It also further ensures that all the original and desirable characteristics are retained during these operations and remain unaltered until the product reaches the consumer. Therefore, quality assurance is a continuous monitoring of a food chain especially at the critical points for ensuring the food safety. Now, let us discuss about the differences in the approaches of quality control and quality assurance in more detail.

Quality control is the evaluation of a final product prior to its marketing, i.e., it is based on quality checks at the end of a production chain aiming at assigning the final product to quality categories such as “high quality”, “regular quality”, “low quality” and “non-marketable”. Since, at the end of the production chain, there is no way to correct production failures or upgrade the quality of the final product, the low-quality products can only be sold at lower prices and the non-marketable products have to be discarded. Their production costs, however, had been as high as those of the high and regular quality products. Thus, quality control has only a limited potential to increase the quality and efficiency of a multi-step production procedure.

Quality Assurance (QA), in contrast to quality control, is the implementation of quality checks and procedures to immediately correct any failure and mistake that is able to reduce the quality of the interim products at every production step. Thus, the desired high quality of the final product is planned and obtained by quality assurance.

Standard Operating Procedures (SOPs) guarantee the desired quality of the interim products at every production step. If an entire production chain is following a written description (handbook) of all SOPs along the entire production chain, the demands for a Good Manufacturing Practice (GMP) are met. The management approach to long-term success through customer satisfaction, based on the participation of all members of an organization (suppliers included) in improving processes, products, services and the working culture is called ‘Total Quality Management (TQM)’.

8.4.1 Quality Assurance in Production, Processing and Distribution of Meats

Majority of the increased concerns with the safety and quality of meat apply to the animal farm i.e., the pre-harvest area of the food production chain. Furthermore, it is
true that the food safety measures taken in the harvest area (abattoir) such as inspection and removing carcasses unfit for human consumption from the food chain, are assuring the consumer’s protection based on the quality control through microbiological analysis of the meat at the end of slaughter i.e., end product analysis. Initially, this approach of quality control was used to cope with increasing quality standards. However, it neither takes into account the disease status of livestock at farm or the measures taken for it, the hygienic and stress-reducing measures taken during animal transport, nor it prevents the major safety-related defects in the slaughtering. The growing need to address these problems has led to the development of quality assurance systems along with production, processing and distribution chain of meat and meat products, with an ultimate aim to produce and sell ‘high quality products’ in increasing numbers.

The difference between the two approaches of meat safety i.e., quality control and quality assurance can be better appreciated by following examples.

- The testing of carcasses for residues is quality control, the implementation of residue avoiding production procedures at farm level is quality assurance;
- The testing of meat products for salmonella prior to their marketing and consumption is quality control the implementation of on- and off-farm salmonella-reducing measures as standard operating procedures is quality assurance.

Quality assurance is a system of self-regulation, which has been incorporated by successful industries and companies worldwide, particularly over the last 25 years. It is well established in food processing industries including dairy products, fish and poultry, and this includes export industries working towards world trade on recognized international standards. QA is based on the principle of building quality and safety into the production process itself rather than imposing “quality control” through detection of defective product after processing operations. Quality assurance has great potential benefits in all operations and is not limited to the regulatory hygiene control system - a QA program can be put in place to control the whole operation. Preliminary data indicates that the microbiological hygiene standard of meat produced under externally audited quality assurance is at least equivalent to, and may be better than, that of meat produced under traditional “inspection” systems.

### 8.4.2 Components of Quality Assurance in Meats

Meat is a potential vehicle for the transmission of disease producing organisms derived from the infected animals and handlers unless precautions are taken to protect it from contamination. Meat hygiene must be ensured during transportation, in collecting centers, in the abattoirs, and as far as the consumers’ home. In short, meat hygiene practices should encompass all activities from the “farm to the table”. Therefore, an efficient meat hygiene programme begins at the farm itself. It immensely helps in determining the suitability of animals for slaughter than a brief preslaughter inspection at the abattoir. This is especially true with regard to invisible meat safety hazards such as chemical residues and certain microbial pathogens.

