



MEAT INSPECTION MANUAL

Bhutan Agriculture and Food Regulatory Authority
Ministry of Agriculture and Forests
Royal Government of Bhutan

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Foreword

As the country strives to become self-sufficient economically, diversification of economic activities in the country has been accorded the highest priority. People of various background have opted to take up livestock production activities including meat businesses.

Although Bhutan places priority on domestic production of meat, various limiting factors compel the country to import huge quantities of meat from India and other countries annually. With both domestic production and import of meat taking place simultaneously, there are a lot of meat business activities taking place in the country at any given point of time requiring the highest attention of Bhutan Agriculture and Food Regulatory Authority (BAFRA) officials.

BAFRA is an agency bestowed with the responsibility of ensuring safety of meat through inspection and certification for human consumption. BAFRA has been delivering this mandates through its offices in 20 Dzongkhags, Entry Point offices and Dungkhag offices. Despite lot of developments taking place in the field of meat science including meat inspection and certification, BAFRA officials have been using the standards and guidelines of meat inspection developed long ago.

This manual has been developed with the objectives to re-orient BAFRA officials in meat inspection and certification as well as to guide them in their day-to-day meat inspection activities, be it in meat processing plants or in meat shops. Besides, having such manual will also ensure uniformity in meat inspection and certification and bring about professionalism at work. Individuals in meat businesses can also use this manual to enhance their knowledge in meat inspection, hygiene and safety as well as for self-compliance to meat inspection requirements.

The manual is designed to suit it the needs of stakeholders involved in meat businesses in the country. It discusses on various inspection requirements viz. the ante-mortem examinations of animals going for processing, post-mortem examinations and procedures, general pathological conditions of carcasses, ante-mortem and post-mortem judgements, meat inspections at retail shops, temperature control and storage of meat. The manual will complement enforcement of other documents viz. the Codes of Practices for Ante-mortem and Post-mortem Inspection of Large Animals, and the Minimum Standards for Meat Retailing and Transportation.

Jamyang Phuntsho
Offtg. Director General

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Chapter 1: Ante-mortem Examination of Meat Animals

Introduction

The term ante-mortem (AM) means *before death*. AM examination is the careful inspection of live animals and birds prior to slaughter. All food animals presented for slaughter must undergo AM examination. AM examination of poultry is performed on a lot basis.

As a part of AM examination, it is important to observe animals both at rest and motion because certain abnormal signs, such as labored breathing can be detected clearly while the animals are at rest. Other abnormalities such as lameness detection becomes easy by observing the animals in motion. AM examination of animals and birds should be carried out within 24 hours before slaughter and repeated if slaughter is delayed. The animals must also be rested for at-least 24 hours and should not be fed for 12 hours prior to slaughter. Animals should be provided with plenty of water during that time.

Many conditions obvious at AM examination show little to no macroscopic evidence on post-mortem examination and thus can be overlooked. For example, certain animal diseases or pathological conditions such as mastitis, tetanus, rabies, tuberculous, meningitis etc. are better detected at AM examination. AM examination is of great value in the detection of animals suffering from infectious diseases particularly anthrax and rabies which are communicable to human beings.

Objectives of ante-mortem examination

The main objectives of AM examination are:

- To prevent animals showing clear evidence of disease or condition that would render the carcass unfit for human consumption from being slaughtered.
- To ensure that only animals fit for slaughter are slaughtered.
- To detect and slaughter separately from healthy animals, all those suffering from or suspected to be suffering from infectious/zoonotic disease or conditions that would render whole or part of the carcass unfit for human consumption.
- To detect certain diseases which are contagious or of food safety concerns and whose diagnosis is either difficult or impossible during the post-mortem examination.
- To ensure that injured animals or those with pain and suffering receive emergency slaughter and that animals are treated humanely.
- To ensure post-mortem examination more efficient, accurate and less laborious.
- To identify sick animals and implement disease control program by tracing back the source of animals.
- To obtain information regarding the animals treated with therapeutic agents like antibiotics and pesticides and to determine suitability for slaughter.
- To prevent the unnecessary contamination of the floor and the equipment of abattoir through handling of diseases or dirty animals.

Pre-requisites of ante-mortem examination

The abattoir should have certain minimum requirements to enable adequate AM examination to be performed satisfactorily. Only animals which have been adequately rested shall be presented for an AM examination. Abattoir employees should assist and co-operate fully with the examining officer in moving, segregating, identifying and marking animals when required. No animal grossly contaminated with mud, filth or faecal material which will contribute a hazard by unnecessary contamination of the floor and the carcass during dressing operations, shall be presented for AM examination until it has been cleaned to the satisfaction of the inspector.

a. Facilities

- Well established slaughter house (refer various categories of abattoirs authorized by Livestock Rules and Regulations of Bhutan 2017) with adequate lighting and space.
- Isolation pens for disease suspect animals with separate drainage and situated as to avoid contamination of other animals.
- Enough manpower to restrain and handle animals during examination

b. Documents checks

- Application form for AM/post-mortem examination (BAFRA-IS-FM-151)
- In-country movement permit of animals (if animals were brought from other Dzongkhag)
- Letter of ownership authentication issued by Local Government Authorities
- Health certificate from Livestock Extension officials
- AM inspection report form (BAFRA-IS-FM-123)
- History taking form including treatment records (treatment /vaccination records of animals for the last 7 day and health records of animals for the last 48 hours).

c. Equipment

- Stethoscope
- Thermometer
- Personal Protection Equipment

Procedures for ante-mortem examination

- 1) An application requesting for AM examination of animals is submitted to the BAFRA/ Livestock official (DoL) at least one day prior to inspection date (*Application Form No. BAFRA-IS-FM-151*) along with other required documents.
- 2) AM examination must take place within 24 hours of arrival at the abattoir and less than 24 hours before slaughter. If the animals are kept for more than 24 hours after the initial AM examination, the AM examination should be repeated on the day of slaughter.
- 3) Animal brought for AM examination should be healthy and free from any diseased symptoms.

- 4) The examining officer shall conduct AM examination in accordance with the requirements to comply with the facilities, required documents and health condition of animal.
- 5) The examining officer may direct any animal to be moved and segregated in the suspect holding pen for a more detailed examination of the animal if necessary.
- 6) Pregnant, highly emaciated and diseased animals will not be allowed to slaughter.
- 7) Failure to declare the correct information of the animal in the application form with the required documents during the AM examination shall result in cancellation of AM examination.
- 8) The animals should be observed in the lairage pens during rest as well as in motion.
- 9) Suspected or diseased animals should be segregated for the detailed examination. Their temperature, pulse, respiration rate should be recorded.

