

Post-mortem inspection

Post-mortem inspection systems should include:

- procedures and tests that are risk-based to the extent possible and practicable;
- confirmation of proper stunning and bleeding;
- availability of inspection as soon as is practicable after completion of dressing;
- visual inspection of the carcass and other relevant parts, including inedible parts, as determined by the competent authority;
- palpation and/or incision of the carcass and other relevant parts, including inedible parts, as determined by the competent authority according to a risk-based approach;
- additional palpation and/or incisions, as necessary to reach a judgement for an individual carcass and other relevant parts, and under appropriate hygiene control;
- more detailed inspection of edible parts intended for human consumption compared with inspection of those parts for indicator purposes alone, as appropriate to the circumstances;
- systematic, multiple incisions of lymph nodes where incision is necessary;
- other organoleptic inspection procedures, e.g. smell, touch;
- where necessary, laboratory diagnostic and other tests carried out by the competent authority or by the establishment operator under instruction;
- performance criteria for the outcomes of organoleptic inspection;
- regulatory authority to slow or halt processing so as to allow adequate post-mortem inspection at all times;
- removal of specified parts if required by the competent authority, e.g. "specified risk materials" for BSE; and
- proper use and secure storage of equipment for health marking.

Source: FAO/WHO. 2004. Draft code of hygienic practice for meat. In *Report of the 10th Session of the Codex Committee on Meat Hygiene*. Alinorm 04/27/16. Rome (available at ftp://ftp.fao.org/codex/Alinorm04/AL04_16e.pdf).

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INTRODUCTION

Post-mortem inspection of carcasses is part of the wider process of screening animals and meat for fitness for human consumption, a process that includes on-farm monitoring, ante-mortem inspection and HACCP implementation in abattoirs.

Lately, there has been a widespread recognition that traditional meat inspection protocols, involving detailed inspection of tissues, particularly lymph nodes, through multiple incision and palpation, are not necessarily universally appropriate and they may in fact introduce or spread contamination. In parts of the world where particular zoonotic diseases that produce gross pathological manifestations have been eradicated or are controlled to the point where occurrence is a rare event, the major hazard in meat is microbiological (*Escherichia coli* in beef; *Salmonella* in beef and pork; *Yersinia* in pork) and traditional inspection methods will not detect this. For these microbiological hazards, a risk-based approach to post-mortem meat inspection may be deemed more appropriate.

However, in areas where diseases such as tuberculosis or erysipelas and parasitic infestations such as *Cysticercus bovis* and fascioliasis are prevalent, incision and palpation are the best means of revealing the disease. In other words, the general rule is that the type of inspection must reflect local disease risk.

Further changes to the inspection process for cattle and sheep have been required since the recognition of a risk to human health posed by transmissible spongiform encephalopathies (TSEs), primarily bovine spongiform encephalopathy (BSE). It is now imperative to remove from the edible carcass known tissues or organs that carry the highest risk of infectivity in a BSE-infected animal and to check that their removal has been complete. In addition, the means of reducing the risk of carcass contamination by brain and spinal cord (the highest risk organs), arising during slaughter and dressing procedures, are being identified as research investigations proceed. Unfortunately, TSEs do not manifest as gross pathological lesions, and cannot be detected on post-mortem meat inspection alone. The risk is minimized by removing suspect animals at ante-mortem inspection, and by removing the high-risk tissues.

The aims of post-mortem inspection are to ensure that the meat produced is wholesome, disease-free, and will pose no risk to human health. The decision as to whether meat is fit for consumption or not will utilize many skills of observation and evaluation, and should take into consideration the results of ante-mortem inspection, as well as any available information on the disease history of the herd or region of origin of the animals.

GENERAL PRINCIPLES

- Post-mortem inspection should be carried out without delay after dressing of the carcass is complete. Some lesions may fade with time. Conversely, it should be possible to set suspect carcasses aside for re-inspection later, as some lesions will intensify with time.
- Apart from skin (plus sheep's and goat's heads, and the penis from all species, where these organs are not intended for human consumption), no part of the animal should be removed from the premises until post-mortem inspection is completed and any samples required for further testing have been obtained.
- If blood is collected for human consumption, it is subject to inspection and subsequent passing as fit or unfit in the same way as edible meat and offal. Where blood or offal from several animals is collected in the same container, the batch must be rejected if any single animal is unfit. Conversely, if batched blood shows a condition requiring rejection of a carcass, all carcasses donating the batched blood are rejected.
- It is essential that correlation of a carcass with its separated offal be maintained until inspection is finished because the result of inspection of either carcass or offal will have implications for the action required to be taken on the other part. An effective labelling system is thus required for both carcasses and offal.
- Parts that contain lesions (e.g. abscesses, inflamed lymph nodes, cysts), exhibit a condition deemed inappropriate in edible meat, or present evidence of adulteration must be detained and labelled as such, until further inspection is completed.

- Parts found to be unfit for human consumption must be labelled as such.
- Clear marking of carcasses passed as fit for human consumption must follow immediately after the completion of inspection. The mark must be clearly visible and unambiguous (e.g. in the European Union [EU] the “health mark”); unfit carcasses are not marked in this way. Where TSE testing is undertaken, the health mark must not be applied until the test result is known.
- Some localized conditions (abscess, arthritis, bruising, contamination) may require partial rejection of a carcass or organ, with only the affected part and tissue in the immediate vicinity being separated and classed as unfit.
- Many conditions exhibit a range of severity ranging from localized to general, acute to chronic, and there is a corresponding range of measures that apply to address the health risk. For example, arthritis can be mild with little damage to the cartilaginous surfaces, non-septic and limited to one joint, which can then be passed as fit for consumption. Or, passing through many intermediate stages, it can be severe and septic, with abscesses around several joints and thus requiring rejection of the whole carcass. Decisions on rejection have to be made on a case-by-case basis, after assessing the significance of the findings.

Post-mortem inspection should provide necessary information for the scientific evaluation of pathological lesions pertinent to the wholesomeness of meat.

Professional and technical knowledge must be fully utilized in:

- viewing, incision, palpation and olfaction techniques;
- classifying lesions into one of two major categories – acute or chronic;
- establishing whether the condition is localized or generalized, and the extent of systemic changes in other organs or tissues;
- determining 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;
- coordinating all the components of ante-mortem and post-mortem findings to make a final diagnosis;
- submitting the samples to the laboratory for diagnostic support, if the abattoir has holding and refrigeration facilities for carcasses under detention.

TRADITIONAL INSPECTION PROCEDURES AND ASSESSMENTS

Post-mortem inspection will utilize many body senses, including sight, smell and touch. Incision into organs and lymph nodes will allow more detailed inspection of these parts. First, a general visual inspection of the carcass, offal and, where appropriate, blood, should be made to detect bruising, oedema, arthritis, condition of peritoneum and pleura and any swelling or abnormality. Other procedures are species- and/or age-determined.

Bovines six weeks old or older

- **Head.** Detailed examination of lymph nodes by incision is needed, the nodes being the submaxillary, retropharyngeal and parotid. The cheek muscles are inspected using deep incisions: two parallel incisions are made in the masseter muscle and a single longitudinal incision in the pterygoid muscle. The mouth and tongue are visually inspected and the tongue is also palpated.
- **Lungs and trachea.** If the lungs are intended for human consumption, incision is additional to visual and palpation inspection required for lungs generally. The trachea and bronchi are opened by knife and the lower ends of the suspended lungs are incised. The bronchial and mediastinal lymph nodes are incised.
- **Heart and pericardium.** Following visual examination of the heart and pericardium, the former is incised down its long axis, cutting through the interventricular septum to expose the ventricular chambers.
- **Liver.** A combination of visual and palpation inspection procedures to include the hepatic and pancreatic lymph nodes. Incision of the caudate lobe of the liver is also required to expose the bile ducts. The presence of fascioliasis lesions should also be checked.
- **Alimentary tract.** Visual inspection of the tract and mesentery accompanied by palpation of the gastric and mesenteric lymph nodes and incision if deemed necessary.
- **Spleen.** Visual/palpation.

- **Kidneys.** Visual and detailed examination of renal lymph nodes if necessary.
- **Diaphragm.** Visual inspection.
- **Genital organs.** Visual inspection.
- **Udder.** If intended for human consumption, each half is incised by a deep cut extending to the lactiferous sinuses and the lymph nodes are incised. Otherwise, visual inspection and examination of the lymph nodes through palpation.

Bovines less than six weeks old

- As for older cattle, except for the following inspections, which are not necessary:
 - **head:** submaxillary and parotid lymph nodes, masseter muscle;
 - **liver:** bile ducts and pancreatic lymph nodes.
- Additional items are:
 - **umbilicus:** visual inspection, and palpation, incision if deemed necessary;
 - **joints:** visual and palpation, incision to examine synovial fluid if deemed necessary.

Pigs

- Similar to adult cattle, except for the following inspections, which are not necessary:
 - **head:** only the submaxillary lymph node is inspected;
 - **liver:** no bile duct incision;
 - **udder:** visual inspection and incision of supramammary lymph nodes in sows.
- As in young cattle, the **umbilicus** and **joints** of young pigs are inspected visually and by palpation and, if thought necessary, by incision.

Sheep and goats

- Inspection of small ruminants is less detailed than for cattle and pigs. The following procedures are generally required:
 - **head:** if destined for human consumption, the throat, mouth, tongue, retropharyngeal and parotid lymph nodes are examined;
 - **lungs:** examine for parasites, particularly nematode worms and hydatid cysts;
 - **carcass:** palpate to detect inoculation abscesses;
 - **heart:** incise lengthways;
 - **umbilicus:** (young animals) visual inspection and incision where necessary;

- **joints:** (young animals) visual inspection and incision where necessary.

RISK-BASED INSPECTION PROCEDURES

In certain circumstances, the competent authority may allow the use of a risk-based system of inspection instead of the traditional inspection procedures outlined above. In traditional systems, each individual animal is fully inspected, whereas a risk-based system may allow random full inspection of a proportion of the animals presented for slaughter. For a risk-based system to ensure wholesomeness of meat, the animals presented must be uniform, slaughter-generation (i.e. young) animals, of known health status. Older, cull animals would not be acceptable in such a system, as they carry a high risk of carrying diseases and pathogens.

To fulfil the requirement of known health status, an integrated rearing system would be needed, so that the disease history and management details of the herd/flock are known to the official carrying out meat inspection, including results of previous post-mortem inspections. From this information, the official would be able to make a judgement on the risk posed by the animals presented, and modify the post-mortem inspection regime accordingly. Therefore, if the risk were microbiological only, minimizing cross-contamination and preventing faecal contamination would be the priority, so the inspection would be predominantly visual. However, if the risks were pathological, there would be a case for returning to traditional meat inspection procedures to allow removal of high-risk tissues and carcasses.

CARCASS JUDGEMENT

Trimming or condemnation may involve:

- any portion of a carcass or a carcass that is abnormal or diseased;
- any portion of a carcass or a carcass affected with a condition that may present a hazard to human health;
- any portion of a carcass or a carcass that may be repulsive to the consumer.

Localized versus generalized conditions

It is important to differentiate between a localized and a generalized condition in the judgement of an animal carcass. In a localized condition, a lesion is restricted by the animal defence mechanisms to a certain area or organ. Systemic changes associated with a localized condition may also occur, e.g. jaundice caused by liver infection or toxæmia following pyometra (abscess in the uterus).

In a generalized condition, the animal's defence mechanisms are unable to stop the spread of the disease process by way of the circulatory or lymphatic systems. The lymph nodes of the carcass should be examined if pathological lesions are generalized.

Some of the signs of a generalized disease are:

- generalized inflammation of lymph nodes, including the lymph nodes of the head, viscera and/or the lymph nodes of the carcass;
- inflammation of joints;
- lesions in different organs including liver, spleen, kidneys and heart;
- the presence of multiple abscesses in different portions of the carcass, including the spine of ruminants.

Generalized lesions usually require more severe judgement than localized lesions.

Acute versus chronic conditions

Acute conditions

An acute condition implies that a lesion has developed over a period of some days, whereas a chronic condition implies the development of

TABLE 8.1. Post-mortem inspection techniques

Tissue	Inspection technique	Examples of abnormality	Examples of possible causes	Judgement
Lymph nodes	Visual Palpation Incision	Enlargement Haemorrhage Abscess Calcification	Local infection e.g. mastitis, foot abscess Systemic disease e.g. tuberculosis, swine fever	Local infections – examine and trim affected part Systemic disease – reject for human consumption, consider animal health risks
Muscle, including heart, tongue, cheek muscles	Visual Palpation Incision	Bruising Abscess Cyst Pale discoloration Petechial haemorrhages (blood splash)	Trauma Infection Tapeworm Protozoal infestation	Bruises – trim, consider welfare Infections – trim, judge carcass on merits Tapeworm – trim, check for others, if generalized, reject Protozoa – reject
Lungs	Visual Palpation Incision	Pneumonia Abscess Cyst	Infection Tuberculosis Tapeworm	Check for generalized disease and judge carcass accordingly
Liver	Visual Palpation Incision	Abscess Swelling Liver flukes	Infection Systemic illness Fluke infestation	Reject liver, check for signs of systemic disease and judge carcass accordingly
Kidney	Visual Palpation Incision	Cyst Petechial haemorrhages Pus	Hydronephrosis Systemic illness e.g. swine fever, pyelonephritis	Hydronephrosis – check carcass for abnormal odour, judge accordingly, reject kidney Pyelonephritis/ petechiae – check for systemic disease, judge accordingly, consider animal health risks

lesions over a period of some weeks, months or years. A subacute condition refers to a time period between an acute and a chronic condition.