(1) **Quality assurance practices at farm**

The quality assurance concept of safe meat production starts with the raising of disease-free livestock at farm. Pathogens on animal farm can be acquired and maintained by infected animals, contaminated feed, water, vehicles and equipment. The use of good husbandry practices at the farm will help to reduce the chances that animals arriving at the slaughter plant are contaminated with pathogens. General approaches, such as pathogen-free feeds, regular cleaning and disinfection of equipment and barns, biosecurity controls, and training and hygienic conduct of employees etc. will contribute in reducing the level of contamination of the animal leaving the farm.

Modern livestock farm practices are more intensive and slaughter of animals at an early age reduces the opportunities of exposure to microbiological and parasitic agents.
However, raising animals intensively may favour the occurrence of subclinical infections, including those of zoonotic (communicable from animals to man and vice-versa) in nature, which are of immense importance in meat hygiene. Therefore, care must be taken to have excellent management practices for raising disease-free livestock through colostrum feeding, use of probiotics, balanced wholesome diet and vaccines rather than relying heavily on use of antibiotics, which may lead to residues in meat and milk. These natural and eco-friendly approaches practices are being developed as a package under ‘organic animal husbandary practices’.

These important managerial practices are discussed below:

(a) **Scientific housing of animals**: It is an essential activity of all modern animal welfare programmes for obtaining maximum productivity from livestock and birds. It aims to provide good housing conditions for protecting the animals and birds from hostile environment, making nutritious food and wholesome water available, providing them comfortable resting space and protecting them from acquiring disease by safe disposal of excreta and wastes. The general layout for animal housing differs with the age and species of livestock and birds, as well as the purpose for which these are reared. i.e., for meat, milk or wool purpose.

(b) **Adequate potable water**: It is required for drinking and washing of animals, cleaning of floors and utensils at animal farms. The location of farmstead is selected giving due consideration to the supply of potable water, adequate sun exposure and efficient drainage. Other factors like uninterrupted power supply, topography and road, transport and market facilities also contribute to the selection of site. The aspects of drainage in animal houses must receive utmost attention.

(c) **Feeding**: There is always a considerable potential of pathogen transfer to animals through feed on farm. Therefore, the use of feed that are free from pathogens will help in reducing the risk of contamination of the animals. Something in the order of 5 to 20% of livestock feeds are estimated to contain detectable *Salmonella* contamination mainly through urine and faeces of lizards and rats.

(d) **Vaccination**: This has remained the most successful approach world over for protecting the animals from disease causing pathogens. This has been used with great success recently by the UK poultry meat and egg industries for controlling *S. Enteritidis* cases seen in England and Wales since 1997.

e) **Antibiotics**: These medicines have been widely used in the livestock and poultry industries for efficient production of animal products such as milk, meat and eggs. At sub-therapeutic levels in diets, antibiotics improve growth rate and efficiency of feed utilization, reduce mortality and morbidity and improve reproductive performance. At high levels (prophylaxis and therapeutic) antibiotics help to prevent disease in exposed animals and to treat diseases. Antibiotics used in animals also improve the safety of food as healthy animals result in a safer food supply through the reduction and elimination of certain pathogens. However, the aimless use of antibiotics, especially for a shorter period than the prescribed may lead to antibiotic resistance in pathogens excreted by the animals, while their use for extended periods than the required time leaves residues in meat and milk products.

(f) **Probiotics**: These substances are the opposite of antibiotics. While antibiotics destroy life, probiotics build up or promote life. The function of a probiotic is to improve the growth and development of the normal, desirable microbial population in the gut, allowing them to maintain domination over the undesirable organisms. The culture of probiotic microorganisms or their fermentation product (bacteriocins) or, extracts of some plants can be used as probiotics. Probiotic microorganisms, including lactic acid bacteria (LAB) such as *Lactobacillus* and *Enterococcus* spp. are commonly used as live microbial feed supplements for overall improvement in health and productivity of all livestock by strengthening helpful microbial populations and suppressing human
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Pathogens, such as *Listeria monocytogenes*, *Staphylococcus* spp. and *Clostridium* spp. In this way, probiotics work just like antibiotics, but have no side effects. In fact, they counteract ill effects of antibiotic treatment by restoring the microbial balance in the gut, thereby, get the livestock quickly on to feed and assist in treatment of off feed/sick animals, especially in cases of pneumonia, diarrhoea, shipping fever. Probiotics can be easily incorporated into the grain ration in the form of a solution or top-dressing and require no refrigeration for storage. Therefore, the probiotics have the potential to be used as an alternative strategy to control contamination of animals at the farm.