Table 1: Physiological parameters of normal animals

Animals	Temperature (°C)	Pulse/minute	Respiration/minute
Cattle	39	50	12-16
Pig	39	75	10-16
Sheep/goat	39.5	75	12-20

- 10) During AM examination, animals must be examined for any abnormalities, signs of diseases, abnormal behaviours, cleanliness of the animals etc.
- 11) Particular attention should be paid to the following details:
 - Manner of standing, movement, gait and posture;
 - State of nutrition;
 - Reaction to environment;
 - Condition of hide/skin, hair and wool;
 - Digestive system (salivation, rumination, consistency and colour of faeces);
 - Appearance of the urogenital system including vulva, prepuce and scrotum;
 - Respiratory system (nostrils including the mucous membranes, nasal discharge, blood tinged froth, quality of respiration);
 - Injuries, swellings (abscesses, enlarged joints, hernia or omphalophlebitis, mastitis, tumours, lumpy jaw, tympany and edema);
 - Body temperature (in suspected / obviously diseased animals);
- 12) The post-mortem inspector should be notified of the result of the AM examination.

Judgements of ante-mortem examination

After the AM examination, the inspector shall categorize the animals and deal with the following decisions.

1) Animals passed as fit for slaughter without any restriction

These are animals with no obvious disease or abnormal conditions and are passed for slaughter without any restriction.

2) Animals permitted for slaughter under close supervision

- These are animals suspected of being affected with a disease or a condition that might render whole or portion of the carcass unfit for human consumption.
- Each of these animals will be carefully examined by an examining officer and the findings recorded. The AM findings shall be taken into consideration for the judgment of the carcass and parts thereof during post-mortem examination.
- Each of these animals will be positively identified such as by tattoo, ear tags, or other identifying methods acceptable to the examining officer.
- The examining officer shall direct any animal to be slaughtered separately in order to prevent unnecessary contamination of other carcass.
- The diseases and or conditions included in this category are:
 - Anaemia;
 - Diarrhoea;
 - Indeterminate symptoms- animals in which symptoms are not clearly defined so that they are merely suspected of being affected with a disease or condition that could result in condemnation of the whole or portion of the carcass;
 - Suspected internal parasitic infestation accompanied by anaemia, diarrhoea or poor in condition;
 - Jaundice;
 - Localized infections such as abscesses or infected wounds unassociated with an elevated temperature;
 - Neoplasms not associated with emaciation;
 - Oedema (localized);
 - Skin and mucosal problems when lesions are widespread (e.g. ecthyma, dermatitis, erythema, mange, photosensitization, ringworm, ulcerations, urticaria and warts);
 - Pox lesions when widespread.

3) Animals withheld from slaughter

- These are animals with a disease or condition that, in the opinion of the examining officer would likely respond to a delay-in-slaughtering or to suitable treatment.
- The diseases and or conditions included in this category are:

- Biological and other drug residues - animals known or suspected to have been recently treated with any chemical, drug or insecticide that may result in residues in its tissues shall be withheld from slaughter until the accepted withdrawal period for the chemical, drug or insecticide has elapsed.
- When the condition is considered to be the result of a poison (chemical, metal or plant) or a toxin of a specific disease such as botulism or tetanus, the animal shall be withheld from slaughter.
- Highly elevated temperatures with accompanying symptoms such as evidence of an infection.
- Metabolic disorders.

4) **Emergency slaughter of animals**

- This is required when an animal is in acute pain or is suffering from a condition where a delay in slaughter may be contrary to animal welfare.
- These are animals that are injured or crippled and in the case of pigs those suffering from heat stress.
- AM examination of such animals shall be performed without undue delay.
- Slaughter and handling of such animals need not be carried out separately from healthy animals.

5) **Animals to be condemned as unfit for slaughter at AM examination**

- These are animals showing clear and unmistakable evidence that they are affected by a disease or condition that necessitates the condemnation of the carcass.
- These animals shall not be permitted to handle on the slaughter floor, nor any portion of the carcass of such an animal be permitted to enter or pass through any section of the establishment where edible product is being handled, prepared or stored.
- The diseases and or conditions included in this category are:
 - Anasarca;
 - Cachexia - cachexic animals resulting from any disease or pathological condition;
 - Camatose animals that in the opinion of the examining officer are unlikely to respond to treatment;
 - Dead animals - this include animals that died in the lairage whilst awaiting slaughter;
 - Infectious diseases such as Brucellosis, Bovine Tuberculosis, Rabies, Anthrax, Colibacillosis, Salmonellosis, acute Swine Erysipelas, Swine Fever (classical and African), Botulism, Bovine Malignant Catarrhal Fever, Hemorrhagic Septicaemia, Tetanus and any other zoonotic diseases or exotic diseases;
 - Neoplasms when associated with emaciation.

In general, it is not only enough to produce healthy meat animals but it is equally important to ensure that these animals reach to the point of slaughter in sound condition. Pre-slaughter care and handling can markedly influence the quality of the meat. Stress and fatigue lowers the quality of the meat due to depletion of glycogen in the muscles. Due to low acid production at post-mortem, the ultimate pH of the muscles remains high. Thus, the keeping quality of the meat is reduced and it looks dark due to high water content.

Table 2: Probable disease/conditions and their salient symptoms/features encountered at AM examination and AM decisions

Sl. No.	Salient symptoms/features	Probable disease/ Condition	AM decision
1	Severely wasted, weak, loss of fat and muscles and extremely pronounced and protruding bones	Emaciation/ Cachexia	Animals to be condemned as unfit for slaughter
2	Udder abnormalities such as swelling, hot, redness, hardness and pain. Watery milk with flakes and clot in it	Mastitis	Animals permitted for slaughter under close supervision
3	Weakness, enlarged and prominent lymph nodes, dyspnea and intermittent hacking cough, diarrhea, fluctuating fever, loss of appetite	Tuberculosis	Animals to be condemned as unfit for slaughter
4	Nervous signs of incoordination, hyper-salivation or drooling of saliva, anorexia, abnormal bellowing, aggressive behavior, muscle spasms, convulsion and anxiety	Rabies	Animals to be condemned as unfit for slaughter
5	Fever, ulcers or blisters on gums or mouth, muzzle, feet and teats, drooling of saliva, smacking of mouths, limping or tendency to lie down.	FMD	Animals to be condemned as unfit for slaughter
6	Stiffness/lameness, swelling on thigh region, buttock, shoulder, neck and lumbar region, labored breathing and accelerate pulse rate. Swellings produce crepitating sounds upon palpation.	BQ	Animals to be condemned as unfit for slaughter
7	Stiffness of the muscles, difficulty walking, lock-jaw, hyperirritability, prolapse of 3 rd eyelid, pump handle position of tail, opisthotonus position and ventral recumbency, absence of rumination, bloat, asphyxiation	Tetanus	Animals to be condemned as unfit for slaughter

