
UNIT 13 MEAT BORNE DISEASES AND ZONOOSES

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13.0 OBJECTIVES

After reading this unit, you will be able to:

- define zoonosis;
- describe the transmission of zoonotic diseases;
- classify meat borne diseases; and
- enlist preventive measures to be taken to control meat borne diseases.

13.1 INTRODUCTION

There are some diseases which are transmitted to human beings through the consumption or handling of meat. These are called as meat borne diseases. Some of these diseases are naturally transmitted between vertebrate animals and man and these are called as zoonotic diseases. These include bacterial, viral, mycotic, and parasitic zoonotic diseases. The number of zoonotic diseases is increasing day by day. The human infiltration into the natural habitat of wild animals is one of the reasons behind this gradual increase in number of zoonotic diseases. Workers in slaughter houses, byproduct utilization plant and veterinary doctors have more risk in acquiring zoonotic diseases. You have already studied that diseased animals may enter into meat chain due to improper ante-mortem and post-mortem inspection. Beside this, contamination and mishandling of meat and meat products at various stages of production due to lack of hygienic practices are the major causes of meat borne diseases.

13.2 ZONOTIC DISEASES

The word 'zoonoses' is derived from greek words – 'zoon' (animal) and 'noses' (diseases). Zoonoses refer to diseases that can be passed between human and animal, whether wild or domesticated. Zoonoses may be acquired through–

- Direct contact with diseased animals/infected material
- Consumption of contaminated meat, water, and milk etc.
- Inhalation of infectious organisms
- Vectors
- Accidental inoculation of pathogen through breach on skin.

The Zoonoses through meat are transmitted by two main modes:

- (i) During the transportation, slaughtering, dehiding, skinning, dressing and processing of the animals and meat, infective agents are transferred from animals/meat, meat products and the equipment and instruments used in the meat production to man.
- (ii) Through the consumption of meat and meat products intoxicated or infected. The animal themselves are the reservoir of food poisoning organism e.g., anthrax, brucellosis, tuberculosis etc. Salmonellosis occurs because of the consumption of poultry meat. *Campylobacter jejuni* has also been found in poultry meat causing food poisoning.

Some of the zoonotic diseases prevalent in India are:

- | | |
|----------------------------------|---------------------------|
| 1. Rabies | 2. Japanese Encephalitis |
| 3. Kyasanur Forest Disease (KFD) | 4. Influenza |
| 5. Salmonellosis | 6. Brucellosis |
| 7. Anthrax | 8. Taeniasis |
| 9. Echinococcus/ Hydatidosis | 10. Guinea worm infection |
| 11. Tuberculosis | 12. Leishmaniasis |
| 13. Borreliasis | 14. Toxoplasmosis |
| 15. Weil's disease | 16. Indian Typhus |
| 17. Q-fever | 18. Haemorrhagic fever |
| 19. Tetanus | |

These all are not meat borne diseases.

It is not possible to narrate all zoonotic disease in this unit. However, some of the important zoonotic diseases that have their link to meat animals or meat have been briefly described. There are a number of diseases which can be broadly classified under following:

- 1) Bacterial disease
- 2) Viral disease

- 3) Parasitic disease
- 4) Fungal disease and Rickettsial disease.
- 5) Disease of other origin.

13.3 MEAT BORNE DISEASES

Meat borne diseases can be classified broadly under following heads:

- 1) Chemical mediated meat borne diseases
- 2) Meat borne zoonoses – endogenous animal infections.
- 3) Exogenous infections and intoxications mediated through meat.

13.3.1 Chemical Mediated Meat Borne Diseases

Chemicals of organic and inorganic origin may enter to meat from various sources and persistent consumption of this meat may cause toxic effect to human being. For example, meat from the animals died of selenium poisoning, lead poisoning are source of meat borne diseases. Certain meat preservatives (you will read later under the course heading – Processed Meat Technology) when used in excess than permissible limit, then may cause diseases in human on consumption of preserved meat product. For example, excess use of nitrite or nitrate may lead to nitrite poisoning.

13.3.2 Meat Borne Zoonoses

Certain endogenous animal infections are transferred to human through the agency of meat and meat products.