(g) **Biosecurity:** The broad meaning of biosecurity literally means the “security from transmission of infectious diseases, parasites and pests”. It aims to protect animals from contact with potential pathogens by following approaches:

- Keeping out other animals, vehicles and people entering the production area.
- Strict compliance of specific hygienic protocols for staff, visitors and, vehicles and their drivers delivering feed or loading finished livestock for slaughter,
- Use of a quarantine facility for isolation and acclimatization for incoming animals.

Biosecurity is most easily achieved where animals are housed throughout their lifetime and more difficult to maintain where animals are on pasture. However, every precaution should be taken to ensure maximum biosecurity to eliminate the risk of introducing disease. In a low-cost system of biosecurity system adopted in Scandinavia by dipping of boots (a common carrier of pathogen) in disinfectant allowed broiler flocks to remain *Campylobacter*-free until slaughter. Strict biosecurity has also been demonstrated in Scandinavia to protect pig herds from *Salmonella* infection.

(h) **Quarantine facility:** Temporary separation of sick and newly purchased animals in quarantine unit allows efficient hygiene and some control over a specific breakdown as affected groups are isolated and can be treated or eliminated as appropriate. It also eliminates the problems associated with mixing of animals from different age groups.

(i) **Animal waste treatment systems:** The survival of pathogens in animal waste may present serious problems of environmental pollution and public health if the waste is discharged into rivers, streams or spread over agricultural land. Pathogens may be amplified in one livestock raising system and then infect another species when manure is mixed with feed. Animal health may be adversely affected if recycled waste-water is re-used in washing animal housing, for further flushing of effluent or for irrigation of pastures or food crops.

(2) **Quality assurance practices in meat plant**

Meat inspection at abattoir involves ante-mortem and post-mortem inspections, and where necessary, laboratory investigations. The traditional, labour intensive, organoleptic inspection procedures employed for detecting macroscopic abnormalities contribute far less to the safety and wholesomeness of the product than the practices of general processing hygiene and laboratory surveillance for microbial and chemical contaminants.

(a) **Risk analysis for meat production and processing:** In modern meat production systems, where the safety of the produced food has the ultimate priority in the framework of quality, meat inspection should ideally be based on the analysis of risk, which essentially involves the identification of risk factors so that these are avoided, reduced or appropriately managed. One widely accepted method of risk analysis for meat production and processing is the Hazard Analysis Critical Control Point (HACCP), which has been recommended by the World Health Organization (WHO) since 1985. HACCP combines common sense with an evaluation of risks to identify the points along the food production chain, where possible hazards (contamination) may occur, and then to strictly manage and monitor these points to make sure the process is under control. In a risk assessed meat inspection programme, where the origin and health
status of slaughtered livestock are known, high-risk groups of livestock receive additional veterinary attention in the abattoir.

(b) Hazard Analysis Critical Control Point (HACCP): The HACCP system aims to prevent the entry of a pathogen in a food chain to avoid food safety problems. Therefore, it has become the internationally recognised system to assure safe food production. Now, let us understand the HACCP system.

The HACCP system is made up of seven parts. Here only three steps are mentioned, rest will be dealt in next unit.

(i) The identification of hazards, and the determination of the severity of the hazard and risks. These are risks associated with growing, harvesting, processing, distributing, preparing and/or using a raw material or food product. Hazard usually means the contamination, growth or survival of microorganisms related to food safety or spoilage. A hazard can also include dangerous chemical contaminants or foreign objects (glass or metal fragments). Risk is the estimate of how likely it is that the hazard will occur.