The acute stage is manifested by inflammation of different organs or tissues, enlarged haemorrhagic lymph nodes and often by petechial haemorrhage of the mucosal and serous membranes and different organs, such as heart, kidney and liver. An acute stage parallels with the generalized disease complex, when an acute infection tends to overcome the animal's immune system and becomes generalized.

Each case showing systemic lesions should be assessed individually taking into account the significance that these lesions have for major organ systems, especially the liver, kidneys, heart, spleen and lymphatic system, as well as the general condition of the carcass.

Chronic conditions

In a chronic condition, inflammation associated with congestion is replaced by adhesions,

necrotic and fibrotic tissue or abscesses. The judgement in the chronic stage is less severe and frequently the removal of affected portions is required, without the condemnation of the carcass. However, judgement on the animal or carcass tends to be more complicated in subchronic and sometimes in peracute stages. If generalized necrotic tissue is associated with previous infection, the carcass must be condemned.

GUIDELINES FOR MINIMUM POST-MORTEM INSPECTION REQUIREMENTS¹

Heads

General

View external surfaces. For cattle, horses, pigs and game view the oral and nasal cavities.

Lymph nodes (Figure 8.1)

Submaxillary, parotid and retropharyngeal: view and incise.²

Tongue

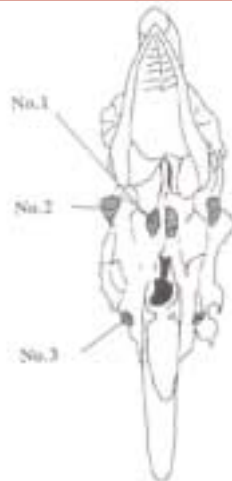
View and palpate.³ View only in calves up to six weeks of age.

Other

Cattle

Except in calves up to six weeks of age, the oesophagus of all cattle and calves should be separated from its attachment to the trachea and viewed. As part of inspection of all cattle and calves over the age of six weeks 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; in addition one incision into *Musculus triceps brachii*, 5 cm behind the elbow, should be made.

FIGURE 8.1 Head inspection



Retropharyngeal (1), parotid (2) and submaxillary (3) lymph nodes are viewed and incised by multiple incisions and slicing

Source: D. Herenda, Canada.

¹ These are guidelines for inspection requirements; the inspection can be made more intensive or less intensive depending on the outcome of the examination.

² "Incise" means to incise by multiple incisions or slicing.

³ "Palpate" means to view and palpate.

Horses

The head should be split lengthwise in the medial line and the nasal septum removed and examined in all horses that are from areas where glanders is endemic.

Pigs

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

Game

Inspection cuts for tapeworm cysts are not necessary, as these cysts are generally not infective for humans.

Viscera

Lungs (Figure 8.2 and Photo 8.1)

View and palpate. Except in sheep and goats, the bronchi should be opened up by a transverse

incision across the diaphragmatic lobes. For horses and cattle, the larynx, trachea and main bronchi should be opened along their length. **Lymph nodes.** Bronchial (tracheobronchial) and mediastinal: incise. View only in calves up to six weeks of age.

Heart (Photo 8.2)

View after the removal of the pericardium.

Cattle

The heart of all cattle and calves over the age of six weeks 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; this inspection of the heart should also be undertaken in calves up to six weeks of age that are from areas where *C. bovis* is endemic.

PHOTO 8.1
Lung inspection in buffalo: open trachea and incised bronchial and mediastinal lymph nodes



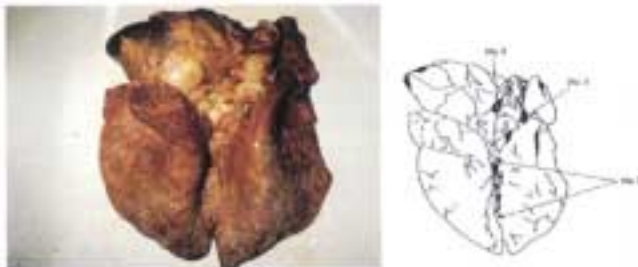
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PHOTO 8.2
Heart inspection: lengthwise incisions (minimum four) from base to apex into the heart muscles; observe cut surfaces

FIGURE 8.2 Lung inspection



Bronchial left (1) and right (2) and mediastinal (3) lymph nodes are viewed and incised
Source: D. Herenda, Canada.



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PHOTO 8.3
Stomach and spleen inspection: viewing of rumen and viewing and palpation of spleen

PHOTO 8.4
Viewing of
rumen, reticulum,
omasum and
abomasum



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Pigs

The heart of all pigs derived from areas where there is a risk of *C. cellulosae* being present should be opened up and the deep incision made into the septum.

Liver (Figure 8.3)

View and palpate entire surface (both sides). View the gall bladder. For cattle over six weeks of age, incise as deemed appropriate to detect liver flukes. Open large bile ducts. For sheep, pigs and game, incise as deemed appropriate for parasites.

Lymph nodes. Portal (hepatic), view and incise.

Spleen (Photo 8.3)

Palpate.

Gastro-intestinal tract (Photos 8.4 and 8.5)

View (only, in calves up to six weeks of age). Mesenteric lymph nodes, view only in calves up to six weeks of age. View and incise if any lesions were observed in the submaxillary lymph nodes.

Kidneys

View after enucleation. In grey and white horses, incise.

Uterus (adults)

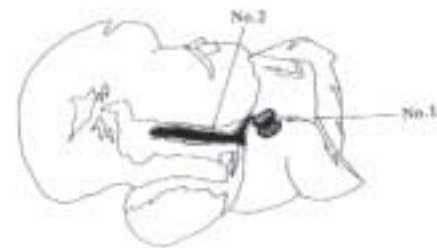
View.

Carcass

General

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

FIGURE 8.3 Liver inspection



Incised portal (hepatic) lymph nodes (1) and opened large bile duct (2)

Source: D. Herenda, Canada.

Lymph nodes

The main carcass lymph nodes – being the precrucial, popliteal, anal, superficial inguinal, ischiatic, internal and external iliac, lumbar, renal, sternal, prepectoral, prescapular and atlantal nodes, as well as the lymph nodes of the head and viscera – should be incised and examined in all animals in which systemic or generalized disease is suspected, in all animals positive to a diagnostic test for tuberculosis and in all animals in which lesions suggestive of tuberculosis are found at post-mortem inspection. In all other animals the following examination techniques should be used for specific lymph nodes:

- superficial inguinal (male) (Photo 8.6) – palpate;
- supramammary (female) – palpate and incise when udder is or has been in lactation, or in the case of mastitis;
- external and internal iliac (Photos 8.6 and 8.7) – palpate iliac nodes in pigs;
- prepectoral (Photo 8.8) – palpate;
- popliteal (Photo 8.9) – palpate (only sheep/goats and game/antelope);
- renal (Figure 8.4) – palpate (cattle, horses, pigs) or incise if disease is suspected;
- prescapular (Photo 8.10) and prefemoral – palpate (only sheep and goats).

Other

The muscles and the lymph nodes (lymphonodi sub-rhomboidei) beneath one of the two scapular cartilages of all grey or white horses should be examined for melanosis after loosening the attachment of one shoulder.

SUPERVISION OF HYGIENIC DRESSING OF CARCASSES

During dressing the carcass is exposed to contamination from:

- the abattoir environment, including implements used and the hands of the operators: a variety of bacteria, fungi and yeasts are present in the abattoir environment. Studies in abattoirs indicate that *Salmonella* counts in the implements used may vary from 0–270 per cm² or more in each implement, depending on their regular cleaning and sanitation, the scabbards having the highest numbers;
- the hides of the animals: hides are heavily contaminated parts and can reach up to 3 x 10⁶ bacteria per cm² or more;

PHOTO 8.6
Superficial inguinal and internal and external iliac lymph nodes in a pig: viewed and palpated on routine post-mortem examination



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PHOTO 8.5
Viewing and incision of the mesenteric lymph nodes: in this case an incision was performed to demonstrate the mesenteric lymph nodes chain



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PHOTO 8.7
Medial view of the hindquarter: superficial inguinal, internal and external iliac and lumbar lymph nodes are palpated and incised in systemic or generalized disease

PHOTO 8.8
Medial view of the forequarter with intercostal, suprasternal, preternal and prepectoral lymph nodes: preternal and prepectoral lymph nodes are incised



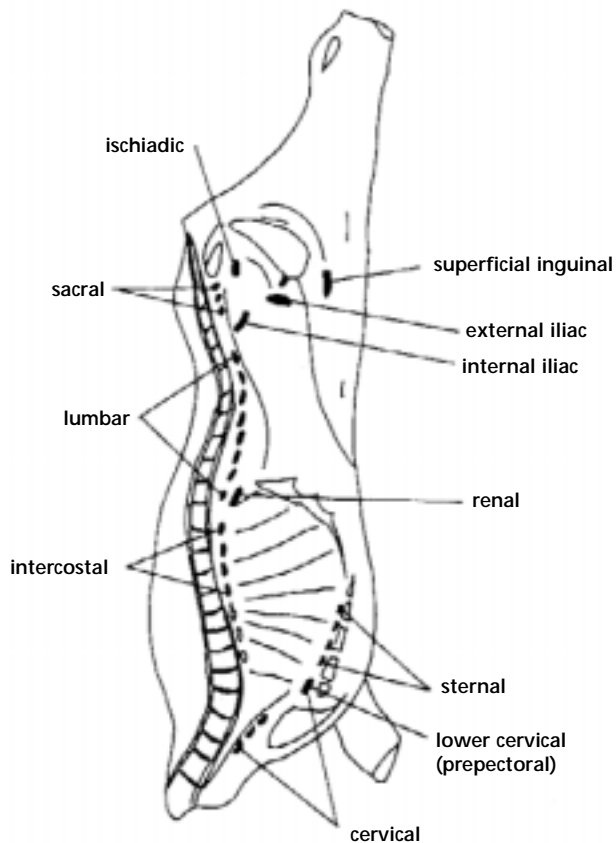
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PHOTO 8.9
Popliteal lymph nodes in a pig: these nodes are incised if a systemic or general disease is suspected

FIGURE 8.4 Medial view of carcass with relevant lymph nodes



Source: D. Herenda, Canada.



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PHOTO 8.10
Lateral view of the carcass: preaural and prescapular lymph nodes are incised in systemic or generalized disease

- the stomach and gastro-intestinal contents: gastro-intestinal contents have the heaviest load of micro-organisms. Faeces contain up to 9.0×10^7 bacteria per gram, and various numbers of yeast and mould. The ruminal contents have only slightly lower numbers of micro-organisms.

Therefore, during meat inspection it is an important duty of the inspecting officer to ensure that:

- the implements used during slaughtering, dressing and meat inspection are well sanitized periodically, or whenever they are likely to be contaminated;
- during cutting into the hide and exposure of the carcass, the external surface of the

hide does not come into contact with the carcass meat;

- the viscera are not accidentally opened during the dressing procedures or during evisceration.

If a carcass or part is contaminated with faeces or visceral contents, such areas should be trimmed off. The opened viscera should be separated from the rest of the carcass as quickly as possible.

The introduction of a Hazard Analysis and Critical Control Point (HACCP) concept can be helpful to maintain high standards of slaughter and dressing hygiene based on an assessment of the risks to human and animal health.

GENERAL PATHOLOGICAL CONDITIONS

For a full description of the conditions and more information on ante-mortem findings, differential diagnosis and judgement refer to Section 6.

Fever (pyrexia)

Post-mortem findings:

- rigor mortis;
- putrefaction;
- congestion of subcutaneous blood vessels and entire carcass;
- enlarged lymph nodes;
- evidence of cloudy swelling of liver, heart and kidneys.

Judgement:

Carcass is condemned if fever syndrome is associated with presence of bacteria or bacterial toxins in the blood and/or findings of drugs and antimicrobial substances.

If typical signs of fevered carcass are not seen, the carcass should be held for 24 hours after slaughter and re-examined. In the case of mild fevered syndrome detected first on post-mortem inspection, the carcass may be conditionally approved with heat treatment providing that bacteriological and chemical tests are negative.

Septicaemia

Post-mortem findings:

- enlarged oedematous or haemorrhagic lymph nodes;
- degenerative changes in parenchymatous organs (liver, heart and kidneys);
- congestion and petechial or ecchymotic haemorrhages in kidney, heart surface, mucous and serous membranes, connective tissue and panniculus adiposus;
- splenomegaly;
- inadequately bled-out carcass as a result of high fever;
- blood-stained serous exudate in abdominal and/or thoracic cavities;
- anaemia resulting from bone marrow depression and icterus may also be present.