1) Zoonoses of bacterial origin

Many bacterial diseases are transmitted to human through intestinal tract like salmonellosis, pasteurellosis, staphylococcus infection etc. In this case, bacteria enter the human body through consumption of inadequately cooked meat. Meat handlers, meat inspectors, abattoir workers, butchers can contract the diseases from meat animals and meat through skin and respiratory tract (inhalation) while capturing, inspecting, slaughtering, skinning the animal and handling the meat and meat products. Some bacterial meat borne diseases are discussed below.

a) Anthrax

It is caused by *Bacillus anthracis*. Anthrax is primarily a disease of animals and man is infected secondarily. This disease is notifiable disease. Workers in meat plants contract anthrax through a skin wound, from wool by inhalation (wool sorters disease). Anthrax in animals is prevented by regular vaccination. In India, Anthrax is prevalent in certain states. The disease occurs normally in summer months after few showers of summer rains. The disease is very much under control. Death rate in humans has been reduced by antibiotics in foreign countries. In animals the disease runs a rapid course, with high temperature 42°C, dark blood coming out of natural orifices like anus, nose etc. and the animal dies suddenly. In pig it occurs in chronic form. Blood smear is taken from tip of the ear for diagnosis. If proved positive for anthrax, the carcass should be disposed off by burying in two meters depth (from surface) with lime. Suitable measures are taken for disinfection of the premises. Anthrax positive animals are never cut open to prevent spread of the disease.

In man the disease may occur in three forms – cutaneous, respiratory and gastrointestinal form. The diseases in man are malignant pustule, pneumonia, otopharyngeal and intestinal anthrax. Other symptoms are high temperature, rigors, headache, lack of appetite and nausea. Treatment with penicillin, tetracycline, erythromycin, chloramphenicol antibiotics has been found effective.

b) Brucellosis

It is a disease primarily of animals that can be transmitted to humans as a result of direct or indirect contact with infected animal population. It primarily affects people who work with animals or animal products (slaughter house workers, veterinarian, farmers, dairy workers). Many species like *abortus* from cattle, *canis* from dogs, *suis* from pig and *melitensis* from goats and sheep are known to infect human. It is being transmitted by contact with infected tissue or milk. It causes mastitis, abortion (7th to 8th month) and sterility in animals. In case of human it produces aches, chills, fever (undulating), sweating, fatigue, myalgia and muscle weakness. Prolonged use (several months) of Rifampicin with tetracycline or streptomycin is advocated as treatment.

c) Erysipelas

Basically it's a disease of pig but may occur in others including man. The causative agent is *Erysipelothrix spp.* The organism is discharged in secretion and excretion of animal and ingestion of contaminant or infection by any means lead to disease in man.

The infection occurs through skin abrasion. This disease is common in meat handlers and fish handlers. The cutaneous infection usually involves fingers or generalized skin eruptions. The duration of disease is about three weeks and in generalized infection is upto two years. Arthritis is seen in systemic infection. In pig, diamond shaped ulcer on skin is pathognomonic lesion. Treatment with Penicillin has been found well responded.

d) Leptospirosis (Haemorrhagic jaundice)

It is an important disease in livestock industry. Natural reservoirs of infection are rats and *Leptospira spp.* is shed in its urine. The infection may take place from urine of infected animals, by inhalation and ingestion and through skin cut and abrasions. It causes septicemia, fever, haemoglobinuria, jaundice, infertility and abortion in most animals. Several cases of leptospirosis in humans have occurred in England. The human leptospirosis also known as Weil's disease. Symptoms include haemolytic anaemia, jaundice, muscular pain, headache, conjunctivitis, vomiting, mental confusion and sometimes meningitis. Adoption of hygienic practices, reduction in rat population and prompt treatment have reduced the hazards of leptospirosis.

e) Listeriosis

It is caused by *Listeria monocytogenes* from intestines of domestic animals and man. The mode of transmission is through direct contact with infective material, aborted foetus and contaminated soil. Infection may occur in man by eating infected meat. The organism has also been isolated from faeces of abattoir workers. In animals the disease takes the form of encephalitis or abortion. In human, transmission is mainly through milk products but contaminated meat could also be a cause of illness. In human being mild infection causes influenza like sign but meningoencephalitis manifested by fever, intense headache, nausea, vomiting, delirium

and coma. It may cause abortion in female. The disease can usually be treated successfully with antibiotics.