(ii) The determination of critical control points (CCP) required to control the hazard. A critical control point is a location, practice, procedure or process which can be used to minimize or prevent unacceptable contamination, survival or growth of food-borne pathogens or spoilage organisms, or introduction of unwanted chemicals or foreign objects.

(iii) Establishment and implementation of monitoring procedures to determine that each CCP is under control. Monitoring systems must be able to effectively determine if a CCP is under control. Corrective action must be defined to be used when a CCP monitoring point shows that the system is out of control.

All this means that the traditional mandatory meat inspection and the classical post-harvest food safety measures have a limited potential for further major improvements of the safety and quality of meat. Therefore, following additional measures must be taken.

- Pre-harvest food safety programs implementing the rules of GMP and the HACCP concept at farm level (from breeding to the slaughterhouse gate) have to be added to the existing harvest (in abattoir) and post-harvest (after abattoir) HACCP programs. In another words, quality assurance systems are essential throughout the entire food chain.

- There are different areas (CCP) in which the pathogen enters a food production chain. Incidentally, the possibilities to reduce the risks by proper handling and/or cooking before consumption are also different. For example, in the case of residues, measures taken on- and off-farm to avoid residues in meat of animals is the only opportunity of prevention, since there is no pre-consumption procedure that reduces the residue-associated risks to human health. On the other hand, proper handling and freezing and/or cooking of the final product reduce the risks due to pathogens. Nevertheless, the pre-harvest risk-reduction programs can either prevent the contamination of the carcass (*Trichinella* and *Toxoplasma*) or remarkably contribute to minimizing the pathogen-associated risks (*Salmonella*, *Campylobacter*, *Yersinia*, *Listeria*).

(3) Quality assurance practices in retail outlets

Despite the production from disease-free animals and processing under most satisfactory hygienic conditions, the meat may be contaminated during its subsequent transport and storage in retail outlets, unless following necessary precautions are taken —

- Avoid the use of improper, inadequate or dirty packaging material including soiled cloths.
Quality Assurance

- Use one cutting board for raw meat, poultry, and fish, and another board for everything else.
- Wash work surfaces; cutting boards, utensils and hands after touching raw meat or poultry.
- Protect the meat from insects, flies, rodents and dust.
- Avoid handling of meat with dirty hands and under unhygienic conditions.
- Store raw meat in frozen conditions and maintain proper storage temperature.
- Avoid adulteration of meat.
- Avoid malicious practices used for better presentation of meat including bloom.

(4) Quality assurance practices at kitchen level

Food handling and preparation by consumers in kitchen are the final critical control points in the food safety process. Even though the kitchen might look clean, your hands, the countertops, and the utensils you use could still contain many bacteria that you can’t even see. Consumers should always follow safe food handling instructions to reduce the risk of foodborne illness, which include:

- Keeping fresh meat in refrigerator or freezer.
- Keeping raw meats and their juices away from other foods in the refrigerator and on countertops.
- Thawing frozen meat in the refrigerator or by using running cold water or in microwave.
- Keeping raw meat and poultry separate from other foods.
- Washing work surfaces; cutting boards, utensils and hands after touching raw meat or poultry.
- Cooking ground beef thoroughly to an internal temperature of 72° C or 160° F. Whole muscle cuts such as steaks or roasts can be cooked to 63°C or 145°F (medium rare), 72° C or 160°F (medium), 77°C or 170°F (well done). Use a meat thermometer to confirm that meat is cooked thoroughly.
- Keeping foods hot before serving and refrigerating leftovers immediately.
- Washing of hands with hot water and soap before preparing any food.
- Washing of hands after handling raw meat, poultry and fish.
- Never put cooked food on a dish that was holding raw meat, poultry, or fish.
- If you use knives and other utensils on raw meat, poultry, or fish, you need to wash them before using them to cut or handle something else. This is necessary to prevent cross-contamination. An example of this is chopping tomatoes on an unwashed cutting board just after cutting raw meat on it.
- If you touch raw meat, poultry, or fish, wash your hands. Don't wipe them on a dish towel- this can contaminate the towel with bacteria, which may be spread to someone else’s hands.
- Use one cutting board for raw meat, poultry, and fish, and another board for everything else.
- When you are preparing food, it is a good idea to wipe down the countertops with a commercial cleaning product. Don’t forget to wash the cutting board in hot, soapy water and then disinfect it with a commercial cleaning product. You can also mix
together 1 teaspoon (5 milliliters) chlorine bleach and 1 quart (about 1 liter) of water and store the solution in a spray bottle.