One or more lesions may be absent. However, if one significant lesion is present, such as generalized acute lymphadenitis, the carcass must be condemned. All gross lesions in the carcass and organs must be considered before the animal is judged septicaemic. Septicaemia is found in many infectious diseases including acute forms of salmonellosis, leptospirosis, swine erysipelas, hog cholera and in anthrax in cattle.

Judgement:

The animals, animal carcasses, offal and other detached portions of animals affected with septicaemia are condemned. In borderline cases bacteriological examination should be carried out wherever possible.

Toxaemia

Post-mortem findings:

- haemorrhage in organs;
- normal or enlarged and oedematous lymph nodes (not hyperplastic as in septicaemia);
- areas of tissue necrosis;
- emphysema in cattle;
- rarely, degenerative changes of parenchymatous organs (heart, liver and kidneys).

Judgement:

If there is evidence of septicaemia or toxaemia the carcass and the viscera should be condemned and the implements used during inspection and the hands and arms of the inspector should be washed and disinfected. The primary lesions causing septicaemia or toxaemia, including metritis, mastitis, pericarditis and enteritis should be observed and recorded as causes of condemnation.

Pigmentation

Pigments are classified as exogenous and endogenous. Exogenous pigments are synthesized outside the body and endogenous within the body itself. Pigments are coloured substances that accumulate in the body cells during the normal physiological process and abnormally in certain tumours and conditions. They have different origins, biological significance and chemical composition.

In anthracosis, carbon particles are found as a black pigment in tissues. This condition is seen as black pigment of the lungs and corresponding lymph nodes in animals raised in urban areas. The lungs affected with anthracosis are condemned and the carcass is approved.

The carotenoid pigments are exogenous pigments, greenish-yellow in colour, which consist of carotene A, carotene B, and xanthophyll. They are important in meat inspection because they cause yellowish discoloration in the fat and muscles of (Jersey and Guernsey) cattle. Carotenoid pigments should be differentiated from bile pigments in icterus. The bovine liver affected with this condition is enlarged and shows a bright yellow colour. Such a liver is condemned with the rationale that the affected liver demonstrates some toxic changes, as damaged liver cells cannot metabolize carotene. Liver carotenosis must be differentiated from pale livers in advanced pregnancy.

The endogenous pigments, except for melanin and lipofuscin, are derivatives of haemoglobin.

Melanosis

Melanosis is an accumulation of melanin in various organs including the kidneys, heart, lungs and liver (Photo 8.11), and other locations such as brain membranes, spinal cord, connective tissue and periosteum. Melanin is an endogenous brown-black pigment randomly distributed in tissue. In grey and white horses,



P. MASZTIS, WESTON VET. CLINIC, CANADA

PHOTO 8.11
Melanin deposits in sheep viscera



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PHOTO 8.12
Myocardial lipofuscinosis



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PHOTO 8.13
Osteohaemochromatosis showing reddish-brown pigmentation of ribs and vertebrae in a six-month-old calf



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PHOTO 8.14
Jaundice of an aged cow caused by liver disease: note yellow discoloration of body fat, lungs, heart and kidneys

this pigment is found under the shoulder, axillary area and *ligamentum nuchae*. Melanin is also found in lymph nodes, pig skin and belly fat or mammary tissue in female pigs. This condition is called “seedy belly” or “seedy cut” since the black colour in the mammary tissue resembles round, black seeds. The melanotic tissue in pigs shows a tendency towards neoplasia. Melanin deposits in the oesophagus and adrenal glands in older sheep are a common finding on post-mortem examination. Multifocal deposits of melanin in the liver of a calf are known as *Melanosis maculosa*. It is common in calves and it usually disappears after the first year of age.

Judgement:

Carcasses showing extensive melanosis are condemned. If the condition is localized, only the affected organ or part of the carcass needs to be condemned.

Differential diagnosis:

Haemorrhage, melanoma, distomatosis (liver flukes).

Myocardial lipofuscinosis (brown atrophy of the heart, xanthosis)

Xanthosis (“wear-and-tear”) pigment is a brown pigmentation of skeletal and heart muscles of cattle (Photo 8.12). The condition is seen in old animals such as “cull dairy cows” and in some chronic wasting diseases. It is prevalent in Ayrshire cows and approximately 28 percent of normal Ayrshire cows have this pigment in skeletal and heart muscles. Xanthosis is not dependent on the age of animals in this breed.

Congenital porphyria (osteohaemochromatosis, pink tooth)

Porphyria is the accumulation of plant or endogenous porphyrins in the blood resulting in tissue pigmentation and photosensitization. This is a hereditary disease and is observed in cattle, swine and sheep. In porphyric cattle, exposure to light will initiate the development of photodynamic dermatitis. In swine, photodynamic dermatitis does not occur.

The disease is also known as osteohaemochromatosis, due to a reddish-brown bone pigmentation (Photo 8.13), and “pink tooth” because of a brownish-pink discoloration of teeth.



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PHOTO 8.15
Yellow discoloration of pig viscera and carcass caused by cirrhosis of the liver

Judgement:

A carcass showing extensive xanthosis is condemned. If the condition is localized, only the affected organ or part of the carcass needs to be condemned. The head and bones of a carcass affected with osteohaemochromatosis are condemned. The bones are “boned out” and the remaining muscles are approved. If the condition is generalized, the carcass is condemned.

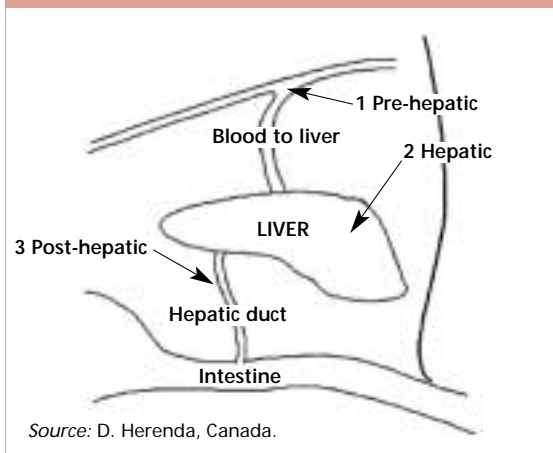
Icterus (jaundice)

Icterus is the result of an abnormal accumulation of bile pigment, bilirubin or of haemoglobin in the blood. Yellow pigmentation is observed in the skin, internal organs (Photos 8.14 and 8.15), sclerae (the white of the eye), tendons, cartilage, arteries, joint surfaces, etc. Icterus is a clinical sign of a faulty liver or of bile duct malfunction, but it may be also caused by diseases in which the liver is not impaired, such as haemolytic crisis caused by blood parasites of *Babesia* spp.

Jaundice is divided into three main categories (Figure 8.5):

- pre-hepatic jaundice (haemolytic icterus);
- hepatic jaundice (toxic icterus);
- post-hepatic jaundice (obstructive icterus).

FIGURE 8.5 Classification of jaundice



Source: D. Herenda, Canada.

Pre-hepatic jaundice

Pre-hepatic jaundice occurs following excessive destruction of red blood cells. Tick-borne diseases such as *Babesia ovis* and anaplasmosis cause this type of icterus, which is one of the main causes of carcass condemnation in southern Africa due to prevalence of these parasites. Overproduced blood pigment, which cannot be metabolized in the liver, builds up in the blood (haemoglobinaemia). It is excreted by the kidneys into the urine (haemoglobinuria). Normal urine colour changes and becomes bright red to dark red.

Hepatic jaundice

Hepatic jaundice occurs due to direct damage to liver cells as seen in liver cirrhosis (Photo 8.15), systemic infections, and in chemical and plant poisoning. In sheep, jaundice may have been caused by phytogenic chronic copper poisoning.

Liver function is impaired and the liver is unable to secrete bile pigments. Obstructive jaundice occurs when the drainage of the bile

pigment bilirubin is blocked from entry into the intestine. This usually occurs due to the obstruction of the hepatic ducts by a tumour, by parasites such as flukes or by gall stones. Obstruction may also occur due to an inflammation of the bile ducts. In hogs, mature ascarides may occlude the bile ducts.

Judgement:

Animals suspected to have icterus should be treated as “suspects” on ante-mortem examination. On post-mortem examination, the carcass and viscera with haemolytic, toxic icterus and obstructive icterus are condemned. Less severe cases are kept in the chiller for 24 hours. Upon re-examination, the carcass may be approved or condemned depending on the absence or presence of pigment in the tissue. If the obstructive icterus disappears after 24 hours, the carcass and viscera can be passed for human consumption.

A simple laboratory test will help to make an objective test for bile pigment icterus. Two drops of serum are mixed on a white tile with two

drops of Fouchets agent (see below). A blue/green precipitate is positive for bile icterus.

Fouchets Reagent	Trichloroacetic acid	25 gm
	FeCl ₃ (10% solution)	10 ml
	Distilled water	100 ml

Differential diagnosis:

Yellow fat in animals with heavy maize rations, nutritional panniculitis (yellow fat disease, steatitis) and yellow fat seen in extensive bruises. In yellow fat disease, the fat has a rancid odour and flavour upon cooking.

To differentiate icterus from the normal colour of fat of certain breeds, the sclera, intima of the blood vessels, bone cartilage, liver, connective tissue and renal pelvis should be examined. If yellow discoloration is not noted in these tissues, icterus is not present.

Icterus should not be confused with yellow fat disease in hogs fed predominantly on fish by-products or by the yellowish appearance of tissue caused by breed characteristics or nutritional factors.

Haemorrhage and haematoma



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PHOTO 8.16
*Fractured bone and muscle haemorrhage
in a market hog*

Haemorrhage is seen at slaughter in various organs, mucous and serous membranes, skin, subcutaneous tissue and muscles. It may be caused by trauma, acute infectious diseases or septicaemia.

In pig muscles, haemorrhage is frequently associated with fractures (Photo 8.16). Petechial haemorrhage is noted as tiny foci 1–2 mm in diameter. Ecchymotic haemorrhage (Photo 8.17) is larger, being up to 2–3 cm in size. Paintbrush haemorrhage includes extensive streaking with haemorrhage. Haemorrhage is also associated with vitamin C deficiencies, a sudden increase in blood pressure with weakened blood vessels, and improper electric current stunning in pigs and sheep. Lengthy transportation, exposure to stress before slaughter, hot weather and excitement are some of the other factors that contribute to muscle haemorrhage.

In haemorrhage caused by improper stunning, there may be a delay between stunning and sticking of the animal. The electrical current used in stunning causes cardiac muscle stimulation and vasoconstriction of blood vessels. This might induce a rapid rise in blood pressure leading to haemorrhages in the organs and muscle (so-called “blood splashing”).

The stunning of animals by a mechanical blow to the head is still practised with sheep and is a significant cause of haemorrhage in organs, particularly the lungs and heart. The blow to the head will initiate a rise in blood pressure. The

PHOTO 8.17
*Ecchymotic
haemorrhage in
the tongue muscle
of a cow*



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normal arterial blood pressure in sheep is 120–145 mm Hg. This may rise to 260 mm Hg or over in a stunned animal. The heart rate will be increased. Immediate bleeding with the fast blood flow from the cut vessels could prevent this type of haemorrhage in sheep.

Agonal haemorrhage (due to rupture of capillaries) is caused by laboured breathing and contraction of musculature during violent death.

A lump formed from a blood clot in tissues or organs is called a haematoma. Haematomas vary in size and may be over 1 m in diameter (Photo 8.18). They are associated with trauma or a clotting defect. Haematoma of the spleen

(Photo 8.19) may be associated with head butting by horned animals.

Judgement:

A carcass is approved if the haemorrhage is minor in extent and is due to physical causes. The affected tissue is condemned. A carcass affected with extensive haemorrhage where salvaging is impractical, or a haemorrhagic carcass associated with septicaemia, is condemned.

Differential diagnosis:

Haemorrhage resulting from blackleg, and sweet clover poisoning.

PHOTO 8.18

Haematoma in the abdominal wall of a ewe



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PHOTO 8.19

Haematoma of the bovine spleen

Bruises

Judgement:

On post-mortem examination, carcasses affected with local bruising are approved after being trimmed. Carcasses affected with bruises or injuries associated with inflammatory lesions are also approved if tissue reaction does not extend beyond the regional lymph nodes. The affected area should be condemned. When bruises or injuries are associated with systemic change and the wholesomeness of the musculature is lost, the carcass will be condemned.

On post-mortem examination of carcasses affected with bruises and fractures, the following judgement should be observed: (a) the fractures associated with bruises are removed and affected tissue is condemned; (b) in compound fractures with damaged skin, the fractured site and surrounding tissues are condemned; (c) in simple fractures without bruises and damaged skin, the affected portion may be approved for mechanical and manual boning operations. If the lower part of the bone is fractured, the bone may be removed by cutting above the fracture. A carcass affected with extensive bruises is condemned on post-mortem examination (Photo 8.20). A slightly or

moderately bruised carcass is approved if no systemic changes are present. Affected tissues are condemned.