f) **Streptococcal Meningitis**

It is a disease of pigs caused by *Streptococcus suis*. The abattoir workers, meat factory workers, butchers, farmers and veterinarians may be affected. Outbreak of meningitis occur in growing pigs. In man it takes the form of a febrile condition with severe headache, numbness of fingers, foot pain, rigor and erythema. Antibiotic treatment is useful.

g) **Streptococcal skin infection**

Outbreak of a skin infection due to *Streptococcus pyogenes* have occurred in meat processing factory workers, in persons involved in the slaughter and dressing of pigs and poultry. Meat handlers are particularly susceptible to streptococcal skin infection, eczematous lesions, infection round the nail and infected laceration. Repeated irritation with water and detergents are predisposing causes. Control measures are high standards of personal and environmental hygiene, attention to cuts and wounds, regular cleaning and disinfection.

h) **Salmonellosis**

It is a disease caused by *Salmonella* spp. in animal and man. *Salmonella typhi* cause typhoid in human and *Salmonella gallinarum* cause fowl typhoid. *Salmonella* can exist in faeces and pastures. They grow well in meat food. *Salmonella* food poisoning occurs due to improperly cooked or thawed meat or poultry, infected food, cross infections from person to person through excreted *Salmonella*. Infected chicken, turkey, eggs are main sources of food poisoning outbreaks. *Salmonella enteritidis* and *Salmonella typhimurium* are main serotypes. *Salmonella* enters food directly at slaughter from animal excreta transferred to food by hands, flies etc.

Control measures are adoption of hygienic standards, hygienic transport and clean lairage, checking cross contamination in abattoir during dressing, avoiding consumption of raw meat and poultry. Adequate cooking destroys *Salmonella*.

i) **Tuberculosis (T.B.)**

It is an infectious disease of man and animal caused by *Mycobacterium tuberculosis*. *Tuberculosis* lesions are seen in any organ and body. Cattle, pigs, sheep, goat and poultry are susceptible to tuberculosis. Generalized tuberculosis occurs from lung tuberculosis. The mode of infection is by digestive and respiratory tract followed by lesion in associated lymph nodes. Animals affected by generalized tuberculosis in animals are rejected for food whereas in localized conditions, the lesions are carefully removed and carcass, if suitable is passed for food. Routine examination of carcass in meat inspection with emphasis on lymph node inspection detects tuberculosis of animals.

j) **Tularaemia (Rabbit Fever)**

The cause is *Pasteurella tularensis*. The infection occurs in hares, squirrels, rabbits and sometimes in sheep. The shepherds and meat handlers are prone to infection. The disease in man is in two forms: glandular and typhoidal or pneumonic form. The first sign is usually a papule. The site of infection is often a finger, which ulcerates. The infection spread to associated lymph nodes which swell. The disease is accompanied by fever, headache and muscular pains and lasts for two – four

weeks. The disease responds well to treatment with *Streptomycin*, *Tetracycline* or *Chloramphenicol*.

k) **Tetanus (Lock jaw)**

Tetanus is caused by *Clostridium tetani*. It is a bacterial disease. For tetanus infection, a cut or injury is predisposing cause. *Clostridium tetani* produces neurotoxin affecting nervous system causing lock jaw, prolapsed eyelid. Usually there is no significant postmortem lesion. The animals are diagnosed at the time of ante mortem itself and prevented from slaughter. Antitetanus vaccine/ serum are available for use in case of cuts and injury due to accidents.

2) **Zoonoses of viral origin**

a) **Contagious Pustular Dermatitis (CPD)**

It is also called as contagious ecthyma or 'Orf'. CPD is caused by a virus and found in sheep and goat. Lesions are seen on lips of lamb, tongue, palate, lungs and digestive tract. Orf is seen in abattoir workers, butchers and meat handlers. Lesions are haemorrhagic with blister at the site of virus entry on the body. The average duration of the symptom is ten months with range of 2-30 months.