(5) Use of epidemiological methods for quality assurance

Application of epidemiological methods involving data collection, collation and analysis into the routine work of veterinary practitioners can help immensely in strengthening meat hygiene practices. There is an urgent need of an information feedback system to have the management tools at hand that can relate data from the slaughter plant (disease-related lesions, slaughter deficiencies and monitoring results) to on-farm data on animal health and residues (mortality, morbidity, pathogens, and drug use). The food-animal practitioner can play an important role in guiding animal production to make it a transparent and high-quality programme by use of epidemiology.

Follow these simple rules to control the quality and safety of your food:

- Identify all steps in your activities which are critical to food safety.
- Put adequate safety controls in place.
- Adequately train all staff in food hygiene.
- Wash hands thoroughly before handling food, and again between handling raw and cooked foods, and after visiting the toilet.
- Clean all equipment, utensils and preparation surfaces thoroughly.
- Keep cooked and raw foods separate during preparation and storage.
- Wash salads thoroughly.
- Use food within its use-by-date and promptly use foods you have already prepared.
- Keep food covered.
- Never use raw eggs in food which is not going to be cooked e.g., mayonnaise.
- Keep animals out of food preparation areas.
- Use a thermometer to monitor temperatures and disinfect the temperature probe each time that it is used.
- Cook food thoroughly (centre temperature more than 70°C for 2 minutes) and serve. If hot, keep the food above 63°C.
- Reheat food to at least 75°C, only reheat food once.
- Ensure any food requiring refrigeration is kept below 8°C and not left out for long periods.
- When preparing food in advance, ensure it is cooked thoroughly, cooled rapidly and stored in the fridge.
- Avoid using left-over food.

Check Your Progress 2

1) What managerial practices are needed at farm for the production of healthy and pathogen free livestock?

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2) What is the basic difference between quality control and quality assurance?

3) What do you mean by probiotic?

4) Fill in the blanks

i) The science of health called…………… is one of the keys to reducing the levels of disease transmission in a production facility and beyond.

ii) The ………….system aims to prevent the entry of a pathogen in a food chain to avoid food safety problems.

iii) The probiotic microorganisms namely ………..and ……….spp. are commonly used as live microbial feed supplements.

iv) The term…………… literally means the “security from transmission of infectious diseases, parasites and pests”.

v) Temporary separation of sick and newly purchased animals in ……………….unit allows efficient hygienic practices.

vi) The most widely accepted method of risk analysis for meat production and processing is …………..which has been recommended by the World Health Organization since 1985.

vii) The term. ………………refers to the methods employed for production, preparation, and presentation of food that is ‘safe’ for consumption and of ‘good keeping quality’.

viii) The testing of carcasses for residues is an approach called…………….., while the implementation of residue reducing production procedures at farm level refers to the approach called……………..

5) Write True or False

i) Quality assurance is a continuous monitoring of a food chain, especially at the critical points for ensuring the food safety.

ii) The ground beef should be cooked thoroughly to an internal temperature of 55º C for safe food.

iii) The determination of critical control points (CCP) is required to control the hazard.

iv) Meat inspection at abattoir is focused on post-mortem inspection only.

v) Food handling and preparation by consumers in kitchen are the final critical control points in the food safety process.

vi) Use of a quarantine facility for isolation and acclimatization of incoming animals is necessary.
vii) Pathogens on animal farm can be acquired and maintained by infected animals, contaminated feed, water, vehicles, and equipment.

viii) Meat is a potential vehicle for the transmission of disease producing organisms.

ix) Quality assurance has great potential benefits in all operations and is not limited to the regulatory hygiene control system.

x) Cleaning and sanitation programme have very little impact on hygienic standard.