8	Inability to eat or drink for several days, drooling saliva, rapid loss of condition, painful and swollen tongue, nodules and ulcers on tongue (wooden tongue)	Actinobacillosis	Animals permitted for slaughter under close supervision
9	Marked swelling of jaw due to osteomyelitis (lumpy jaw syndrome), difficulty in mastication	Actinomycosis	Animals permitted for slaughter under close supervision
10	Rapid and shallow breathing, cough, fever, frothy nasal/oral discharge, muzzle dryness, adventitious sounds (rales), loss of appetite	Pneumonia	Animals permitted for slaughter under close supervision
11	Pigs - fever, huddling of sick animals, loss of appetite, dullness, weakness, conjunctivitis, constipation followed by diarrhoea, and an unsteady gait, cyanotic skin colour of ears, abdomen and inner thighs.	Classical Swine Fever	Animals to be condemned as unfit for slaughter
12	Pigs - high fever, loss of appetite, depression, vomiting and or diarrhoea with bloody discharge, cyanotic skin colour of extremities (nose, ears, tail and lower legs), heavy discharge from eyes and/or nose.	African Swine Fever	Animals to be condemned as unfit for slaughter
13	Pigs - fever, disinclination towards movement, excessive squeal upon forcing the animal to move, skin erythema (diamond skin lesion), seeks cool wet place to lie down, shift weight between limbs	Swine erysipelas	Animals to be condemned as unfit for slaughter
14	Severe diarrhea with foul smell, may contain blood, fever, loss of appetite, dehydration.	Salmonellosis	Animals to be condemned as unfit for slaughter

Chapter 2: Post-mortem Examination

Introduction

Examination of the carcass and parts thereof after slaughter is called post-mortem examination (PME). All carcasses have to be subjected to post-mortem examination. PME procedures and judgments should be a science-based protocol wherein the primary production system and the ante-mortem examination report should be taken into account in reaching the final judgment of PME. PME requires observation of all parts of the carcass, dressing procedures, equipment, and facilities to prevent contamination of edible parts. Many diseases and abnormal conditions not detected on AM examination necessitates a careful PME. The examining officer must ensure that the condemned carcasses and parts are disposed safely.

Objectives

The objectives of the PME are:

- 1) To detect and remove gross abnormal parts of carcass and pass the meat for human consumption.
- 2) To reduce the chances of contaminated meat or meat from diseased animals entering the human food chain.

Facilities

- 1) Well organized and spacious room with adequate lighting facilities of 540 lux
- 2) Post-mortem table
- 3) Adequate hand washing facilities with supply of hot and cold running water, liquid soap and towel
- 4) Complete post-mortem set
- 5) Sterilizers for complete immersion of knives, saws, cleavers etc.
- 6) PPE set
- 7) Sample collection set
- 8) Biohazard bags
- 9) Disinfectants and organ preservatives

Post-mortem examination procedure

PME should be carried out simultaneously as the slaughter team continue with evisceration and other dressing process. As a thumb rule, viscera and head should remain identifiable with the carcass until the inspection is complete. Adequate care should be taken to prevent carcass from getting mutilated in the process as it will interfere with arriving at the accurate judgment. Employing the techniques such as observing the carcass, making incision, palpation and olfaction, the examining officer should;

1. Initiate classification of the lesions into one of two major categories - acute or chronic.
2. Establish whether the condition is localized or generalized, and determine the extent of systemic change.

3. Determine the significance of primary and systemic pathological lesions and their relevance to major organs and systems, particularly the liver, kidneys, heart, spleen and lymphatic system.
4. Coordinate all the components of AM and PM findings to make a final judgement.
5. Submit the samples (if required) to the laboratory for diagnostic support.

Post-mortem examination of carcasses of cattle, pig, goat and sheep

1) Carcass

Examine carcasses (including musculature, exposed bones, joints, tendon sheaths etc.) to determine any sign of disease or defect. Attention should be paid to bodily condition, efficiency of bleeding, colour, condition of serous membranes (pleura and peritoneum), cleanliness and presence of any unusual odours/colors.

- Viscera should be examined as they are removed from the carcass and/or after their removal from the carcass, in which case they should be clearly identifiable with the carcass until inspection has been completed.
- If incisions are made, every precaution should be taken to prevent contamination of the premises, equipment and personnel.
- Where in the opinion of the examining officer a more detailed PME or a microbiological, parasitological, chemical or any other examination necessary to render a judgment on a carcass or viscera is required, he should take all necessary specimens from such carcass or viscera for the required examination.
- The action taken following the judgement of carcass and parts thereof involves:
 - Trimming of affected parts like bruises, pneumonia, milk spots etc.
 - Local condemnation of the affected organs like in chronic fascioliasis, hydronephrosis, pericarditis etc.
 - Total condemnation of carcass and organs like in specific diseases, e.g. TB, melioidosis etc.

2) Lymph nodes

In all animals in which systemic or generalized disease is suspected or lesions suggestive of tuberculosis are found at PME, the main carcass lymph nodes viz. the precrucial, popliteal, superficial inguinal, ischiatic, internal and external iliac, lumbar, prepectoral, prescapular and atlantal nodes, as well as the lymph nodes of the head and viscera should be incised and examined.

3) Heads

Cattle - the oesophagus should be separated from its attachment to the trachea and observed. As a part of inspection for *Cysticercus bovis*, the muscles of mastication should be viewed and one or more linear incisions made parallel to the lower jaw into the external and internal muscles of mastication.

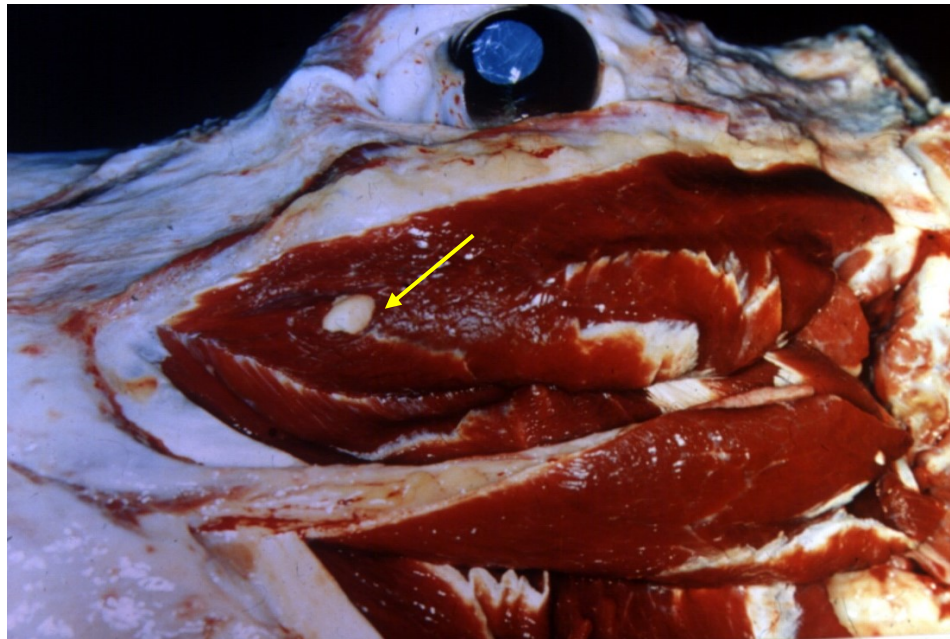


Figure 1: *Cysticercus bovis* in masseter muscle of a cattle

Figs - where there is a risk of *Cysticercus cellulosae* being present, the outer muscles of mastication, the abdominal, diaphragmatic muscles and the root of the tongue should be incised and the blade of the tongue viewed and palpated.