3) **Zoonoses of parasitic origin**

a) **Taeniasis**

Taeniasis is caused by tape worm – *Taenia saginata* and *Taenia solium*. The adult tape worms are seen in human being and the larval stage of *T. solium* is *Cysticercus cellulosae* and that of *T. saginata* is *Cysticercus bovis* which are seen in the musculature of pig and cattle respectively. The worm affected meat is called as measly beef in case of cattle and measly pork in case of pig. Infection enters into human body through consumption of raw or inadequately cooked beef or pork which contains larval stages of the worms. Taeniasis results in gastrointestinal disorder and nervous symptoms in human being. Thorough postmortem inspection helps in eliminating the measly beef and pork from the food chain. The tape worm infection can be prevented by thorough cooking of the meat, refrigeration of meat at least for 21 days or freezing at -9.5°C for at least 6 days and proper sanitation and meat inspection.

b) **Trichinosis**

This is also a helminthic zoonoses caused by *Trichinella spiralis*. Man gets infection through the consumption of raw or undercooked or improperly cured meat. The larval stages are seen in the muscles of man. It produces symptoms like vomiting, diarrhoea, sweating, muscular pain, debility, neuropathy etc. in human being. Trichinosis can be prevented by proper cooking and freezing of meat.

c) **Echinococcosis/Hydatidosis**

The causative parasite is *Echinococcus granulosus*. Larval stage of this worm is found in human being cattle and sheep. Larva produces cyst in the visceral organs. This cyst is also called as hydatid cyst. Muscular and intestinal forms are seen in human. Usually liver and lungs are affected. Cranial cysts are also found in some cases. The symptoms may include pain, coughing and some cases where cysts get ruptured somehow fatal anaphylaxis is observed. The infected organs must be condemned while rest of the carcass may be passed for human consumption. This disease can be controlled by taking adequate hygienic measures and consuming well cooked meat.

d) **Toxoplasmosis**

This is caused by *Toxoplasma gondi* which is rarely transmitted to human through intestinal tract. The infection reaches human through inadequately cooked meat or food containing infective cysts and to the infants through the mother who get infection during pregnancy. Veterinarian may get infection from the animals and may transmit the infection to their wives.

e) **Sarcocystosis**

It is a protozoan disease which affects the muscle. Man gets infection through ingestion of partially cooked contaminated meat. Man acts as intermediate host for species found in pig and cattle. Symptoms in human beings are – transient nausea, diarrhoea and abdominal pain. This disease produces fever, anorexia, muscle spasm, diarrhoea, weakness and anaemia in animals. This is responsible for non-acceptance of meat abroad.

4) **Zoonoses of fungal and rickettsial origin**

a) **Avian psittacosis and ornithosis**

Both the diseases are transmissible to man from parrots and some other birds. The disease is common in poultry, ducks, turkey and pigeons which are a common source of infection to man. Human infection occurs from dust infected by bird droppings. Conjunctivitis may occur in persons working in poultry industry. The workers in evisceration line of duck processing line are more susceptible. Symptoms in humans are gastrointestinal pain, vomiting, headache, insomnia and pneumonia. The disease responds to antibiotics. Prevention of dust and better ventilation are needed for control.

b) **Q fever (Abattoir fever)**

Coxiella burnetti is the cause of Q-fever. Abattoir workers and veterinarians have been found to be positive. Cattle and sheep are usually considered to be main reservoirs of infection. The disease in man is an acute febrile disease with anorexia, weakness lasting for one to two weeks and pneumonia. It is transmitted by the bites of ticks and inhalation of infected dust. The infected materials exist in animals in high concentration at the time of handling newborn animals, placental tissue, blood or soiled bleeding. In human being, the disease may lead to a fever (104 to 105°F), pneumonia, hepatitis, etc. The disease is self-limiting in nature. The disease in farm animals occurs most often in ruminants – sheep, goat and cattle. The disease is rarely caused by ingestion of meat and milk.

c) **Ringworm**

It is caused by fungi known as dermatophytes and may occur in workers handling and slaughtering cattle. The two main genera responsible for ringworm in animals are *Trichophyton* and *Microsporum*. In man the disease is termed as 'tinea'. Direct contact with infected animal is usual mode of disease transmission but indirect contact may also lead to condition.