8.5 LET US SUM UP

There are many opportunities for food to be contaminated between production and consumption. Food can be contaminated at farm, food-processing plants and during transport to the food establishments. Finally, food can be contaminated during the last stages of production, at retail establishments, and by consumers in their homes. Meat hygiene must be ensured during transportation, in collecting centers, and the abattoirs, and as far as the consumers’ home. These hygienic practices should encompass all activities from the “farm to the table”. The pathogen-free feeds, regular cleaning and disinfection of equipment and barns, biosecurity controls, and training and hygienic conduct of employees reduce the level of contamination of the animal. The important managerial practices at farm to reduce the level of contamination and to produce healthy animals for slaughter include scientific housing of animals, adequate potable water, feeding, vaccination, antibiotics, probiotics, biosecurity, quarantine facility and animal waste treatment systems.

Quality assurance is a continuous monitoring of a food chain, especially at the critical points for ensuring the food safety. Quality assurance systems enable the application and verification of control measures intended to assure the quality and safety of food. Hygiene deals with the reduction of the levels of disease transmission in a production facility and maintains health through the practice or principles of cleanliness. The desired high quality of the final product is planned and obtained by conducting the Standard Operating Procedures (SOPs) and Good Manufacturing Practice (GMP). Quality assurance practices at farm level, meat plant, in retail outlets and at kitchen level are needed for ensuring the production of safe and high quality meat. The HACCP system aims to prevent the entry of a pathogen in a food chain to avoid food safety problems.

In addition to the above approaches, application of epidemiological methods can help in strengthening meat hygiene practices. These methods help analyzing the available information in order to identify the factors that caused food safety problems so that necessary preventive and control measures may be taken to prevent its recurrence.

8.6 KEY WORDS

**Barn**: A barn is an agricultural building used for storage and as a covered workplace. It may sometimes be used to house animals or to store farming vehicles and equipment.

**Biosecurity**: This is a comprehensive approach of providing the security from transmission of infectious diseases, parasites and pests at farm.

**Food Hygiene**: It refers to the methods employed for production, preparation and presentation of food that is ‘safe’ for consumption and of ‘good keeping quality’.
Quality Assurance

Hygiene: Hygiene refers to the ‘cleanliness’. Hygiene helps in reducing the levels of disease transmission in a production facility and beyond, as it is the science dealing with the preservation of health through the practice or principles of cleanliness.

HACCP: Hazard Analysis Critical Control Point (HACCP) system aims to prevent the entry of a pathogen by exerting the control at critical points in a food chain in order to avoid food safety problems.

Probiotics: These are dietary supplements containing potentially beneficial bacteria or yeast and used to assist the body’s naturally occurring gut flora to reestablish themselves.

Prophylaxis: It is any medical or public health procedure whose purpose is to prevent, rather than treat or cure, disease.

Therapeutic: Treatment and care of a patient for the purpose of both preventing and combating disease or alleviating pain or injury.

Top Dressing: Application of feed additives on the surface of feed.

Quality: The ‘Quality’ refers to a combination of characteristics that enhance the acceptability of a product. It relates to the chemical, physical, technological, bacteriological and aesthetic characteristics of products.

Quality Control: It is the evaluation of a final product prior to its marketing, i.e., it is based on quality checks at the end of a production chain aiming at assigning the final product to quality categories such as “high quality”, “regular quality”, “low quality” and “non-marketable”.

Quarantine: It is the temporary separation of sick and newly purchased animals in an isolated unit. This helps to control a specific breakdown as affected groups are isolated and can be treated or eliminated as appropriate.

Quality Assurance: It is a continuous monitoring of a food chain especially at the critical points for ensuring the food safety. It is the implementation of quality checks and procedures to immediately correct any failure and mistake that is able to reduce the quality of the interim products at every production step.

TQM: Total Quality Management (TQM) is the approach to long-term success through customer satisfaction, based on the participation of all members of an organization (suppliers included) in improving processes, products, services and the working culture.