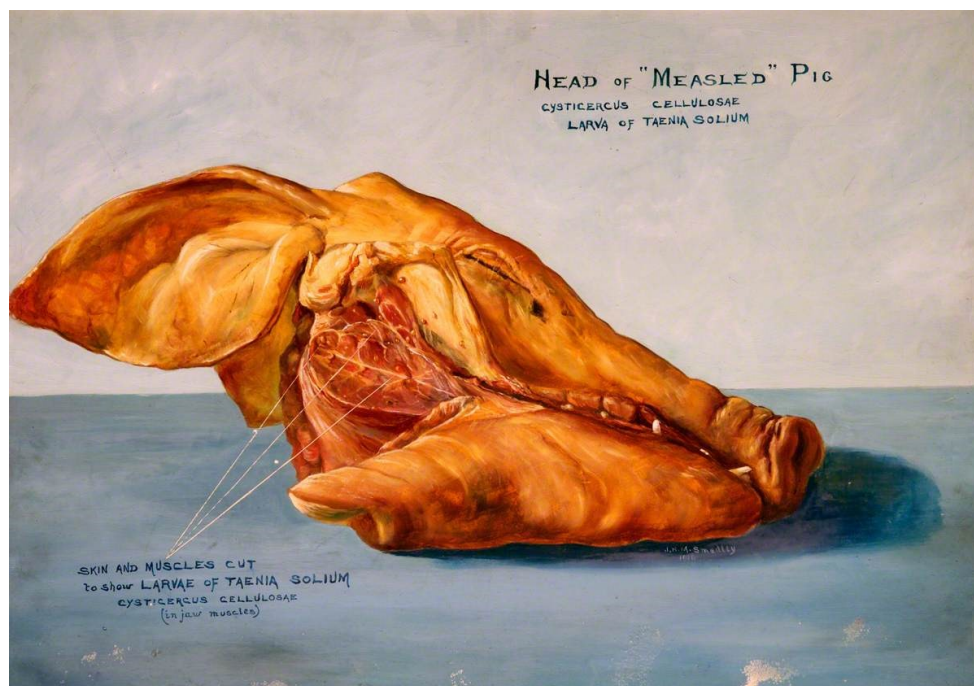


Figure 2: *Cysticercus cellulosae* in the mastication muscles of pig

4) Viscera

1) Lungs

View and palpate. Except in sheep and goats, the bronchi should be opened up by a transverse incision across the diaphragmatic lobes. For cattle the larynx, trachea and main bronchi should be opened along their length. Bronchial and mediastinal lymph nodes should be incised and examined.

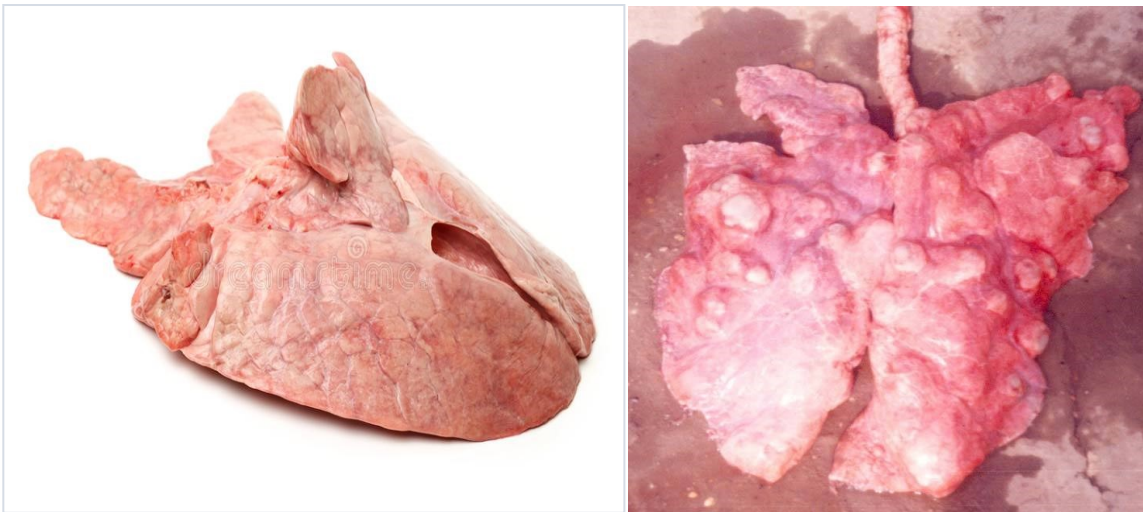


Figure 3: Normal lung (left) and cystic lung (right)

2) Heart

Incise lengthwise (minimum four) from base to apex into the heart muscles. Observe cut surfaces. The heart of all cattle should be inspected for *Cysticercus bovis* either by making one or more incisions from base to apex or by everting the heart and making shallow incisions that enable the cardiac valves and muscle tissue to be inspected. The heart of all pigs derived from areas where there is a risk of *Cysticercus cellulosae* being present should be opened up and the deep incision made into the septum

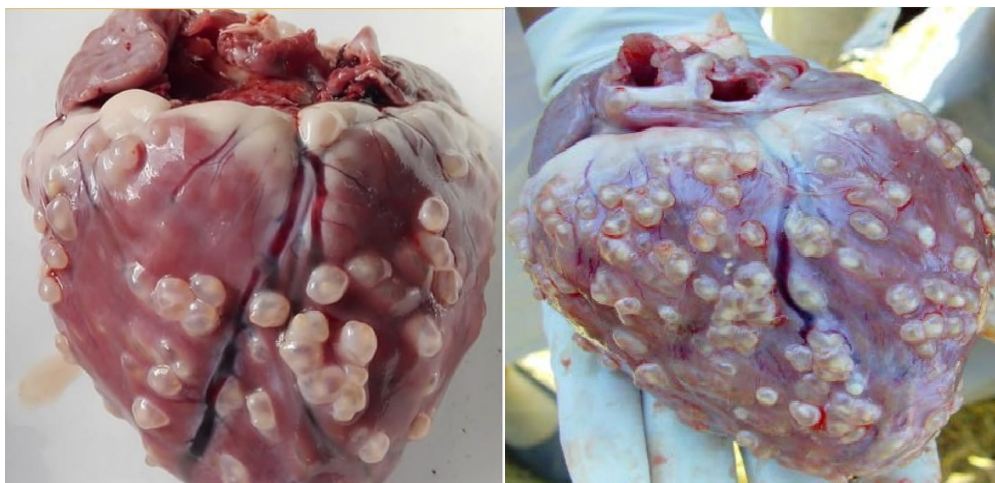


Figure 4: Cardiac cysticercosis in pig

3) Liver

View and palpate entire surface (both sides). View the gall bladder. For cattle incise as deemed appropriate to detect liver flukes. Open large bile ducts. For sheep and pigs incise as deemed appropriate for parasite.