PHOTO 8.20
Extensive bruises on a beef carcass

Abscesses

The most common bacteria in liver abscesses include *Actinomyces (Corynebacterium) pyogenes*, *Streptococcus* spp. and *Staphylococcus* spp. In the lungs, the most common bacteria are *Pasteurella* spp. and *Actinomyces pyogenes*. *Fusobacterium necrophorum* causes liver abscesses (Photo 8.21) as a complication of rumen inflammation (rumenitis) in adult cattle. This condition is common in feedlots where cattle are fed a high grain diet that produces acidity in the rumen and ulcerative rumenitis. The rumen lesion is invaded by *F. necrophorum* which pass further via the veins to the liver and stimulate abscess formation.

Judgement:

The judgement of carcasses affected with abscesses depends on findings of primary or secondary abscesses in the animal. The portal of entry of pyogenic organisms into the system is

also of importance. The primary abscess is usually situated in tissue that has contact with the digestive tract, respiratory tract, subcutaneous tissue, liver, etc. The secondary abscess is found in tissue where contact with these body systems and organs is via the



PHOTO 8.21
Liver abscesses caused by F. necrophorum

bloodstream. The brain, bone marrow, spinal cord, renal cortex, ovary and spleen (Photo 8.22) may be affected with secondary abscesses. In judgement of the carcass, the inflammation of the renal medulla and contact infection in the spleen and ovaries must be ruled out. A single huge abscess found in one of the sites of secondary abscesses may cause the condemnation of a carcass if toxæmia is present. In pigs, abscesses are frequently observed in the jaw and in the spine. Spinal abscesses in pigs are commonly caused by tail biting (Photo 8.23). The bacterial agent from the tail penetrating the spinal canal could be arrested in the lumbo-sacral and cervical spinal enlargements, initiating an abscess formation.

Inspectors should differentiate abscesses in the active and growing state from the older, calcified or healed abscesses. In domestic animals, the primary sites of purulent infections are post-partum uterus, umbilicus or reticulum in hardware disease. Secondary abscesses are frequently observed in distant organs. Small multiple abscesses may develop in the liver of calves as a result of infection of the umbilicus ("sawdust liver", Photo 8.24). Carcasses with such condition should be condemned.

On post-mortem examination, the carcasses are condemned for abscesses, if the abscesses resulted from entry of pyogenic organisms into the bloodstream and into the abdominal organs, spine or musculature. An abscess in the lungs may require condemnation of the lungs and passing of the carcass if no other lesions are noted. Liver abscesses associated with umbilical infection require condemnation of the carcass. If no other infection is present, the abscess is trimmed off and the liver may be utilized for human or animal food depending on the regulations of the respective country. Multiple abscesses in the liver require condemnation of the organ.



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PHOTO 8.22
Secondary abscesses in the spleen of an aged cow



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PHOTO 8.23
Tail necrosis caused by biting and secondary spine abscesses



P.G. CHAMBERS, ZIMBABWE

PHOTO 8.24
Multiple abscesses in a calf liver as a result of an umbilical infection; a carcass with such a condition should be condemned

Emaciation

Emaciation is associated with gradual diminution in the size of organs and muscular tissue as well as oedema in many cases. The organs and muscular tissue appear thinner, moist and glossy. Emaciation is a post-mortem descriptive term that should be differentiated from thinness.

Post-mortem findings:

- serous atrophy of fat in the carcass and organs, especially the pericardial and renal fat (Photo 8.25);
- the fat is watery, translucent or jelly-like and hangs from the intervertebral spaces (Photo 8.26);

PHOTO 8.25
Serous atrophy of renal fat: note petechial haemorrhages, seen frequently in septicaemic diseases



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PHOTO 8.26
Hanging gelatinous fat between the spinal processes



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- oedema and anaemia may develop due to starvation and malnutrition due to parasite infestations.

Judgement:

On post-mortem examination it is important to assess and differentiate emaciation from leanness. In case of doubt, the carcass may be held in the refrigerated room and the general setting of the carcass should be examined the following day. If the body cavities are relatively dry, oedema of muscle tissue is not present and the fat is of an acceptable consistency, i.e. has "set", the carcass may be passed for food.

Well nourished carcasses with serous atrophy of the heart and kidneys and mere leanness may also be fit for human consumption. A carcass with any amount of normal fat may be approved if everything else appears normal. The carcasses from animals that have been in transport for a long period of time may show extensive serous atrophy of fat (mucoid degeneration of fat tissue) without any changes in organs and muscles. If, after being in the cooler for 24–48 hours, the fat resumes its normal consistency, the carcass is approved. Otherwise, the carcass is condemned.

The carcass and viscera must be condemned if emaciation is due to chronic infectious disease. An objective judgement of emaciation with oedema may be made using a 47% ethanol in water solution. A clear, pea-sized piece of bone marrow, taken from the distal radius, is put carefully into the solution. If it sinks, the marrow, which reflects the water content of the carcass as a whole, has approximately 45 percent water content. The carcass should be condemned.

Differential diagnosis:

Thinness-leanness, oedema and uraemia.

Leanness (poorness) is often observed in range bulls on poor-quality pasture, high-milking cows and young growing animals that have had protein-deficient diet. The animals are physiologically normal and the reduced fat deposits of the animal carcass are normal in colour and consistency. The reduced muscle tissue is firm and of a normal consistency. The muscle colour is darker than normal, and fat tissue may still be present in the orbit of the eye.

Oedema

Post-mortem findings:

- wet, sloppy musculature that pits on pressure;
- accumulation of clear or faint yellow fluid in the thorax, abdomen and subcutaneous tissue.

Judgement:

When making a judgement of a carcass affected with oedema, it is important to know the underlying cause of the oedema and also to know the significance of all other lesions found in the carcass.

The carcass may be totally or partially condemned depending on the extent and cause of the condition. The presence of localized oedema necessitates removal of the affected area. The carcass is then approved. Oedema associated with diseased conditions such as traumatic pericarditis, malignant neoplasm or septicaemia requires condemnation of the

carcass because of the primary condition.

Oedema observed in the mesentery is commonly related to circulation interference in the caudal vena cava resulting from liver abscess or chronic liver disease. Such a carcass may be held in the cooler for re-examination. Dry serous membranes of the abdominal and thoracic walls and a carcass appearing normal after re-examination can be passed for human consumption. Carcasses that have been condemned for oedema associated with malnutrition only may be salvaged for animal food (except in the case of oedema associated with septicaemia).

Differential diagnosis:

Pericarditis, peritonitis, pleuritis, renal amyloidosis, liver disease, grain overload and vagal indigestion, high altitude disease and uraemia.

Emphysema

Emphysema in animals is associated with some disease conditions and is caused by an obstruction to the outflow of air or by extensive gasping respiration during slaughter procedures.

All species may be affected by alveolar emphysema. However, interstitial emphysema (Photo 8.27) occurs mostly in cattle. In the latter, the lack of collateral ventilation forces the rupture of alveoli and the migration of air into the interstitium. The lobules of the lungs become separated by the distended interstitial

tissue and marked lobulation of lungs is observed.

Alveolar emphysema appears as small air bubbles due to air trapped in dilated alveoli. Large accumulations of air, a few centimetres in diameter, are called "bullae" or "bullous emphysema".

Post-mortem findings:

Post-mortem findings of the emphysematous lungs include a pale, enlarged greyish-yellow, pearl-like shiny lesion. Upon palpation, the affected area feels puffy and crepitant.

Two diseases of food animals associated with emphysema are chronic obstructive pulmonary disease (COPD) in horses, and interstitial pneumonia in cattle. COPD is also called "heaves" and frequently described under chronic bronchitis or bronchiolitis in horses. Interstitial pneumonia in cattle is also described under fog fever or acute chronic pulmonary oedema and emphysema.



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PHOTO 8.27
Interstitial emphysema in a cow's lungs

Judgement:

Affected lungs are condemned.

Tumours or neoplasms

A tumour is an abnormal mass of tissue that grows without control and uncoordinated with the tissue or organs of origin or those nearby. Its presence is often cumbersome to the tissue or organ. It arises either by pressure or by replacement of normal functional tissue. Tumour cells resemble healthy cells but serve no useful purpose. The term tumour in current medical lexicon is limited to neoplastic growths.

Tumours are usually divided according to the tissue of origin, i.e. epithelial, mesenchymal (connective tissue), haemopoietic, nervous, etc. Tumour behavioural classification includes their mode of growth and the degree of invasiveness. Slow-growing, non-invasive circumscribed tumours are considered benign, and fast-growing, infiltrative and frequently metastatic tumours are malignant. The spread of neoplasm is by direct expansion and infiltration, via lymphatics and blood circulation, and by implantation. Carcinomas are tumours of the epithelial tissue. They are usually spread via the lymphatic system. Sarcomas are connective tissue tumours, commonly spread via haematogenous route. Implantation to surrounding parietal cavities is observed in ovarian carcinomas. The spread of malignant tumours via lymphatics, or haematogenous spread to another area not directly connected with the original site, is called "metastasia".

Some of the common tumours found during beef inspection are squamous cell carcinoma (Photo 8.28), lymphosarcoma, pheochromocytoma and mesothelioma.

Judgement:

A carcass affected with metastatic neoplasms is condemned. Multiple benign tumours in different organs also require condemnation of the carcass. A carcass affected with circumscribed benign tumours is approved after removal of the tumours.

PHOTO 8.28
Squamous cell carcinoma affecting cow's eye and parotic lymph node. In this case, tumour lesions were also observed in the lungs; the carcass was condemned



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Calcification

Calcification is the deposition of calcium salts in dead and degenerating tissue. It may be regarded as a body reaction to immobilize some foreign agents. It may occur in any tissue or organ. In dairy cows, calcification is noted in the heart (endocardium) and is caused by excessive dietary supplementation with Vitamin D. In cattle, mineralization of the aorta and brachiocephalic trunk (Photo 8.29) is sometimes seen. Calcification is also seen in parasitic infections (Photo 8.30) and in many chronic infections such as tuberculosis and botryomycosis. The presternal pressure necrosis of fat (putty brisket) seen in cattle and rarely in sheep may also eventually mineralize. Inflammatory metaplasia leading to ossification

is an incidental finding during post-mortem examination of food animals. It is most commonly found in peritoneal scars of hogs.

If calcium particles are removed from the surrounding tissue, they appear white or grey, irregularly rounded and frequently honeycombed. Calcification is detected on post-mortem examination by a gritty sound upon incision with a knife.

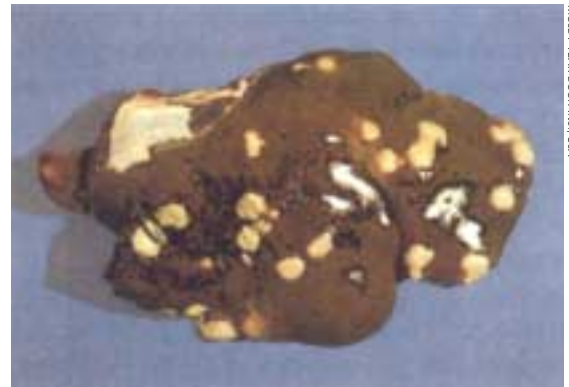
Judgement:

A carcass and viscera affected with presternal calcification are approved. Affected brisket is condemned. Calcified parasitic organs and heart in dairy cows are also condemned.



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PHOTO 8.29
Calcification of the aorta and brachiocephalic trunk in a young heifer



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PHOTO 8.30
Parasitic lesions undergoing mineralization in a sheep's liver

Degeneration

Degeneration implies the change of tissue to a lower or less functionally active form, or deterioration (impairment) of an organ or cell due to changes in its size. If chemical change of the tissue occurs, this is regarded as a true degeneration. Cloudy swelling (parenchymatous degeneration, albuminous degeneration or granular degeneration, acute cellular swelling) in the cell is a response to cell insults, including trauma, anoxia, immune mechanisms, toxins, viral and bacterial agents. In cloudy swelling, cell proteinaceous substances become cloudy and the cell increases in size. It is observed in the heart, kidneys, liver, glands and muscles.

Cloudy swelling is often associated with fatty degeneration. Affected organs are pale, lustrous and softer than normal, slightly enlarged and have the appearance of having been boiled (Photo 8.31). In slight insults, the animal may recover and in severe cases cloudy swelling is succeeded by fatty degeneration.

Fatty infiltration is an accumulation of fat in the heart, liver, kidneys, pancreas, etc. The liver is yellow, soft in consistency, has round edges, dimples on pressure, is enlarged and has a greasy texture on cut surfaces. Fatty infiltration may disappear from the tissues if the causative agent is removed. The extensive accumulation of fat in the liver is caused by an increased dietary intake of fat, increased mobilization of fat during lactation or starvation. It is also seen in healthy animals slaughtered shortly after



P. G. CHAMBERS, ZIMBABWE

PHOTO 8.31

Degeneration, cloudy swelling and associated fatty change in a pig's liver

parturition and often accompanies advanced pregnancy in cows and ewes.

Fatty degeneration is an irreversible process and occurs when fat accumulates in the damaged cell. The liver capsule is dull and has a turgid appearance. This condition is associated with acute febrile and toxic conditions and with chemical poisoning by arsenic, phosphorus, chloroform, etc. The liver and kidneys affected are a pale, clay-red colour and greasy on touch. They have a patchy or spotted appearance.