8.7 SOME USEFUL BOOKS

Betty C. Hobbs and Diane Roberts. Food Poisoning and Food Hygiene, 5th edition. ??publisher’s name

8.8 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress 1

1) Hygiene related with meat production is meat hygiene which ensures production of safe and clean meat through application of product hygiene, process hygiene and personal hygiene. The hygienic methods are employed for production, preparation, and presentation of meat that is ‘safe’ for consumption and of ‘good keeping quality’. Proper cleaning and sanitation programme leads to clean rooms, machines and equipment of hygienic standard. Adequate personal hygiene of human workers and visitors assures the overall cleaning process and it helps in the control of pathogen introduction and transmission. Along with these the maintenance of hygienic standard during processing (process hygiene) also plays great role in clean meat production.

2) The factors that may affect the efficacy of process hygiene in a meat plant are as follows:
   - The type of processing
   - Processing buildings (site, size, buildings)
   - Equipment available
   - Permanent or non-permanent personnel (working routines, training)
   - Climatic conditions
   - Sanitary facilities
   - Water and energy supplies and
   - Liquid and solid waste disposal.

3) For safe food production, poultry should be cooked to 82°C and ground beef should be cooked to at least 72°C.

Check Your Progress 2

1) For the production of healthy and pathogen free livestock, following managerial practices are needed at farm:
   - Scientific housing of animals
   - Supply of adequate potable water
   - Feeding of pathogen free feed
   - Vaccination
   - Use of antibiotics
   - Use of Probiotics
   - Biosecurity
2) The basic difference between quality control and quality assurance is that the quality control is the evaluation of a final product prior to its marketing, i.e., quality checks at the end of a production chain and there is no way to correct production failures or upgrade the quality of the final product, whereas quality assurance is the implementation of quality checks and procedures to immediately correct any failure and mistake that is able to reduce the quality of the interim products at every production step. Thus, the desired high quality of the final product is planned and obtained by conducting quality assurance.

3) Probiotics are the substances which build up or promote life by improving the growth and development of the normal, desirable microbial population in the gut, allowing them to maintain domination over the undesirable organisms. They counteract ill effects of antibiotic treatment by restoring the microbial balance in the gut. The culture of probiotic microorganisms or their fermentation product or, extracts of some plants can be used as probiotics. For example: Lactic acid bacteria.

4) i) Hygiene; ii) HACCP; iii) *Lactobacillus* and *Enterococcus*; iv) Biosecurity; v) Quarantine vi) Hazard Analysis Critical Control Point; vii) Food Hygiene; viii) Quality control; Quality assurance.

5) i) T; ii) F; iii) T; iv) F; v) T; vi) T; vii) T; viii) T; ix) T; x) F;
1. Food safety and hygiene

1.1 Introduction

1.2 Lifting and transportation of food grains

1.3 Procurement of oil, pulses and condiments

1.4 Procurement of perishable raw materials

1.5 Storage of raw materials

1.6 Food safety measures during preparation

1.6.2 Food safety measures during cooking

1.7 Tasting of mid-day meal

1.8 Testing of mid-day meal

1.9 Cleaning of cooking areas

1.10 Cleaning of utensils, equipments and other materials

1.11 Personal hygiene, cleanliness and health checkups of cook cum helpers

1.12 Pest control

Quality assurance of mid-day meal and food safety should be an integral part of food handling procedures at the school kitchen. Food safety - assurance that food will not cause harm to the consumer when it is prepared and/or eaten according to its intended use. Food suitability - assurance that food is acceptable for human consumption according to its intended use. Primary production - those steps in the food chain up to and including, for example, harvesting, slaughter, milking, fishing.

Section III - primary production

Potable water should be as specified in the latest edition of WHO Guidelines for Drinking Water Quality, or water of a higher standard. Non-potable water (for use in, for example, fire control, steam production, refrigeration and other similar purposes where it would not contaminate food), shall have a separate system.

Program description - September 2021. The Food Safety and Quality Assurance - Food Processing program is a two-semester, full-time graduate certificate program designed for students having a previous degree or advanced diploma in science, food or engineering, and who want to be prepared for a career in the food processing industry in the area of food safety and quality assurance. The program offers a suite of courses designed to enhance skills and knowledge gained in previous education stages for direct applicability in the food processing environment with respect to food safety and quality...