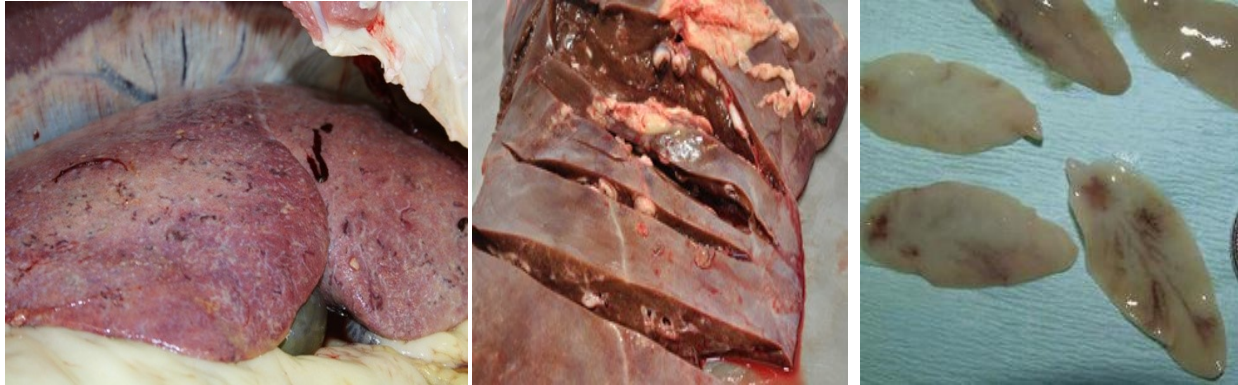


Figure 5. Liver fluke (*Fasciola hepatica*) in cattle liver and liver fluke (extreme right)

4) Spleen

View, palpate and incise the spleen for any changes in colour and size.

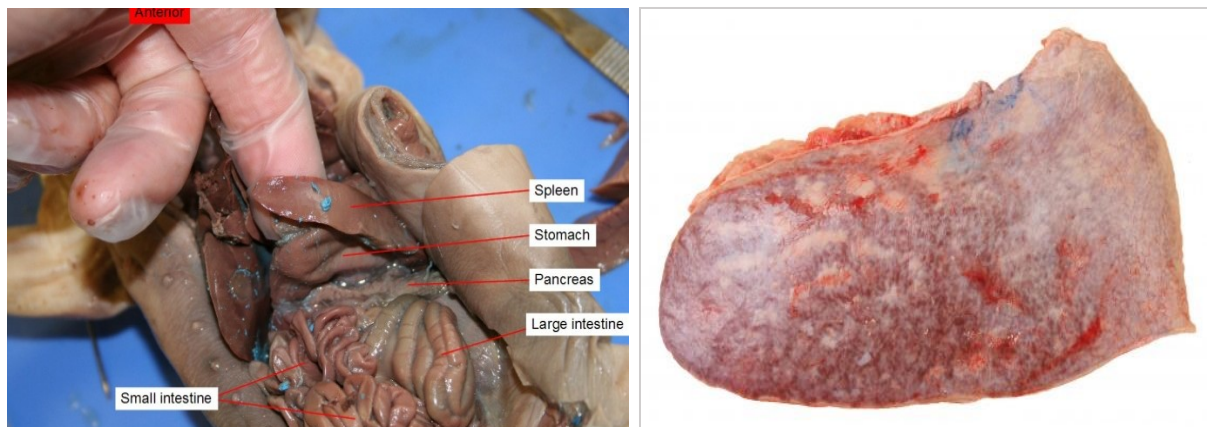


Figure 6: Dissection of pig carcass showing spleen (left), bovine spleen (right).

5) Gastrointestinal (GI) tract

View, palpate and incise the GI track for any changes in consistency, colour, shape, size and presence of any foreign materials.

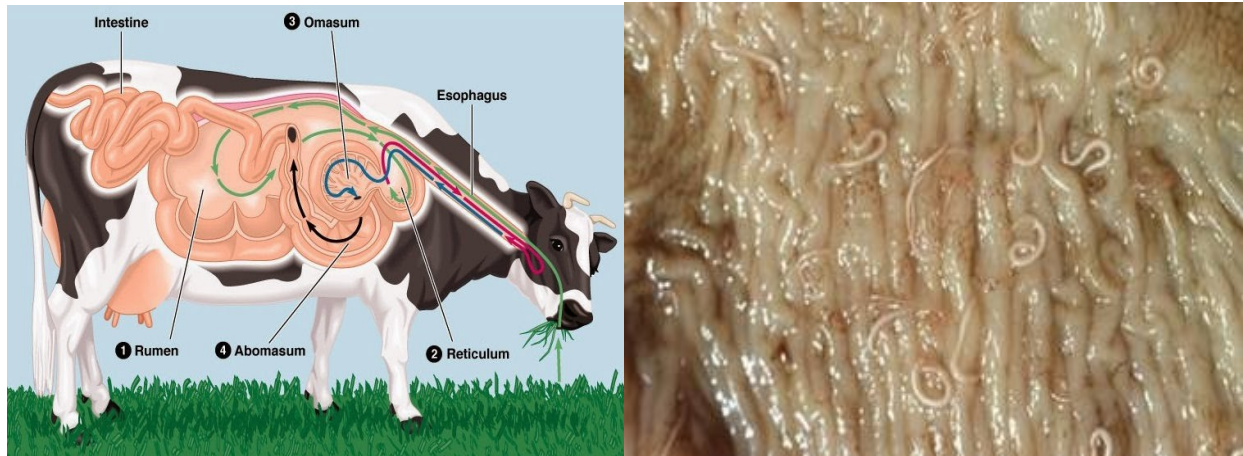


Figure 7: Anatomy of a cow showing GI tract (left), worm infestation in bovine GI tract

6) Kidneys

View, palpate and incise the kidney for any changes in consistency, colour, shape and size.

Post-mortem examination judgement

Four judgment that an examining officer can arrive at during PME are;

1) Pass for human consumption

When the PMS has revealed no evidence of any unacceptable disease or defect and the slaughter operation has been implemented in accordance with hygienic requirements, the carcass and edible offals should be approved as fit for human consumption without any restriction.

2) Conditionally passed for human consumption

Carcasses that are contaminated but may be treated under official supervision in a manner resulting in safe and wholesome meat. Different diseases and defects may require different methods of treatment.

The meat before distribution, may require undergoing boiling or steaming. The treatment should be such that a temperature of 90°C is reached in the centre of each piece of the meat.

The meat before distribution, may require freezing at a temperature that will kill the parasite of concern. The time and temperature will vary according to the nature and size of the piece of meat undergoing treatment and the parasite concerned.