Judgement:

Organs and muscles affected with cloudy swelling are condemned. Detailed examination of the carcass is necessary since systemic changes are usually present and the carcass is therefore condemned. A liver affected with fatty infiltration is approved.

Telangiectasis

This liver condition is found in cattle, sheep and horses. It is more frequent in older cows. The liver lesions are bluish-black and irregular with depressed surfaces and dilated blood-filled hepatic sinusoids. A cause of hepatic telangiectasis ("Plum pudding", Photo 8.32) in cattle is thought to be local ischaemia.

Judgement:

A slightly affected liver is approved after appropriate trimmings. An extensively affected liver requires condemnation. Condemned material can be used for animal food.



P. G. CHAMBERS, ZIMBABWE

PHOTO 8.32

Bovine liver affected with telangiectasis

Abnormal odours

Abnormal odours may result from the ingestion of certain feedstuffs, drugs, various pathological conditions, absorption of odours from strong smelling substances and sexual odour from some male animals. Pig carcasses may have a fishy odour if the pig was consuming excessive fishmeal in the diet or was fed codfish oil. Drugs that may cause absorption of odours include turpentine, linseed oil, carbolic acid, chloroform, ether and aromatic spirits of ammonia.

In cows affected with ketosis, the sweetish odour of acetone may be present in the muscles. If treatment was not successful in dairy cows affected with milk fever, the odour of acetone may be noted in the connective tissue, kidney fat and musculature. The flesh of bloated and constipated animals may give off a faecal odour. If the meat is kept in a room that was recently painted, the odour may pass on to the carcass. The odour is most noted in a carcass right after slaughter.

Judgement:

A carcass with fishmeal odour has inferior meat. Viscera and organs are also inferior. Generalized

drug treatment requires that the carcass be condemned. However, if local treatment and withholding periods are observed, the carcass and viscera can be approved.

Sexual odour in a carcass can have a limited distribution according to consumers' tastes. Extremely strong sexual odour requires condemnation of the carcass.

A carcass that gives off a pronounced odour of medicinal, chemical or other foreign substances should be condemned. If the odour can be removed by trimming or chilling, the carcass may be passed for human food consumption after the removal of affected parts or dissipation of the condition.

Carcasses affected with sexual odour should be held in the cooler and re-tested periodically. If the odour disappears, the carcass is approved. If the sexual odour is present after 48 hours, the carcass should be condemned. Young boars and ridglings are treated as "suspects" and held pending a heat test.

If abnormal odour is suspected, the smell will be enhanced by placing a piece of muscle or tissue in cold water and bringing to the boil.

Immaturity

The muscle of immature animals is moist, pale, flabby and poorly developed. It is low in protein and high in water content, and the carcass contains a high proportion of bone. Immature animals should not be slaughtered for human consumption.

Post-mortem findings:

- presence of the umbilical cord;
- bluish and not completely retracted gums;
- greyish muscles are flabby, tear easily and are not well developed;

- dark red kidney and oedematous kidney capsule.

Judgement:

The carcass and offal of immature animals are condemned.

Remarks:

The presence or non-presence of fat around the kidneys ("caul fat") should not be used as a guide for judgement of immature animals.

Plant and chemical poisoning

Clinical signs of poisoning are discussed in Section 6.

Gross lesions may include gastro-enteritis, fatty degeneration of the liver and inadequate bleeding.

Judgement:

The carcass, offal and intestine should be condemned if clinical signs of poisoning are associated with post-mortem lesions.

Spear grass penetration of sheep

Grassland in many parts of Africa contains scattered grasses with spear-like seeds. These seeds may penetrate through the wool and skin to the subcutis, and further through the abdominal wall into the abdominal cavity.

Post-mortem findings:

- spear-like seeds in the wool and skin;
- spear-like seeds in the connective tissue, fat and musculature (Photo 8.33);
- acute inflammation of the affected tissue;
- abscessation;
- spear-like seeds in the abdominal cavity causing low-grade peritonitis.

Judgement:

If an acute generalized inflammation is associated with haemorrhages and abscesses, the carcass should be condemned; otherwise the carcass is approved.



PHOTO 8.33

Spear grass penetration of sheep: numerous spear-like seeds in the sheep carcass

SPECIFIC DISEASES

DISEASES CAUSED BY VIRUSES

Foot-and-mouth disease (FMD)

Post-mortem findings:

- necrosis of heart muscle (tiger heart), usually only in young, acutely infected animals;
- ulcerative lesions on tongue, palate, gums, pillars of the rumen and feet.

Judgement:

If FMD is suspected on post-mortem examination, the carcass and viscera are condemned and appropriate action

recommended by the regulatory authorities of the country must be taken. In countries where this disease is present, the judgement should be in accordance with the current animal health requirements, and consistent with effective public health protection. Particular attention should be paid to secondary bacterial infections and general findings. Sanitary measures should be taken to comply with national animal health policy.

Rinderpest (RP)

Post-mortem findings:

- punched-out erosions in the oesophagus;
- oedema or emphysema of the lungs;
- haemorrhage in the spleen, gall bladder and urinary bladder;
- haemorrhagic or ulcerative lesions in the omasum;
- congested abomasum filled with bloody fluid (ulcers may also be observed);
- severe congestion and haemorrhage in the intestine and enlarged and necrotic Peyer's patches (Photo 8.34);
- last portion of the large intestine and rectum are haemorrhagic showing "tiger striping" of longitudinal folds;
- enlarged and oedematous lymph nodes;
- emaciated carcass.

Judgement:

A carcass derived from a feverish and debilitated animal showing the signs of acute disease on ante-mortem examination should be

condemned. In endemic zones, if acute symptoms of the disease are not present during clinical examination, the carcass may have limited distribution. In areas affected with an outbreak that are protected by vaccination, heat treatment of meat is suggested if economically worthwhile. The affected organs are condemned.



PHOTO 8.34
The mucosal surface of Peyer's patches showing necrosis and congestion

Vesicular stomatitis (VS)

Post-mortem findings:

- the skin and mucous membrane lesions resemble the lesions of other vesicular diseases;
- secondary bacterial or fungal infections;
- mastitis.

Judgement:

The carcass of an animal affected with VS is approved if the disease is not in the acute stage and secondary changes are not present. Parts of the affected carcass and organs are condemned. A carcass showing acute changes and systemic lesions is condemned. If VS is not confirmed by laboratory examination, the judgement will be the same as for FMD.

Malignant catarrhal fever (MCF)

Post-mortem findings:

- lesions are not present in acute cases;
- crater-like erosions of the nose, mouth, conjunctiva, oesophagus and gastro-intestinal tract;

- lungs may be congested, swollen or emphysematous;
- white areas in the kidneys;
- swollen and reddened abomasal folds;
- intestinal oedema and petechial haemorrhage;
- “tiger striping” in the distal colon (Photo 8.35);
- enlarged and reddened lymph nodes;
- dehydrated and emaciated carcass.

PHOTO 8.35
MCF: “tiger striping” in the distal colon



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Judgement:

In the early stages of the disease, when fever, emaciation and systemic signs are lacking, the carcass of the affected animal may be approved as inferior meat. Otherwise, when fever, emaciation and systemic signs are present, the entire carcass and viscera are condemned. The condemned material may be used for rendering.

Rabies

Post-mortem findings:

- possible inflammation of gastro-intestinal mucosa.

Judgement:

In endemic areas, carcasses may be approved if the animal was bitten no more than 48 hours before slaughter. The bite area and surrounding tissue must be condemned, and precautions taken to prevent occupational hazards.

Lumpy skin disease

Post-mortem findings:

- ulcerative lesions in the mucosa of the respiratory and digestive tract;
- reddish, haemorrhagic to whitish lesions in the lungs;
- oedema (interlobular) and nodules in the lungs (Photo 8.36);
- heart lesion (endocardium);
- thrombosis of skin vessels followed by cutaneous infarction and sloughing.

Judgement:

The carcass of an animal showing mild cutaneous lesions and no fever associated with general signs of infection is conditionally approved pending heat treatment. The affected parts of the carcass and organs are condemned.



PHOTO 8.36

Cut surface of the nodules in the parenchyma of the lung and interlobular oedema

Bovine herpes dermophatic disease (BHD)

Post-mortem findings:

- microscopy reveals intranuclear inclusions and giant cells in the skin.

Judgement:

The carcass of an animal affected with BHD is disposed of in a similar manner to that of an animal affected with lumpy skin disease.

Infectious bovine rhinotracheitis (IBR)

Post-mortem findings:

- acute inflammation of the larynx, trachea (Photo 8.37) and bronchi;
- profuse fibrino-purulent exudate in the upper respiratory tract in severe cases;
- chronic ulcerative gastro-enteritis in feedlot cattle;
- lung emphysema;
- secondary bronchopneumonia.

Judgement:

The carcass of an animal affected with IBR is approved if signs of acute infection are not present and the animal is in good body condition.

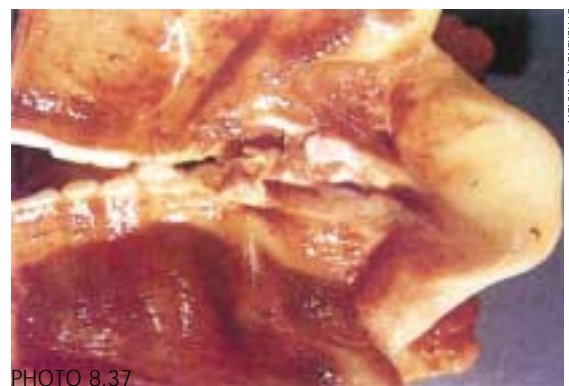


PHOTO 8.37

IBR: acute inflammation of the larynx and trachea

Bovine viral diarrhoea (BVD)

Post-mortem findings:

- shallow erosions present on the entrance of the nostrils, mouth, pharynx, larynx, oesophagus, rumen (Photo 8.38), omasum, abomasum (Photo 8.39), caecum and, less frequently, in Peyer's patches in the small intestine;
- erythema of the mucosa with submucosal haemorrhage in the abomasum, small intestine, caecum and colon. Striped appearance on the caecal and colon mucosa is similar to that seen in RP;
- cerebral hypoplasia and cataracts in calves.



PHOTO 8.38
BVD:
congestion and erosions in the ruminal mucosa

Judgement:

The carcass and viscera of an animal that on ante-mortem examination shows generalized signs of acute infection accompanied with fever and/or emaciation are condemned. Chronic cases of BVD with no systemic involvement have a favourable judgement of carcass, viscera and organs.



PHOTO 8.39
BVD: *inflammation of the abomasum (abomasitis, gastritis)*

Bovine leukosis

Post-mortem findings:

- lymph node enlargement (clay-like consistency);
- enlargement of spleen (splenomegaly);
- thin watery blood;
- neoplastic lesions in the heart (Photo 8.40), intestines (Photo 8.41) (virtually all of the organs may be involved);
- ventral oedema;
- enlarged haemolymph nodes.

Judgement:

The carcass of an animal affected with leukosis (lymphosarcoma) is condemned. When a diagnosis cannot be made by post-mortem findings, a laboratory diagnosis should be performed. If lymph node hyperplasia is the histological diagnosis, the carcass is approved for human consumption. Depending on disease prevalence, leukosis reactors may be totally approved or conditionally approved pending heat treatment.

PHOTO 8.40
Leukosis:
neoplastic mass infiltrating the heart muscle



PHOTO 8.41
Leukosis:
neoplastic growths in the intestine - both lesions were histologically confirmed as lymphosarcoma



DISEASE CAUSED BY PRIONS

Bovine spongiform encephalopathy (BSE, “mad cow disease”)

Diagnosis can be confirmed only on the post-mortem histological examination of brain tissue. Microscopic lesions include degenerative lesions in the cerebral cortex (Photo 8.42), medulla and central grey matter of the midbrain.

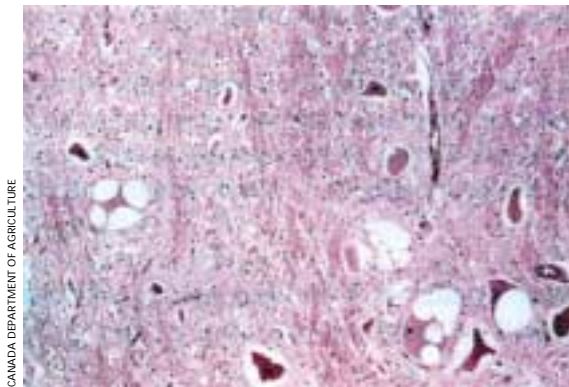
Judgement:

The carcass is condemned.