5) **Disease of other origin**

Bovine spongiform encephalopathy (BSE) is a progressive fatal disease which affects nervous system. It is also known as mad cow disease. In sheep and goat it is known as scrapie. In human being, it is called as Creutzfeldt Jacob Disease. It is caused by an infective agent which may be prion (a minute pathogen which

contains a protein resistant to procedures that hydrolyses the nucleic acid) or may be a virion (a small microorganism containing nucleic acid and associated with cellular protein). Man acquired this infection through the ingestion of contaminated meat or brain of the animal. In man, seizures, ataxia, disorientation, hyper aesthesia, loss of speech and blindness. Meat and the visceral organs from the affected animals should be totally condemned and even should not be allowed for production of animal food also.

13.3.3 Exogenous Infections and Intoxications Mediated through Meat

There are some microorganisms which are spoilage organisms i.e., these can spoil the meat without directly affecting the human health and there are also some pathogenic microorganisms which without changing the physical qualities of meat can threaten the human life when these are ingested through meat. These microorganisms can enter the meat from environment like water, soil, air etc. during production, handling and processing of meat and meat products. Some of these are - *coliforms*, *staphylococcus* spp. and *clostridium* spp.

Staphylococcus organisms get lodged in the human nose, throat, intestine and skin. Meat products like ham and bacon which are subjected to extensive handling and stored at ambient temperature for a long time are prone to this infection. These organisms produce enterotoxin when enter the human body through meat and ready to eat meat products. Meat handlers with cuts, abrasions, boil, eczema, sore throat etc. should not be allowed in slaughterhouse, meat processing plant or marketing channels. Adequate hygienic measures, cooking temperature (at least 65°C core temperature for 30 min) and proper refrigeration (<10°C) can be used for minimizing the *staphylococcus* infection and lowering the production of enterotoxin.

Clostridium spp. produces different types of endotoxins which develop botulism in man. Botulism toxins attack the nervous system and result in paralysis, muscular weakness, convulsions etc. in man. The soil containing the organism or the spores of the organism may contaminate the meat and meat products. These are anaerobic organisms, so can contaminate the canned foodstuffs like corned beef, canned meat or ham and bacon stored in anaerobic condition. These organisms and their spores are very much resistant to several environmental factors. As these are soil borne organisms, meat handlers should take adequate hygienic measures. Bacterial growth and toxin production can be prevented by lowering the storage temperature of meat and meat products to 5°C. Spores of these organisms can be destroyed by increasing the acidity of the product and cooking at high temperature like 248°F for 20 minutes and the vegetative organisms can be killed by heating at 80°C for 10-15 minutes.

13.4 PREVENTION AND CONTROL OF MEAT BORNE DISEASES

There are a number of diseases in man because of animal's contact or animal product. The causative organisms remain present in animals may be transmitted to man through contaminated meat. Therefore, the presence of organism in animals, their detection in meat and assessment of public health hazards are important aspects to be studied in detail. In a study, disease in man, prevalence of organisms in

animals, detection at meat inspection and importance to public health has been reported as follows:

Table 13.2: Possibilities of Meat Inspection to Detect Zoonoses

Disease in Man	Prevalence of organism in animals	Detection at meat inspection	Importance to public health
Tuberculosis	+++	+++	+++
Brucellosis	+++	+	+++
Campylobacteriosis	++	+	++
Salmonellosis	++	+	+++
Yersiniosis	++(+) swine	+	++
Leptospirosis	+	+	+
Listeriosis	++	+	+
Trichinosis	(+)swine	+	++
Cysticercosis			
a) from Cattle	+	+	+
b) from Swine	+	++	+++
Sarcosporidiasis	++	(+)	+?
Hydatidosis	++	+++	+

(Graduation according to 1 to 3 plus system.)

The slaughter house is the most important area in the meat production and maximum precaution should be taken to ensure that all the animals are slaughtered with utmost care under hygienic condition. Foodborne illness remains a serious problem particularly in developing countries like India. Meat is the primary source of foodborne illness worldwide.

Bacterial contamination of animal carcasses is an unavoidable consequence of processing of animal into meat. This contamination can come from processing equipment, workers, and the environment, but the primary source is the animal. The hide, hooves, intestinal contents and blood can harbour large numbers of bacteria, some of which are pathogenic. Therefore, all such visible contamination must be removed from the surfaces of carcasses.