3) Partial condemnation

While the whole carcasses may not be fit for human consumption, the affected part may be trimmed off and rest passed for consumption. For example, carcasses with cystic lung or pneumonic lung, the affected organs may be condemned and rest passed for human consumption depending on the type of disease conditions and infectious agent involved.

4) Total condemnation

The carcass and offals should be condemned or otherwise disposed of for inedible purposes in one or more of the following circumstances:

- The carcass is hazardous to handlers, consumers and or livestock;
- They contain residues that exceed established limits;
- They contain lesions indicative of zoonotic or infectious in nature;
- The meat has been conditionally passed for consumption, but the treatment stipulated is either unavailable or not effective.

Table 3: Disease/conditions and PM judgements

Sl.no	Salient PM lesions	Probable disease /condition (Species)	Differential diagnosis	Judgement
1	General appearance of carcass is good. Necrosis of heart muscle (tigroid heart), usually only in young acutely infected animals. Ulcerative lesions on tongue, palate, gums, pillars of the rumen and feet.	FMD. All cloven footed animals	Rinderpest, blue tongue, mucosal disease, bovine papular stomatitis, infectious bovine rhinotracheitis, PPR	Carcasses totally condemned in acute febrile cases. Otherwise conditionally passed after condemnation of tongue and head.
2	Punched out erosions in the oesophagus, edema or emphysema of the lungs, congested abomasum filled with bloody fluid. Ulcers may also be observed. Severe congestion and hemorrhages in the intestine showing “tiger stripping” or zebra marking appearances.	Rinderpest Cattle, occasionally in sheep, goat and pig	FMD, PPR, MCF, BVD, IVR, bovine papular stomatitis, CBPP, CBPP, ECF	Total condemnation
3	Erosions of the nose, mouth, conjunctiva, oesophagus and gastrointestinal tract. Lungs may be congested, swollen or emphysematous. White areas in the kidneys. Swollen and reddened abomasal folds, presence of intestinal edema and petechial haemorrhage.	Malignant catarrhal Fever (MCF) Cattle, buffalo	IBR/IPV, rinderpest, pneumonic pasteurelosis, photosensitive dermatitis, mucosal disease	Total condemnation
4	Possible inflammation of GI mucosa.	Rabies	Encephalitis, botulism, Guillain-barre syndrome,	Total condemnation

		Cattle, pig , other animals	herpes simplex encephalitis, poliomyelitis, tetanus	
5	Ulcerative, nodular lumps on the skin. Thrombosis of skin vessels followed by cutaneous infarction and sloughing. Ulcerative lesions in the mucosa of the respiratory and digestive tract. Reddish, haemorrhagic to whitish lesions in the lungs. Edema (interlobular) and nodules in the lungs and heart lesions	Lumpy skin disease Cattle, sheep, goat	Pseudo lumpy skin disease, bovine herpes mamillitis, dermatophilosis, ring worm, tick bites, rinderpest, demodecosis, hypoderma bovis infestation, photosensitization, Bovine popular stomatis, cutaneous TB	Mild lesions-conditionally approve. If general systemic lesions, total condemnation.
6	Emphysamatus carcass and blood stained frothy exudates from the nostrils and anus. Dark red to black discolouration of the loin, back or leg. Sponge like bubbly appearance of the muscles with a peculiar rancid odour. Yellowish, gelatinous subcutaneous tissue and associated gas bubbles. Blood stained fluid in body cavities	Black quarter Cattle, sheep and goat	Anthrax, lightning strike, clostridial infection, bacillary hemoglobinuria, lactation tetany, extensive hemorrhage, acute lead poisoning	Total condemnation
9	Tubercle lesion in the lymph nodes of the head, lungs, intestine and carcass. These have usually a well-defined capsule enclosing a caseous mass with a calcified centre. Active lesions may have a reddened periphery and caseous mass in the centre of a lymph node. Inactive lesions may be calcified	Tuberculosis Cattle, sheep, pig, birds and goat	Bilateral focal pneumonia, carcinomatosis, silicosis, sarcoidosis, pulmonary congestion	Localized to few locations - conditionally passed. If lesions are generalized, total condemnation

	and encapsulated. Nodules on the pleura and peritoneum and also lesions in the lungs, liver, spleen, kidneys			
10	Thickened and corrugated intestinal mucosa and enlarged caecal lymph nodes	Johne's disease Cattle, sheep, and goat	Bovine TB, chronic fasciolosis, gastrointestinal parasitism,	Total condemnation if carcass is emaciated. Otherwise only intestines are generally condemned.
11	Viscid exudates mixed with pus, foetus cotyledon and maternal caruncle are covered with grey and yellow purulent materials. In male, necrotic and purulent foci in testicles.	Brucellosis Cattle, Pig, and goat	Typhoid fever, malaria, TB, lymphoma, leptospirosis, Rheumatic diseases	Total condemnation
12	Peracute septicemia showing multiple sub-mucosal or subserosal haemorrhage and few cases of necrotising fibrinous enteritis. Acute enteritis showing blood stained contents	Salmonellosis (Paratyphoid) Cattle, Pig, sheep and goat	Campylobacterial infection, cyclospora infection, E. coli infection, listeriosis, shigellosis, vibro infection, Yersinia enterocolita	Total condemnation
13	Dark-tarry blood discharge from body orifices. Absence of rigor mortis. Haemorrhage of the mucous and serous membranes, lymph nodes and subcutaneous tissue. Splenomegaly and Severe haemorrhagic enteritis. Degeneration of the liver and kidneys. Emphysematous and rapid decomposition of carcass. Localized	Anthrax Cattle, Pig, sheep	HS, coccidiomycosis, diphtheria, meningitis, viral pneumonia	Total condemnation

	lesions in the intestine of pigs (dysentery)			
14	Subcutaneous swellings characterized with yellowish gelatinous fluid especially around the throat region, brisket and perineum. Enlarged haemorrhagic lymph nodes. Haemorrhage in the organs and pneumonia. Petechial haemorrhage in the serous membranes which are extensive in some cases	Hemorrhagic septicemia (Pasteurellosis) Cattle	Black leg, rinderpest, anthrax, poisoning	Total condemnation
15	Enlarged tongue showing tough fibrous consistency. A cluster of small yellowish nodules and erosions of tongue mucosa. Granulomatous lesions in the lymph nodes. Marked thickening of the lower part of oesophagus and stomach wall. Raised plaques and erosions in the mucosa of rumen and reticulum. Liver and diaphragm lesions due to contact spread from reticulum	Actinobacillosis (Wooden tongue) Cattle	Actinomycosis, pyogenic abscesses, granulation tissue, neoplasia	Partially condemned. If the lesions are generalized, carcass and offal are totally condemned.
16	Lesions in the mandible or maxilla. Granulomatous lesions in lower part of oesophagus or anterior part of the reticulum. Local peritonitis. Mild abomasitis and enteritis	Actinomycosis (Lumpy Jaw) Cattle	Aspiration and bacterial pneumonia, blastomycosis, brain abscess, colon cancer, nocardiosis, Non-Hodgkin lymphoma, TB	Partially condemned Affected organs such as head, tongue, stomach, liver, lungs are condemned.