Discussion:

Certain tissues or organs in the slaughtered animal are known to present a higher risk than

others of containing the infective agent in a BSE-afflicted animal. Of relevance to post-mortem procedures and inspection are the brain and spinal cord, representing the central nervous system, plus the dorsal root ganglia (peripheral nervous system) (Photo 8.43). These have been shown to contain the highest levels of infectivity and their removal from the edible parts of the animal is recommended in countries where BSE is known to occur. Specified risk material (SRM) should be appropriately disposed of (Photo 8.44). The brain is removed as part of



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PHOTO 8.42
BSE: degenerative lesions in the cerebral cortex



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PHOTO 8.43 **Sample collection of the brain stem (medulla oblongata)**

PHOTO 8.44
Disposal of specified risk material (SRM)



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the head and, following invasive stunning methods such as captive bolt shooting (see also Section 7), contamination of the head is possible so the entire head (apart from the tongue) may be regarded as risk material. Splitting the carcass in the medial plane is necessary in order to remove the spinal cord from the spinal canal (Photo 8.45) but, if this is accomplished by a

power saw the cord fragments and some of it is disseminated on the medial surface of the sides, particularly on the dorsal regions, along the vertebral column (Photo 8.46). It is currently not known how much spinal cord remains after carcass jointing and butchery or, therefore, how big a risk this poses to consumers.



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PHOTO 8.45 *Removal of the spinal cord from the spinal canal*



M. BLEICH, SWITZERLAND



M. BLEICH, SWITZERLAND

PHOTO 8.46
Splitting the carcass in the medial plane by power saw

DISEASES CAUSED BY *RICKETTSIA* AND *MYCOPLASMA* SPP.

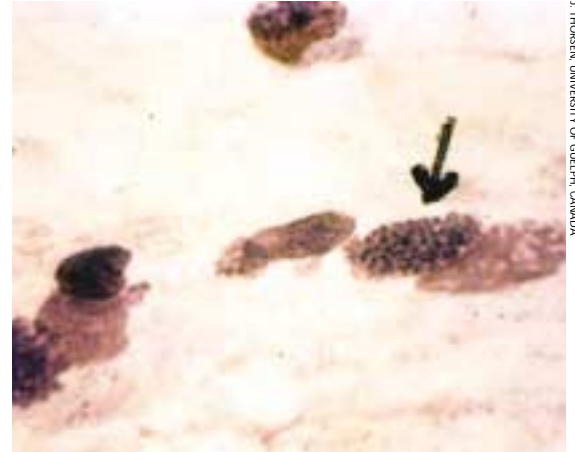
Heartwater (hydropericardium)

Post-mortem findings:

- hydropericardium;
- hydrothorax;
- pulmonary oedema and ascites;
- haemorrhagic gastro-enteritis;
- enlarged liver, spleen and lymph nodes;
- haemorrhage in the abomasum and intestine;
- oedema and haemorrhage of the brain (Photo 8.47).

Judgement:

The carcass of an animal affected with heartwater is condemned in the acute stage of the disease. In a chronic case, the carcass may be approved if it is adequately bled and the muscles are wholesome in colour and texture. The affected organs are condemned.



J. THORSEN, UNIVERSITY OF GUELPH, CANADA

PHOTO 8.47
Heartwater (Cowdria ruminantium) in bovine brain smear (arrow)

Contagious bovine pleuropneumonia (CBPP)

Post-mortem findings:

- fibrinous inflammation of the pleura (pleuritis);
- straw-coloured fluid in the thorax (Photo 8.48);
- lobar pneumonia with red hepatization, marbled appearance of lung lobules (Photo 8.49) due to thickening of interlobular septae and interlobular pulmonary oedema;
- enlarged mediastinal lymph nodes;
- walled-off sequestra formation in chronic cases;

- haemorrhage in the heart;
- arthritis and tenosynovitis.

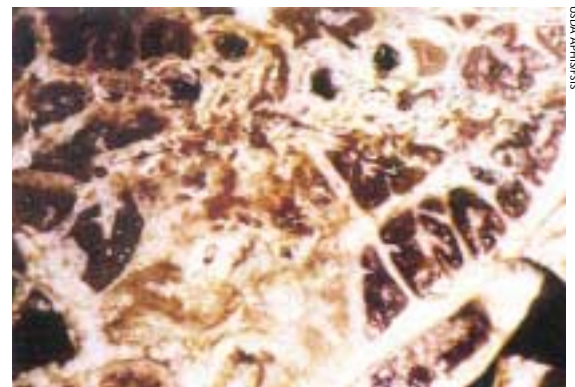
Judgement:

The carcass of an animal affected with CBPP is condemned if the disease is associated with fever, inadequate bleeding of the carcass, serous infiltration of the brisket and emaciation. Recovered animals showing no generalized signs of the disease are approved and the affected organs are condemned.



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PHOTO 8.48
CBPP: straw-coloured fluid in the thorax and partial lung hepatization



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PHOTO 8.49
CBPP: lobar pneumonia with red hepatization and marbled appearance of lung lobules

DISEASES CAUSED BY BACTERIA

Blackquarter (blackleg)

Post-mortem findings:

- lying on one side with affected hind leg stuck out – commonly seen in cattle;
- bloating of carcass and blood-stained frothy exudates from the nostrils and anus;
- dark red to black muscle of the loin, back or leg (Photo 8.50);
- 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.

Judgement:

The carcass of an animal affected with blackleg should be condemned. It is prohibited to slaughter and dress an animal diagnosed with this disease at ante-mortem examination.



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PHOTO 8.50

Blackleg: dark red skeletal muscle of a heifer showing haemorrhage, necrosis, oedema and emphysema

Botulism

Post-mortem findings:

- foreign material in fore-stomachs or stomachs may be suggestive of botulism.

Judgement:

Total condemnation of the carcass because of human hazards.

Malignant oedema

Post-mortem findings:

- gangrene of the skin in area of infection site;
- foul putrid odour is frequently present;
- gelatinous exudate in the subcutaneous and intramuscular connective tissue;
- subserosal haemorrhage;
- accumulation of sero-sanguineous fluid in body cavities;

- muscle tissue is dark red but has little or no gas.

Judgement:

Carcasses of animals affected with malignant oedema are condemned.

Tuberculosis

Post-mortem findings:

- tuberculous granuloma in the lymph nodes of the head, lungs (Photo 8.51), intestine and carcass;
- these usually have a well defined capsule enclosing a caseous mass with a calcified centre;
- they are usually yellow in colour in cattle, white in buffalo and greyish-white in other animals;
- active lesions may have a reddened periphery and caseous mass in the centre of a lymph node;
- inactive lesions may be calcified and encapsulated;
- nodules on the pleura and peritoneum;
- lesions in the lungs (Photo 8.52), liver, spleen and kidneys;
- bronchopneumonia;
- firmer and enlarged udder, particularly rear quarters;
- lesions in the meninges, bone marrow and joints.

The diagnosis may be confirmed by making a smear of the lesion and staining with Ziehl-Neelsen (carbolfuchsin) reagent. The tuberculosis bacterium is a very small red staining bacillus.



PHOTO 8.51
Tuberculous granuloma in the mediastinal lymph nodes; Mycobacterium bovis was isolated

Judgement:

The carcass of an animal affected with tuberculosis requires additional post-mortem examination of the lymph nodes, joints, bones and meninges. It is suggested that the Codex Alimentarius judgement recommendations for cattle and buffalo carcasses be followed.

Carcasses are condemned:

- where an eradication scheme has terminated, or in cases of residual infection or re-infection;
- in the final stages of eradication – where natural prevalence is low;
- during the early stages of eradication in high-prevalence areas.

The carcass of a reactor animal without lesions may be approved for limited distribution. If the economic situation permits, this carcass should be condemned. Heat treatment of meat is suggested during early and final stages of an eradication programme: in low- and high-prevalence areas where one or more organs are affected, and where miliary lesions, signs of generalization or recent haematogenous spread are not observed. If the economic situation permits, then the carcass is condemned.

In some countries, the carcass is approved if inactive lesions (calcified and/or encapsulated) are observed in organs and without generalization in the lymph nodes of the carcass.



PHOTO 8.52
Lesion of tuberculosis in the lungs

Johne's disease (bovine paratuberculosis)

Post-mortem findings:

- thickened and corrugated intestinal mucosa (Photo 8.53);
- enlarged caecal lymph nodes.

Judgement:

The carcass of an animal affected with Johne's disease is approved when generalized systemic signs of disease are not present. A poor, thin and slightly moist carcass should be held in the chiller and assessed after 24 or 48 hours. If the dryness and setting of the carcass improves during this time it can be released. A carcass with associated oedema and emaciation is condemned.



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PHOTO 8.53
Johne's disease: thickened and corrugated intestinal mucosa

Leptospirosis

Post-mortem findings:

- anaemia and jaundice;
- subserosal and submucosal haemorrhage;
- ulcers and haemorrhages in the abomasal mucosa;
- rarely, pulmonary oedema or emphysema;
- interstitial nephritis (Photo 8.54);
- septicaemia.

Judgement:

The carcass of an animal affected with acute leptospirosis is condemned. A chronic and localized condition may warrant an approval of the carcass.



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PHOTO 8.54
Leptospirosis: interstitial nephritis in a bovine

Brucellosis (contagious abortion, Bang's disease)

Post-mortem findings:

In cattle:

- occasional inflammation of testes and epididymis;
- hygromas on the knees, stifles, hock and angle of the haunch, and between the nuchal ligament and the primary thoracic spines.

In sheep:

- in chronic stage enlarged and hard epididymis, thickened scrotal tunics and frequently atrophic testicles.

Judgement:

Cattle and horse carcasses affected with brucellosis are approved (after removal of the affected parts), as *Brucella* bacteria remain

viable in the muscles for only a short period after slaughter. In the acute abortive form (after the miscarriage), cattle carcasses are condemned. Pig, sheep, goat and buffalo carcasses require total condemnation. Heat treatment may be recommended in some areas for these species due to economic reasons. Affected parts of the carcass, udder, genital organs and corresponding lymph nodes must be condemned.

Reactor animals should be carefully handled during slaughter and dressing procedures. Gloves and goggles should be worn when known reactors are being slaughtered and hygroma lesions should be sprayed liberally with 1 percent lactic acid at meat inspection.

Anthrax

Post-mortem findings:

- dark tarry blood discharge from body orifices;
- absence of rigor mortis;
- haemorrhage of the mucous and serous membranes, lymph nodes and subcutaneous tissue;
- enlarged spleen;
- severe haemorrhagic enteritis;
- degeneration of the liver and kidneys;
- bloating and rapid decomposition of carcass;
- localized lesions in the intestine of pigs (dysentery).

Diagnosis of anthrax is carried out by direct microscopic examination of tissues and fluids (Photo 8.55).

Judgement:

Condemnation of the carcass and its parts by burning or burial. If disposed of by burial, the carcass should be buried at least 2 m below ground. The site should be surrounded by a layer of quicklime 0.30 m thick.

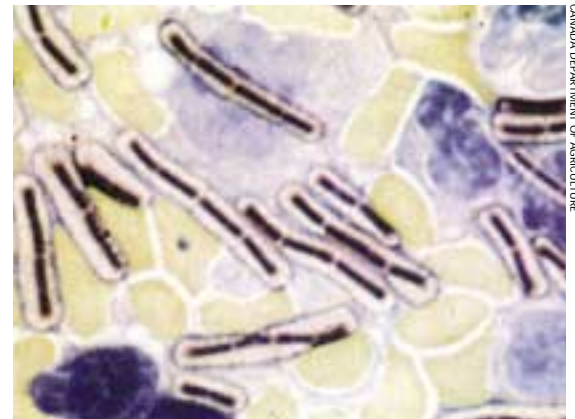


PHOTO 8.55

Anthrax: *Bacillus anthracis* in a bovine spleen stained with Toluidine blue; anthrax bacilli in tissue seen in short chains surrounded by a common capsule

Salmonellosis in bovines

Post-mortem findings:

Septicaemic form:

- absence of gross lesions in animals;
- submucosal and subserosal haemorrhage.

Acute enteritis:

- mucoenteritis to diffuse haemorrhagic enteritis;
- severe necrotic enteritis of ileum and large intestine caused by *Salmonella typhimurium*;
- abomasitis in *Salmonella dublin* infection;
- enlarged, oedematous and haemorrhagic lymph nodes;
- thickened inflamed gall bladder wall;
- fatty change of the enlarged liver;
- subserous and epicardial haemorrhage.

Chronic enteritis:

- areas of necrosis in the wall of caecum and colon;
- swollen mesenteric lymph nodes and spleen;
- chronic pneumonia.

In the septicaemic and acute enteric forms, *Salmonella* organisms are present in the blood, liver, bile, spleen, mesenteric lymph nodes and in intestinal content. In the chronic form, bacteria are present in the intestinal lesions and less frequently in other viscera.

Judgement:

A carcass affected with salmonellosis is condemned.

Haemorrhagic septicaemia

Post-mortem findings:

- subcutaneous swellings characterized with yellowish gelatinous fluid, especially around the throat region, brisket and perineum;
- enlarged haemorrhagic lymph nodes;
- haemorrhage in the organs;
- pneumonia (Photo 8.56);
- rarely, haemorrhagic gastro-enteritis;
- petechial haemorrhage in the serous membranes, which is extensive in some cases.

Judgement:

The carcass of an animal affected with haemorrhagic septicaemia is condemned. Dressing of such a carcass would create potential danger for the spread of infection to other carcasses.