There are numerous anti-microbial interventions being utilized in slaughter processes. In this presentation, we will look at the most commonly used interventions and their effectiveness as shown in scientific studies. It should be noted that antimicrobial interventions are not a substitute for sanitary dressing procedures. Until recent years, knife trimming and carcass washing with plain water have been the primary means of reducing meat contaminants. However, the occurrence of foodborne disease outbreaks and scientific advances over the years have shown that trimming and washing alone will not accomplish the level of food safety that consumers expect from meat products. Numerous anti-microbial interventions in the slaughter process are as follows:

a) **Steam vacuum system**

Steam vacuum systems are designed to remove small visible spots of contamination from carcass surfaces. The steam vacuum is a hand-held apparatus that uses a hot water spray (185°F) in a vacuum nozzle, with steam sprayed above and below the vacuum head. The hot water sprayed onto a carcass kills 90 per cent or more of the bacteria and detaches contaminants such as ingesta and faeces, which is then vacuumed off.

b) **Carcass washes followed by organic acid rinses**

After hide/skin removal, the carcass may be subjected to a pre-evisceration wash and subsequent organic acid rinse. The use of a carcass spray immediately after hide removal serves to remove bacteria before they are attached firmly to the carcass surface and grow thereon. The subsequent organic acid rinse then provides a significant kill step for any bacteria that remain on the carcass surface. This intervention is also applied after the slaughter process is complete and before the carcasses enter the cooler. The organic acids commonly used are acetic acid and lactic acid, although citric acid is also approved for this purpose. The concentration of the organic acid is between 1.5 and 2.5 per cent and it may be used as a mist, fog, or a small droplet rinse.

c) **Other antimicrobial chemicals**

Some other chemicals utilized as an anti-microbial rinse in slaughter include the following:

- (i) Acidified Sodium Chlorite can significantly kill *E. coli*, *Listeria*, *Campylobacter*, *Salmonella*, and other bacteria. Different concentration of this solution can be applied at ambient temperature by spray.
- (ii) Lactoferrin is applied as a spray in the final step of the slaughter process. Lactoferrin has been shown to be effective against more than 30 foodborne pathogens, including *E. coli*, *Salmonella*, and *Listeria*.

d) **Hot water rinses**

High temperature water (>160°F) can be sprayed on the carcass as the last step prior to chilling. It is effective in reducing the numbers of *E. coli* and *Salmonella*.

e) **Steam pasteurization**

Steam pasteurization is a process where carcasses are placed in closed chamber at room temperature and sprayed with steam that condenses over the entire carcass. The surface temperature of the carcass is raised to 185° F which results in the killing of 95 to 99 per cent of all bacteria. Carcasses are then sprayed with cold water which reduces the surface temperature of the carcasses to approximately 60°F. The rapid procedure prevents discolouration and a 'cooked look' to the carcasses. The steam pasteurization system is an efficient automated technology which kills a large percentage of bacteria on carcass surfaces and greatly reduces the risk of enteric pathogens such as *E. coli* and *Salmonella* in the meat supply.

f) **Multiple hurdle approach**

Studies have shown that it is more effective to use the "multiple hurdle" approach to pathogen control rather than relying on any one intervention. Using the "multiple hurdle" approach, an establishment will utilize multiple interventions at various steps

in the slaughter process to achieve maximum reduction of bacterial numbers on the carcass. For example, an establishment may use carcass wash with water, an anti-microbial spray prior to evisceration and after evisceration followed by steam pasteurization and rinsed again with an anti-microbial spray.

g) Thermal organic rinse (TOR)

Thermal organic rinse (TOR) utilizes organic acid heated to 131°F and it provides the most effective documented anti-microbial performance. TOR provides one more shield against potential contamination with *E. coli*, *Listeria*, *Salmonella*, or *Campylobacter*.