17	Adhesions of rumen, reticulum and peritoneum and abscessation. Acute or chronic peritonitis. Splenic abscessation. Traumatic pericarditis. Metallic objects such as nails, pieces of wire, magnets etc. in the reticulum. Lung abscessation or pneumonia Septic pleuritic. Edema of the chest	Traumatic Reticuloperitonitis. All animals.	Abomassal ulceration, liver abscessation, pyelonephritis, ketosis, abomassal displacement, volvulus, grain over load	Conditionally passed
18	Inflammation of oral cavity with ulcers, erosions and necrosis especially the dental pads. Tongue becomes blue and enlarged and ulceration of intestines. Generalized oedema and necrosis of cardiac and skeletal muscles	Blue tongue Cattle, Pig, sheep	FMD, vascular stomatitis, PPR, photosensitization	Total condemnation
19	Degenerative changes in the CNS	BSE (Mad cow disease) Cattle	Rabies, brain tumor, lead poisoning, metabolic disease, polioencephalomalacia	Total condemnation
20	The cyst of this tapeworm in the massester muscles beside shoulder, tongue, diaphragm, oesophagus, heart, lungs, livers or other internal organs.	Measly beef Cattle	Tumor, eosinophilic myositis, abscess, granuloma	Conditionally passed if the cyst infestation is localized.
21	The cyst of the tapeworm <i>Taenia solium</i> are noticed in the heart, tongue, diaphragm, abdominal and intercostals muscles. Also found in the deep muscles of thigh etc.	Measly pork Pig	Brain abscess, tuberculoma, tumors, vasculitis	Conditionally passed if the cyst infestation is localized.

22	The cyst of the tapeworm noticed in the liver and lungs.	Hydatid disease Cattle, sheep and pig	Tenia ovis, Taenia saginata, T. hydatigina	Conditionally passed if the cyst infestation is localized.
23	Greyish white nodules of varying sizes from pin head to pea form in the intestines	Pimply gut Cattle, sheep and pig	Bacterial bronchopneumonia, abscess, necrobacillosis, TB, actinobacillosis, hydatid cyst	Conditionally passed if the cyst infestation is localized.
24	Trichinella found in the tongue, diaphragm, oesophagus, trachea, intercostals and abdominal muscles. Macroscopically, numerous white specks are seen in meat, which gets calcified and make gritty sound when cut with knife.	Trichinosis Pig	Strongyloidiasis, toxocariasis,	Total condemnation

Post-mortem examination in poultry

The same general principles apply to poultry as for large animals. PME consist of viewing the carcass, palpation and smell. The colour, shape, and consistency of organs and tissues must be observed carefully. The colour of the poultry carcass depends on age, sex, nutrition and the scalding temperature.

Examine the external surfaces of carcasses for dressing defects, bruises or disease lesions. Intestinal tract, liver, spleen, and heart must be exposed for visual examination and palpation. The examining officer should be able to look inside the carcass and detect any pathological lesions such as air sac inflammation, peritonitis, oviduct inflammation (salpingitis) etc. Contamination by faeces and bile should also be observed. External lesions on the carcass include the swelling of the sinuses, nasal and ocular discharge (if the head is present), skin lesions, joint swellings etc.

Judgement of the PME

The carcasses or parts thereof of all poultry inspected at an abattoir and found at the time of postmortem inspection, or at any subsequent inspection to be affected with any disease or conditions shall be dealt in accordance with the followings.

General abnormal conditions

1) Air sac infection

- If the lesions are severe and the carcass is emaciated or there is systemic disturbance, the entire carcass shall be condemned.
- If the lesions are slight and restricted, the affected part of the carcass shall be removed and the remaining carcass passed for human consumption.

2) Bruise

- The whole carcass shall be condemned if the bruising is severe and extensive.
- If bruising is localized, only part of the carcass is removed and the rest of the carcass shall be passed for human consumption

3) Contamination

- Carcasses contaminated by extensive bile or faecal spillage, or other substance which render the carcass unfit for human consumption shall be condemned.

4) Gout

- Carcasses affected with gout and showing marked deposits or urates in the organs or tissues or evidence of general systemic disturbances shall be condemned

5) Inflammatory Process

- If the inflammatory process is wide-spread or there is evidence of systemic disturbance the whole carcass shall be condemned
- If the inflammatory process is localized, affected part shall be removed and the remaining part of the carcass shall be passed for human consumption.

6) Parasitic Infestation

- If the parasitic infestation is extensive or if the carcass is emaciated, the entire carcass shall be condemned.
- If the parasitic infestation is slight, the affected part shall be removed and the remaining part of the carcass shall be passed for human consumption.

7) Pyemia, Septicemia or Toxemia

- Carcass showing evidence of any pyemia, septicemia or toxemia shall be condemned.

8) Tumours

- Any organ or part affected with a tumour shall be removed and the remaining part shall be passed for human consumption.
- The entire carcass shall be condemned if there is evidence of metastasis or that the general condition of the bird has been affected by the size, position or nature of tumour.
- Emaciated carcass which are poorly fleshed with obvious wasting of the breast and thigh muscle shall be condemned.

9) Specific Diseases

- Carcass affected with infectious/and zoonotic diseases shall be condemned:

Post-mortem changes and assessment of quality of fish

Fresh seafood is highly perishable and undergoes rapid post-harvest quality decline due to autolysis induced by endogenous enzymes. The endogenous enzymes from fresh tissues are thought to be causing seafood texture softening.

Following the death of fish, the brain control as well as blood circulation ceases. This results in an inability to resynthesize adenosine triphosphate (ATP) and to transport various materials essential in living cells. The death-stiffening of the muscle tissue referred to as rigor mortis, occurs sooner or later and glycolysis forms some organic acids to decrease in pH values. After passing the rigor mortis, the muscle tissue loses the stiffness, followed by autolysis forming amino acids and other low molecular weight compounds. Then, microorganisms grow by utilizing these compounds. During the spoilage by microorganisms, some specific putrefactive substances such as trimethylamine and histamine are formed depending on fish species. When glycogen is degraded to lactic acid, the pH of the muscle tissue begins to fall from initial physiological values of 7.2 to 7.4 to the ultimate post-mortem pH of 6.0 or less.

This rate of spoilage is temperature dependent and lowering the temperature will reduce the rate of spoilage. There are many methods like sensory and non-sensory or instrumental method of quality assessment.

Sensory evaluation of fish quality in the market

The sensory evaluation of raw fish in markets and landing sites is done by assessing the appearance, texture and odour. Most scoring systems are based upon changes taking place during storage in melting ice. The characteristic changes vary depending on the storage method. The appearance of

fish stored under chilled condition without ice does not change as much as for iced fish, but the fish spoil more rapidly and an evaluation of cooked flavour will be necessary.