PHOTO 8.56

Haemorrhagic septicaemia: fibrinous bronchopneumonia

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Calf diphtheria

Post-mortem findings:

- inflammation and ulceration with large masses of yellow-grey material in the mouth, tongue, pharynx and larynx;
- often, aspiration pneumonia.

Judgement:

The carcass of an animal affected with local lesions is approved. Generalized diphtheric lesions associated with pneumonia or toxæmia require condemnation of the carcass. The carcass is also condemned if lesions are associated with emaciation.

Actinobacillosis (“wooden tongue”)

Post-mortem findings:

- enlarged tongue showing tough fibrous consistency (“wooden tongue”) (Photo 8.57);



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PHOTO 8.57

Actinobacillosis of the tongue: the tongue is enlarged, firm and contains numerous granulomatous lesions. It is called “wooden tongue” because of its firmness due to diffuse proliferation of fibrous tissue

- a cluster of small yellowish nodules and erosions of tongue mucosa;
- granulomatous lesions in the lymph nodes (Photo 8.58);
- marked thickening of the lower part of the 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.

Typical actinobacillosis lesions in the lymph nodes and organs consist of greenish-yellow thick creamy pus with “sulphur granules”. These are bacterial colonies surrounded by club-like structures.

Judgement:

The carcass of an animal affected with active progressive inflammatory lesions of actinobacillosis in lymph nodes and lung parenchyma is condemned. Condemned material should be sent to an authorized rendering plant. If the disease is slight and confined to lymph nodes, the head and tongue and whole carcass are approved after the condemnation of lymph nodes. If the tongue is diseased and no lymph nodes are involved, the head and carcass are approved. The tongue is condemned.

PHOTO 8.58
Actinobacillosis: multifocal, well demarcated yellow lesions in the retropharyngeal lymph node of a bovine animal



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Actinomycosis (“lumpy jaw”)

Post-mortem findings:

- lesions in the mandible (“lumpy jaw”) or maxilla (Photo 8.59);
- granulomatous lesions in the lower part of the oesophagus or anterior part of the reticulum;
- local peritonitis;
- mild abomasitis and enteritis.

Judgement:

See actinobacillosis.



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PHOTO 8.59

Actinomycosis: diffuse granulomas in maxilla and formation of green yellow pus; “sulphur granules” are found in the pus

Pyelonephritis (contagious bovine pyelonephritis)

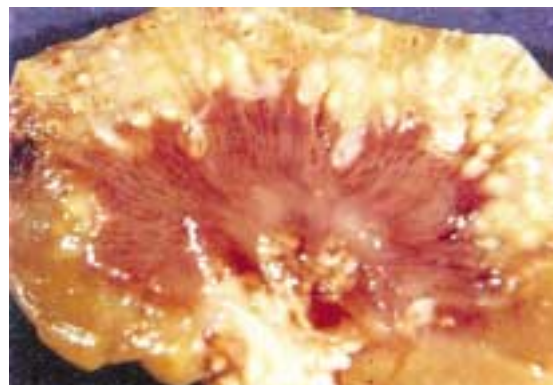
Post-mortem findings:

- pyelonephritis showing enlarged, pale and greyish coloured kidney (Photo 8.60) and enlarged renal lymph nodes; purulent lesion in the medulla, pelvis and ureters;
- inflammation of kidney and kidney stones (uroliths) (Photo 8.61);
- enlarged renal lymph nodes;
- uraemia.

Judgement:

Judgement depends on infection of one or both kidneys and/or presence of a urine odour. The carcass of an animal affected with pyelonephritis or nephritis is condemned if: 1) renal insufficiency is associated with uraemia; 2) acute infection of the kidney is accompanied with systemic changes in the organs and lymph nodes, and/or degeneration of body tissues. Borderline cases with uraemic odours should be kept in the chiller for 24 hours. They are subjected to a boiling test. If a urinary odour is not present after detention, the carcass may be approved.

Subacute or chronic kidney infections with no systemic changes allow for a favourable judgement of the carcass. Only the affected parts are condemned. Pyelonephritis associated with kidney stones often has a favourable judgement of the carcass.



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PHOTO 8.60

Pyelonephritis (contagious bovine pyelonephritis): cut section of kidney showing multifocal abscessation in the cortex and medulla



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PHOTO 8.61

Pyelonephritis associated with urolithiasis (stones); chemical analysis revealed oxalate composition

Metritis

Post-mortem findings:

- enlarged flaccid uterus showing “paintbrush” haemorrhages on the serosal surface;
- inflammation of the uterus with light brown foul-smelling uterine exudate (Photo 8.62);
- enlarged uterus containing greenish-yellow purulent exudate (pyometra, Photo 8.63);
- inflamed peritoneum at the entrance of the pelvic cavity;
- enlarged iliac, lumbar and sacral lymph nodes;



PHOTO 8.62
Metritis: necrotizing inflammation of the uterus with light brown foul-smelling uterine exudate

- degeneration of the liver, kidney and heart muscles may be present;
- congested musculature of the carcass;
- necrosis of abdominal fat.

Judgement:

The carcass of an animal affected with acute metritis is condemned if it is associated with septicaemia or toxæmia. In chronic cases, when toxæmic signs are lacking, the carcass may be approved if no antibiotic residues are found.



PHOTO 8.63
Pyometra: enlarged uterus containing greenish-yellow exudate

Mastitis

Post-mortem findings:

- pale yellow granular appearance of the udder parenchyma (Photo 8.64);
- light brown oedematous udder parenchyma (Photo 8.65);
- enlarged supramammary, iliac and lumbar lymph nodes;
- injection sites.

PHOTO 8.64
Chronic mastitis: enlarged, firm udder. Incision into the udder parenchyma shows normal milk and pale yellow granular appearance of the udder parenchyma



Judgement:

The carcass and viscera are condemned if acute or gangrenous mastitis is associated with systemic changes. If infection has spread from the supramammary lymph nodes via the iliac lymph nodes to the lumbar lymph nodes, this can be taken as evidence of spread of infection from its primary location. The condemnation of the carcass may then be warranted. A localized condition of the udder has a favourable judgement of the carcass.



PHOTO 8.65
Brownish-red oedematous udder parenchyma. The udder culture resulted in a heavy growth of Staphylococcus aureus

Endocarditis

Post-mortem findings:

- large cauliflower-like lesions (Photo 8.66) in the endocardium;

PHOTO 8.66
Endocarditis: vegetative valvular endocarditis



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- small wart-like and verrucose lesions in the endocardium;
- embolic lesions in other organs including the lungs, spleen and kidneys.

Judgement:

The carcass of a debilitated animal is condemned for verrucose endocarditis if it is associated with lesions in the lungs, liver or kidneys. A carcass affected with ulcerative or verrucose endocarditis with no signs of systemic changes and negative bacteriological result may be approved after heat treatment is applied. Endocarditis showing scar tissue is approved. The heart is condemned.

Traumatic reticuloperitonitis (TRP, hardware disease, traumatic gastritis, traumatic reticulitis)

Post-mortem findings:

- adhesions of rumen, reticulum and peritoneum and abscessation;
- acute or chronic peritonitis;
- splenic abscessation;
- traumatic pericarditis (Photo 8.67);
- metallic objects such as nails, pieces of wire or magnets in the reticulum;
- lung abscessation or pneumonia;
- septic pleuritis;
- oedema of the chest.

Judgement:

The viscera and carcass are condemned:

- if the animal is affected with acute diffuse peritonitis or acute infectious pericarditis associated with septicaemia;
- if the carcass has traumatic pericarditis associated with fever, large accumulation of exudate, circulatory disturbances, degenerative changes in organs, or abnormal odour;
- if the carcass has chronic traumatic reticulo-peritonitis and/or purulent pericarditis with associated pleuritis, abscessation and oedema of the chest.

Chronic adhesive localized peritonitis and chronic pericarditis without systemic changes in well nourished animals allow a favourable

judgement of the carcass. The affected parts of the carcass and organs are condemned.

A carcass affected with infectious exudative pericarditis in a subacute stage may be conditionally approved pending heat treatment, if bacteriological and antibiotic residue findings are negative.



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PHOTO 8.67

TRP: cross-section of the heart reveals thick fibrinous deposits that encircle the heart. In this case a rusty nail has penetrated through the wall of the reticulum into the pericardium

PARASITIC DISEASES

■ Diseases caused by helminths ■

Lungworms

Post-mortem findings:

- haemorrhagic inflammation of bronchi with froth;
- lung oedema and emphysema;
- consolidation of lung parenchyma;
- lungworms;
- enlarged lung lymph nodes.

Judgement :

Carcass of animal affected with lungworms is approved if infestation is slight and no secondary changes are observed. The lungs are condemned. The carcass is condemned if lungworm infestation has caused pneumonia which is accompanied with emaciation or anaemia.

Fascioliasis

Post-mortem findings:

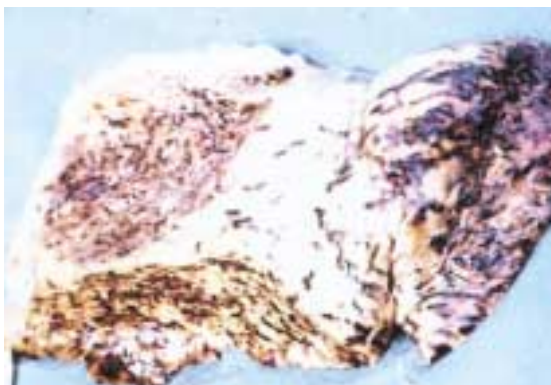
- emaciated, anaemic or oedematous carcass in severe chronic infestations;
- presence of flukes in enlarged and thickened bile ducts and in the liver parenchyma;
- hepatic abscesses and secondary bacterial infection;
- calcification of bile ducts;

- black parasitic material (excrement) in the liver, lungs, diaphragm and peritoneum;
- haemorrhagic tracts of migratory immature flukes in the lungs and liver in an acute infestation (Photo 8.68);
- black lymph nodes of the lungs and liver due to fluke excrement;
- icterus due to liver damage.

Judgement:

Judgement depends on the extent of the fluke lesions and the condition of the carcass. Severe infestation with associated emaciation or oedema would necessitate total condemnation of the carcass. Mild, moderate and heavy infestation without emaciation may have a favourable judgement. If the parasitic lesions in the liver are clearly circumscribed, the liver may be salvaged after trimming of affected tissue. Otherwise it is condemned.

PHOTO 8.68
*Acute
haemorrhagic
tract in a bovine
liver*



P.G. CHAMBERS, ZIMBABWE

Oesophagostomiasis (pimply gut, nodular worms)

Post-mortem findings:

- greyish-white nodules ranging in size from a pinhead to a pea (Photo 8.69); the nodules may contain a greenish pasty material in younger lesions or a yellow-brown crumbly material in older lesions;
- thickening of the intestinal wall;
- local peritonitis;
- mild inflammation of the intestine in the acute stage;
- chronic inflammation of the colon in the chronic stage.

Judgement:

Intestines affected with nodular worms are condemned. The carcass is also condemned if severe infestation of this parasite is associated with emaciation and oedema. Mild, moderate and heavy infestation without emaciation may

have a favourable judgement. However, intestines should always be condemned as they cannot be used for sausage manufacture.



PHOTO 8.69
Oesophagostomiasis: parasitic nodules on the intestinal mucosa (top) and serosa (bottom) in a young bovine animal

Cysticercosis

Post-mortem findings:

- small white lesions (cysticerci two to three weeks after infection) in muscle tissue;
- clear transparent bladders 5 mm x 10 mm (infective cysticerci, 12–15 weeks after infection) (Photo 8.70);
- opaque and pearl-like cysts (over 15 weeks of infection);
- degeneration, caseation and calcification of the cysts (after 12 months or more after infection);
- degenerative myocarditis.

Judgement:

The carcass and viscera of an infested animal should be differentiated between those with “heavy” infestation and those with “light” infestation. The carcass and viscera of heavily infested animals are condemned and those with light infestations should be treated either by boiling or freezing. The extent of heavy infestation is prescribed by the controlling authority. An animal is commonly considered heavily infected if lesions are discovered in two of the usual inspection sites, including the masseter muscles, tongue, oesophagus, heart, diaphragm or exposed musculature, and in two sites during incisions into the shoulder and into the rounds. Generalized infection according to Canadian regulations means two or three cysts found on each cut into the muscles of mastication, heart, diaphragm and its pillars, and also if two or three cysts are found in muscles exposed during dressing procedures. In moderate or light infestation consisting of a small number of dead or degenerated cysticerci, the carcass is held depending on the existing country regulations for approximately 10 days at -10 °C.

PHOTO 8.70
Caseous cysticercus:
numerous clear transparent cysts
0.6 mm in diameter in the heart muscle



P.G. CHAMBERS, ZIMBABWE

Hydatid disease (hydatidosis, echinococcosis)

Post-mortem findings:

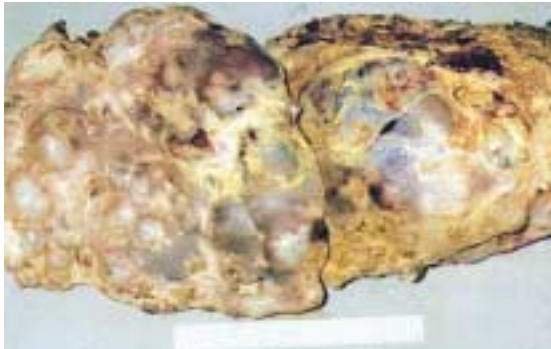
Hydatid cysts are found in:

- the liver (Photo 8.71), heart (Photo 8.72), lungs, spleen, kidneys;
- muscle and brain;
- any tissue including bone.