The prevention and control measures for meat borne diseases and zoonoses can be summarized as follows:

- 1) Monitoring of emerging zoonoses like bird flu, BSE and meat borne pathogens.
- 2) Development of rapid diagnostic tests applicable under field conditions.
- 3) Development of rapid isolations/detection techniques for on-line testing during production/processing itself for meat quality control.
- 4) Development/Standardization of quality control tests for detection of pathogens/toxins in meat and meat products using enzymes, endotoxins or molecular biology techniques.
- 5) Developing protocols for recovery of injured (stressed) cells by resuscitation procedures.
- 6) Development of Vaccines/diagnostics against zoonotic infections/infestations e.g., *Salmonella*, *Listeria*, *Brucella*, EHEC, viral infections etc.
- 7) Laying down quality standards/microbiological specifications for meat and meat products.
- 8) Formulation of HACCP system of GMP programmes for indigenous/other products.
- 9) Working out status of mycotoxins, pesticides and insecticides in foods of animal origin.
- 10) Proper disposal of non or slow biodegradable wastes to minimize environmental pollution.
- 11) Creation of awareness amongst masses by properly designed educational and training programmes and through print or electronic media.

Check Your Progress

- 1) What do you mean by zoonoses?

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2) How the zoonotic diseases are transmitted?

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3) Name four meat borne zoonotic diseases along with the causative organism.

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4) What are the differences between measly beef and measly pork?

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5) What is meant by hydatid cyst?

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6) Enlist anti-microbial interventions in a slaughter process.

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13.5 LET US SUM UP

Meat borne diseases are those diseases that are transmitted through the agency of meat and meat products and by-products from slaughtered animal either directly or indirectly. These may be bacterial, viral, parasitic, mycotic, rickettsial and chemical origin. The persons engaged in handling the meat animals, slaughtering the animals, processing the meat and meat products, handling slaughterhouse by-products, inspecting meat animals and meat, marketing and distribution of the meat and meat products are prone to these diseases. Consumers also get infection through the consumption of contaminated meat and meat products. Therefore, proper measures for control and prevention of meat borne diseases should be

taken. There are several such measures like inspection before and after slaughter of the animal, hygienic slaughter and processing of meat products, proper disposal of condemned material, quality control system and creation of public awareness etc.

13.6 KEY WORDS

Anthrax	: Disease caused by a bacteria – <i>Bacillus anthracis</i>
Brucellosis	: Disease caused by bacteria – <i>Brucella abortus</i>
Erysipelas	: Disease caused by bacteria – <i>Erysipelothrix spp.</i>
Leptospirosis	: Disease caused by bacteria – <i>Leptospirosis spp.</i>
Listeriosis	: Disease caused by bacteria – <i>Listeria monocytogenes</i>
Streptococcal meningitis	: Disease caused by bacteria – <i>Streptococcal spp</i>
Tetanus	: Disease caused by a bacteria – <i>Clostridium tetany</i>
Tularaemia	: Disease caused by a bacteria – <i>Pasteurella tularensis</i>
Salmonellosis	: Disease caused by a bacteria – <i>Salmonella spp.</i>
Tuberculosis	: Disease caused by a bacteria – <i>Mycobacterium tuberculosis</i>
Contagious postural dermatitis	: Disease caused by virus.
Psittacosis	: Disease caused by <i>Chlamydia psittaci</i> .
Q fever	: Disease caused by a rickettsia – <i>Coxiella burnetti</i> .
Ring worms	: Disease caused by a fungi – <i>Dermalophytes spp.</i>
Hydatid disease	: Disease caused by a parasite – <i>Echinococcus granulosus</i> .
Toxoplasmosis	: Disease caused by a parasite – <i>Toxoplasma gondi</i> .
Taeniasis	: Disease caused by a parasite – <i>Taenia spp.</i>
Trichinosis	: Disease caused by a parasite - <i>Trichinella spiralis</i> .
Sarcocystosis	: Disease caused by protozoa.
Measly pork	: The muscles of pig affected with the larval stage (<i>cysticercus cellulosae</i>) of <i>Taenia solium</i> .
Measly beef	: The muscles of cattle affected with the larval stage (<i>cysticercus bovis</i>) of <i>Taenia saginata</i> .
Emerging zoonoses	: Zoonoses those are newly recognized or newly evolved or have occurred previously but show an increase in incidence or expansion in geographical, host or vector range.

7) Antimicrobial interventions in a slaughter process are listed below:

- (i) Steam vacuum system
- (ii) Carcass wash followed by organic acid rinse
- (iii) Carcass wash with chemicals like acidified sodium chlorite and lactoferrin
- (iv) Hot water rinse
- (v) Steam pasteurization
- (vi) Multiple hurdle approach
- (vii) Thermal organic rinse.