The characteristic sensory changes in fish post mortem vary considerably depending on fish species and storage method. A general description for practical implementation in quality assessment of fish in the market is provided in the Table 4. The rating scale ranges from 0 to 3 where 3 corresponds to the best quality while 0 corresponds to the worst quality and those with the rating of 0 must be deemed unfit for human consumption.

Table 4: Freshness assessment and rating of fresh fish in the market

Part of fish inspected	Ratings			
	3	2	1	0 (unfit)
Appearance				
Skin	Bright and iridescent pigmentation, no discoloration. Mucus looks aqueous and transparent	Pigmentation bright but not lustrous. Slightly cloudy mucus	Pigmentation in the process of becoming discoloured and dull. Milky mucus	Dull pigmentation Opaque mucus
Eye	Convex (bulging). Transparent cornea. Black and bright pupil.	Convex and slightly sunken. Slightly opalescent cornea. Black and dull pupil.	Flat. Opalescent cornea. Opaque pupil.	Concave in the centre. Milky cornea. Grey pupil.
Gills	Brightly coloured. Mucus translucent.	Less coloured. Slight opacity in mucus.	Becoming discoloured. Opaque mucus.	Yellowish. Milky mucus.
Organs	Bright red, as should the blood inside the aorta	Dull red, blood becoming discoloured	Pale red	Brownish discolouration
Condition				
Flesh	Firm and elastic. Smooth surface	Less elastic	Slightly soft (flaccid), less elastic. Waxy (velvety) and dull surface	Soft (flaccid). Scales easily detached from skin

Peritoneum	Sticks completely to flesh	Sticks	Sticks slightly	Does not stick
Smell				
Gills, skin abdominal cavity	Seaweed	No smell of seaweed or any bad smell	Slightly sour	Sour

Chapter 3: Meat Inspection in Meat Shop

Introduction

Examining the meat intended for human consumption at retail shops before such meat are sold to the consumers has become an essential activity in the meat value chain to ensure the stored meat is not spoilt in the process of storage. As meat is a high risk category of food, meat inspection procedures should be holistic enough to exclude every threats from the meat before allowing for sale. Meat inspection involves organoleptic examination to identify any abnormalities in meat, removing it by incision and partial/total condemnation of meat/organs. The main purpose of meat inspection is to provide safe and wholesome meat for human consumption. This serves as another layer of check to prevent unsafe meat items entering human food chain.

Meat inspection tools/equipment

The meat inspection officials must be provided with the following tools/equipment:

- Meat inspection knives
- Probe-thermometer
- Sample collection tubes
- Gloves
- Face mask
- Meat inspection checklist
- Fit for Human Consumption Certificates (booklet)

Inspection at meat shops

To ensure critical inspection points are not missed and to comply with the inspection requirements, a meat inspection checklist has to be used every time inspection is carried out.

- All meat shops should be operating in accordance with the requirements of the *Minimum Standard for Meat Retailing and Transportation*
- Meat shops should be assessed for compliance with the requirements prescribed in the standard.
- General principles of meat inspection in meat shop are similar to inspection of carcass at post mortem. Follow the techniques of organoleptic evaluation (visual examination, smell, palpation) and incision wherever required.
- Minimum Personal Protection Equipment (PPE) viz. hand gloves and face mask should be worn while carrying out meat inspection.
- Surfaces of meat should be examined for any abnormalities (blood clots, caseated pus, cysts, bruises, contamination with feces/ soil etc.).
- Surfaces of organs must be palpated for any evidences of parasitic cysts/parasites and if required, clean incisions have to be made for closer examination.
- Mastication muscles of the head and the tongue muscles may be incised and checked for parasitic cysts.
- Frozen meat items should be sold frozen. Once thawed, re-freezing should be discouraged.

- Core temperature of chunky frozen meat items should be checked using probe thermometer.
- Remains of previous stock should be assessed for evidence of contamination, microbial growth (bacteria and fungus), slime formation, colour change, putrefaction, abnormal odour etc. before allowing such stocks for resale.
- Freezers should be checked for temperature abuse and over stocking.
- Organs or parts viz. stomach, intestine, head, trotters etc. should be examined at the end.
- Improperly cleaned stomach and intestine must not be allowed for sale from a meat shop. If desirable, such items should be thoroughly cleaned and sold from a separate container/display counter.
- Head and trotters meant for human consumption should be de-haired properly, hooves and horns removed, cleaned and sold from a separate counter/container.
- Wherever required, samples may be collected and submitted for laboratory analysis.
- Once satisfied, fit for human consumption certificate may be issued with the validity of 24 hours for the quantity of meat inspected. The certificate shall be displayed on the notice board of the meat shop.

Freezing and storage of meat

Freezing is an excellent way to preserve animal products such as meat, fish and sea foods. In some instances, eggs and dairy foods can also be frozen for later use. Freezing does not sterilize food. The extreme cold simply retards the growth of microorganisms and slows down the changes that affect quality or cause spoilage in food. The quality and safety of the final product depends on how the product is handled before, during and after freezing. Freezing affects the texture, colour, juiciness and flavour of foods. Hence, it is important to start with high quality meat. Freezing does not improve meat quality, it only prolongs the shelf life.

Operation of freezer truck for transportation of frozen meat

1) Pre-loading preparations

- Check and ensure that the loading compartment and sealing strip are in good condition. The doors must be securely locked, and the sealing strip must be well sealed.
- Close the compartment doors to prevent the outside air from affecting the refrigeration effects and prolong the time required for the pre-cooling of the freezer truck.
- Start the refrigeration system along with temperature monitoring system.
- Turn the refrigeration system off when the freezer truck is pre-cooled to the coldest temperature required by meat transport (-16 to -18°C).

2) Loading operation

- When the pre-cooling temperature of the freezer truck reaches the range of -16 to -18°C, put off the refrigeration system and start loading frozen meat.
- After the refrigeration system is stopped, the frozen meat can be loaded into the truck as fast as possible to prevent the outflow of cold air.

- After the freezer truck is loaded with frozen meat, close the door and make sure that the door is tight and without leakages.
- Re-start the refrigeration system.
- The loading time must be as short as possible (maximum 5 minutes), and the interval between re-opening the door must be more than 10 minutes.

3) Transportation of frozen meat

- During transportation, the door of the freezer truck should not be opened at will if there is no abnormal situation.
- The transporter/driver should pay attention to the control panel of the freezer truck temperature control system to ensure that the temperature of the compartment during transportation meets the meat storage conditions (-16 to -18°C).
- If an abnormal situation occurs during transportation, the driver must immediately activate emergency plan to avoid temperature abuse of the frozen meat.

4) Unloading operation

- On reaching the destination, switch off the refrigeration system and note the temperature record on the control panel.
- Complete the unloading process and store the frozen meat in the frozen meat store.

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