Judgement:

Carcass showing emaciation, oedema and muscular involvement is condemned and destroyed. Otherwise the carcass is approved. Affected viscera and any other tissue are also condemned and destroyed. Burying the carcass is not sufficient, since dogs may retrieve the affected organs.

PHOTO 8.71
Hydatid cysts in a
bovine liver



P. SEVENANTIA, AUSTRALIA



P. G. CHAMBERS, ZIMBABWE

PHOTO 8.72
Hydatid cysts in a bovine heart; note the detached
germinal layer

Onchocercosis

Post-mortem findings:

- firm fibrous nodules (0.5–5.0 cm in diameter) singly or in clusters in the regions of the brisket (Photo 8.73), buttocks and thighs;
- the nodules have tightly coiled worms;
- the worms may be dead or calcified in older nodules.

Judgement:

The affected carcasses can be passed after the nodules have been removed. In heavy infestations the affected briskets are removed, and the tissue and the fascia around the stifle and the brisket are stripped off before the carcasses are passed.



P. SEVENANTIA, AUSTRALIA

PHOTO 8.73
Firm fibrous nodules of *Onchocerca gibsoni* in the
brisket of an ox

PARASITIC DISEASES

■ Diseases caused by protozoa ■

Trypanosomiasis

Post-mortem findings:

- enlarged lymph nodes;
- enlargement of the spleen, liver and kidneys may also occur;
- oedematous and emaciated carcass;
- mild icterus.

Judgement :

The carcass affected with trypanosomiasis or any other protozoan diseases is condemned if an acute condition is associated with systemic body

changes. Heat treatment may be recommended in some cases if economically feasible. The carcass of recovered and reactor animals may be approved if generalized lesions are lacking.

A carcass showing borderline emaciation or slight oedema should be examined after 24–48 hours in the chiller. A satisfactory setting would lead to a favourable judgement of the carcass.

The affected parts of the carcass and organs are condemned.

Theileriosis (East Coast fever)

Post-mortem findings:

- froth in nostrils and bronchi associated with pulmonary oedema and emphysema;
- swollen, oedematous lungs and interstitial pneumonia (Photo 8.74);
- enlarged and haemorrhagic lymph nodes and splenic lymphoid hypertrophy;
- enlarged and mottled liver;
- infarcts, thrombosis and lymphoid hypertrophy in spleen (Photo 8.75);
- white spots of lymphoid aggregates in the kidneys;
- brownish coloration of fat;
- haemorrhagic and, rarely, ulcerative enteritis.

Confirmation of diagnosis is only made through detection of parasites in a Giemsa-stained lymph node biopsy smear and/or blood smear.

Judgement:

Carcass and viscera of an animal affected with febrile chronic theileriosis and without systemic lesions are approved. Carcass is condemned if acute febrile theileriosis is accompanied with fever and generalized lesions. The affected organs are also condemned.

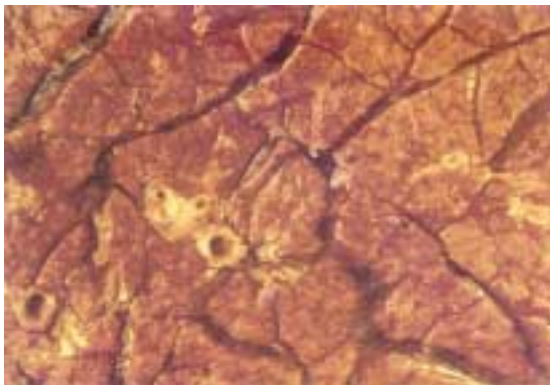


PHOTO 8.74
Theileriosis: swollen oedematous lungs and interstitial pneumonia



PHOTO 8.75
Theileriosis: infarcts, thrombosis and lymphoid hypertrophy in spleen

Besnoitiosis

Post-mortem findings:

- inflammation of the pharynx, larynx and trachea;
- sand-like granules and cysts in the turbinates and nostrils (Photo 8.76);
- sand-like granules in the endothelium of large vessels;
- dermatitis.

Judgement :

The carcass is approved if the lesions are localized with no systemic involvement. Carcass is condemned if disseminated, generalized lesions are accompanied with emaciation.

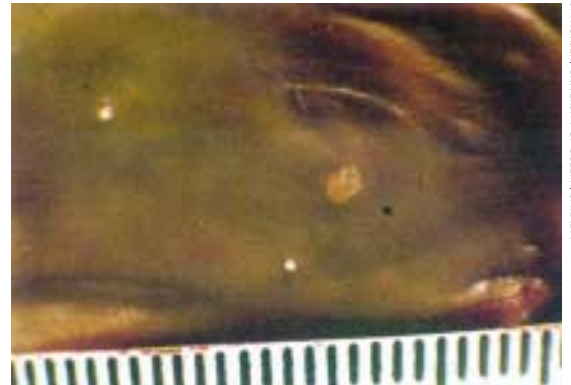


PHOTO 8.76

Besnoitiosis: sand-like granules and cysts in the nostrils of an antelope

J. THORSEN, UNIVERSITY OF GUELPH, CANADA

Anaplasmosis (gall sickness)

Post-mortem findings:

- enlarged and congested spleen (splenomegaly) showing soft pulp;
- distended gall bladder with dark tarry bile;
- thin, watery blood, which clots poorly;
- enlarged, icteric liver, deep orange in colour and distended bile ducts (Photo 8.77);
- lemon yellow carcass and connective tissue of the sclera of the eye, tendons, pleura, peritoneum and attachments of the diaphragm.

Diagnosis can only be confirmed by detecting parasites in a blood smear stained with Giemsa.

Judgement:

Carcass of an animal showing acute infection should be condemned. Recovered and "suspect" animals manifesting inconclusive signs of anaplasmosis are approved if otherwise healthy. A mildly yellow discoloured carcass may be chilled and assessed after setting. If the discoloration has disappeared, the carcass is approved. Animals affected with anaplasmosis could be treated under the supervision of a government official. Guidelines for the withdrawal period for therapeutic agents should be followed if the animals are being shipped for slaughter.



PHOTO 8.77

Anaplasmosis: ox liver affected with disease showing distended bile ducts

J. THORSEN, UNIVERSITY OF GUELPH, CANADA

Babesiosis (piroplasmosis, Texas fever, red water fever, tick fever)

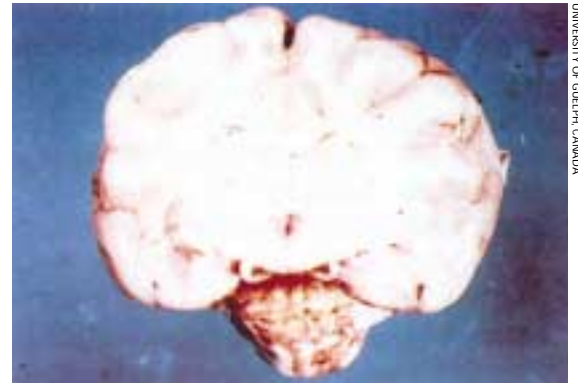
Post-mortem findings:

- oedema and congested lungs;
- enlarged and yellow liver and distended gall bladder with thick dark green bile;
- enlarged spleen;
- anaemia and pale muscles;
- jaundice particularly noted in the connective tissue;
- oedematous and haemorrhagic lymph nodes;
- yellowish-orange colour of musculature (mild cases);
- occasionally dark kidneys with no other findings;
- pink haemorrhage of a bovine brain (Photo 8.78).

Diagnosis can only be confirmed by identification of the parasite in the peripheral blood smear stained with Giemsa (Photo 8.79).

Judgement :

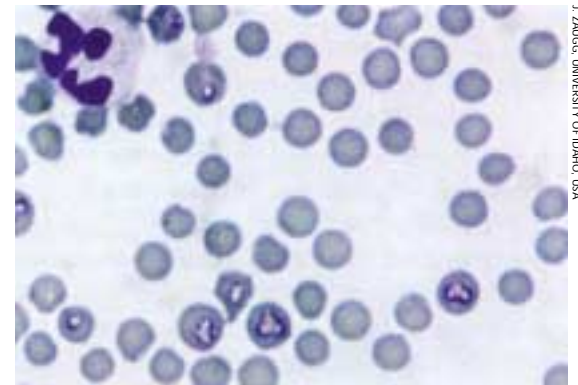
The carcass of an animal with the acute form of the disease, with associated icterus, is condemned. An emaciated, jaundiced carcass showing yellow gelatinous fat also requires total condemnation. A mild form of this disease showing yellow-orange coloration of the carcass, not associated with icterus, may be approved. The satisfactory setting of the carcass in the chiller must be considered in this approval.



UNIVERSITY OF GUELPH, CANADA

PHOTO 8.78

Pink haemorrhage: cerebral form of babesiosis caused by Babesia bovis; it is characterized by formation of thrombi and emboli in brain capillaries



J. ZAUSG, UNIVERSITY OF IDAHO, USA

PHOTO 8.79

Babesia bigemina in American bison blood

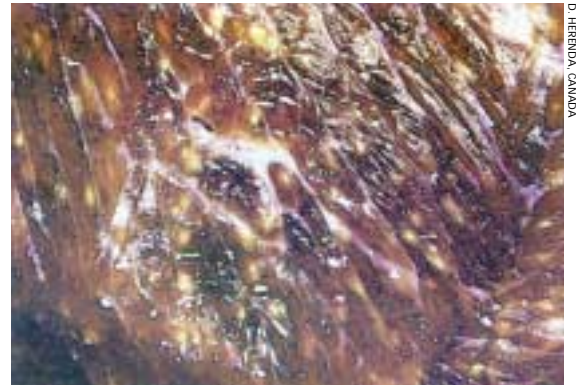
Sarcocystosis (sarcosporidiosis)

Post-mortem findings:

- the cysts are microscopic and therefore are not detected on routine post-mortem inspection;
- the cysts cause little tissue reaction;
- in some cases the cysts may be associated with eosinophilic myositis (Photo 8.80);
- histological section of bovine muscle shows massive accumulation of eosinophiles and microcysts of *Sarcocystis cruzi* (Photo 8.81);
- *S. hirsuta* cysts may be seen as fusiform objects 8 mm x 1 mm in the oesophagus, diaphragm and skeletal muscles of older animals, especially bulls;
- macroscopic cysts of *S. fusiformis* in the skeletal muscle of buffalo (Photo 8.82).

Judgement:

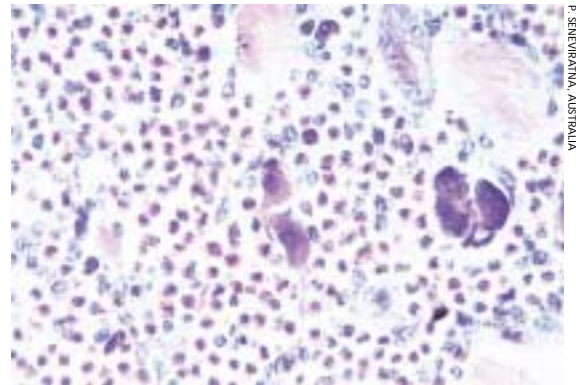
Judgement should be made on macroscopic presence of cysts. In heavy and widespread infestations with visible cysts the whole carcass is condemned. In lighter infestations those parts of the carcass that are not affected are passed for human consumption.



D. HERRIDA, CANADA

PHOTO 8.80

Sarcocystosis: eosinophilic myositis



P. SENEVIRATNA, AUSTRALIA

PHOTO 8.81

Sarcocystosis: histological section showing accumulation of eosinophiles and two microcysts of S. cruzi; there is no tissue reaction



P.G. CHAMBERS, ZIMBABWE

PHOTO 8.82

S. fusiformis in the skeletal musculature of buffalo

PARASITIC DISEASES

■ Diseases caused by arthropod parasites ■

Hypoderma bovis infestation

Post-mortem findings:

- inflamed area of subcutaneous tissue, red, green or yellow in colour, around the maggot or at the site where the maggot lodged;
- inflammation of the oesophagus, which may cause rumen bloat due to obstruction;
- *Hypoderma bovis* larvae (Photo 8.83).

Judgement:

Carcass of an animal affected with *Hypoderma bovis* is approved. Subcutaneous lesions are removed.



PHOTO 8.83
Hypoderma bovis larvae

Screwworm myiasis

Post-mortem findings:

After five to seven days of infestation, a wound may be expanded to 3 cm or more in diameter and 5–20 cm deep with larvae from a single screwworm egg mass. Usually by this stage, additional screwworm flies have deposited eggs, resulting in a multiple infestation. However, after death the larvae leave the body as a result

of the temperature reduction and some third-stage instar larvae may pupate in the body.

Judgement:

The affected carcass can be passed after the wound tissues have been removed and incinerated.