

MEAT INSPECTORS MANUAL

GAME



DIRECTORATE: VETERINARY SERVICES

VETERINARY PUBLIC HEALTH

NATIONAL DEPARTMENT OF AGRICULTURE

REPUBLIC OF SOUTH AFRICA

JANUARY 2007

FOREWORD

The delivery of meat hygiene services in South Africa has gone through various phases of change since the function was officially made the responsibility of the Department of Agriculture in the early 1960's. Little did we realise when the first Animal Slaughter, Meat and Animal Products Act, 1967 (Act No. 87 of 1967) was published in 1967, what challenges would lie ahead 40 years later. We have seen the third Act related to the delivery of meat hygiene services promulgated by Parliament. The Meat Safety Act 2000 (Act 40 of 2000), has replaced the Abattoir Hygiene Act (Act 121 of 1992) signifying, not only by the change in names of the relevant Acts since 1967 but also in the objectives of the Act, the obligation of Government to react to the needs of its clientele and to address the concerns of consumers.

The emphasis on the delivery of services as reflected in consecutive legislation since 1967, has changed gradually from a structural and process-control approach of service delivery, to a holistic approach with the focus on food safety. Growing international concern that the State should be the custodian on all matters related to food safety and provides the sanitary guarantees required by consumers and our trade partners, necessitated a change of focus on the delivery of these services. We are confident that these manuals will guide and enable all those responsible for the delivery of a meat safety service, to focus on the new challenges and to claim ownership of the initiative to establish a culture of hygiene awareness.

Over the last 40 years many teams and co-workers collected and collated material for training future meat inspection staff. This was made available to all tertiary training institutions free of charge in order to ensure that the minimum standards proposed by this Directorate would be known to all. During 2006 the task of updating, co-ordinating and maintaining this intellectual property of the Department of Agriculture, was given to Dr. T. Bergh from the Limpopo Province. All the persons involved in this work, are congratulated with what eventually emerged after many months of hard and dedicated work.

There is no doubt that this manual, being dynamic and reflecting change, will serve as a benchmark for the future to enable the delivery of meat safety services to be accessible and affordable for all.



DR. M. MAJA

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DEPARTMENT OF AGRICULTURE

PRETORIA, JANUARY 2007

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INTRODUCTION

The Directorate Veterinary Services of the National Department of Agriculture was constitutionally tasked ensure that norms and standards concerning abattoir hygiene be implemented uniformly on a national basis.

Since the Department is the custodian of the “Meat Safety Act” (Act 40 of 2000) it is fitting that the Department set the standards required for meat inspection personnel.

It was decided to write a manual containing a minimum norm of required knowledge for all persons involved with meat hygiene in abattoirs as well as doing meat inspection.

With the necessary adaptation, these manuals can thus be used over a wide spectrum of training requirements and should be in the possession of all persons involved with meat inspection and hygiene-control in an abattoir.

The final manuals, after various versions, have now been revised and have been blended in such a way as to enhance a smooth transition from the basic concepts of food safety management systems, applicable to all meat disciplines, to a more specific approach for the specific disciplines.

The manuals are drafted to address the following concepts:

- Abattoir hygiene

This manual highlights the international principles of food safety management systems e.g.

- Basic microbiology
- Building requirements
- Sanitation
- Pest control
- Personnel hygiene
- Waste management & control of condemned material
- Quality control

The follow up manuals in the respective disciplines of red meat, poultry, game, ostrich & crocodile deals with the requirements specific to the trade e.g.

- Specific building requirements
- Process control
- Anatomy
- Pathology
- Diseases
- Meat inspection

A special word of thanks to all who helped redrafting these final manuals and all the hours of hard work put in to have them available for the New Year.

EDITOR:

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MEAT INSPECTORS MANUAL

GAME

PART II MEAT INSPECTION

MODULE 1

ABATTOIR LAYOUT AND CONSTRUCTION SPECIFIC REQUIREMENTS FOR GAME ABATTOIRS & CUTTING PLANTS

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ABATTOIR LAYOUT AND CONSTRUCTION

1. Introduction

Specific requirements for game abattoirs

Over and above the general requirements that are specified in the module "Layout & Construction", every specific meat trade has its own requirements that enhance the hygienic production of that specific type of meat. Abattoirs have its own specific design that will enable the workers to slaughter and dress the carcass hygienically and that will promote easy working conditions to reduce stressful working conditions that will result in unacceptable practices in the work place.

Regulations have been promulgated to ensure that the layout of the building will enhance the easy handling of carcasses and that acceptable practises are adhered to.

This module will guide you through the specific requirements needed for game meat abattoir, its cutting plants and how it will enhance the process of slaughter and dressing to ensure a safe and hygienic product.

2. Additional requirements for game culling and low and high throughput game abattoirs.

2.1. Transport of Harvested Game

- (1) Vehicles used for harvesting Category C or small game must –
 - (a) have a hanging frame to bleed carcasses in a hanging position which must be
 - (i) corrosion resistant and free from holes and cracks;
 - (ii) durable, non-toxic, smooth surfaced and impervious;
 - (iii) resistant to impact;
 - (iv) easily cleanable;
 - (v) high enough to prevent contamination from dust & soil
 - (b) be equipped with facilities for cleaning and sterilising of bleeding knives with water at 82°C or chemical sterilization as approved by the Provincial Executive Officer;
 - (c) have a hand wash facility, with potable running water and soap, for the workers bleeding the harvested game;
 - (d) keep no equipment or loose objects, other than is required for the harvesting and bleeding of game, on the processing area of the vehicle;
 - (e) have artificial light of at least 220 lux where culling takes place at night.
- (2) Vehicles used for harvesting Category B or medium game must –
 - (a) comply with the requirements (b),(c),(d) and (e) as for category C game;
 - (b) have a hoist and a ramp at 20° to 30° for hanging and bleeding of the animals.
- (3) Vehicles used for harvesting Category A or large game will be determined by the species harvested and a protocol approved by the provincial executive officer will be required to ensure an approved method of killing and handling procedures for each specie.

2.2. Transferable Depots

Transferable depots must be provided with –

- (a) a dry dust free area where carcasses can be received
- (b) a hanging frame of sufficient height to prevent heads and necks of carcasses making contact with the ground;
- (c) a separate table for the inspection of the rough offal;
- (d) adequate hooks for the inspection of heads and feet if removed as well as for red offal;

- (e) an approved protocol regarding the accumulation of blood and waste products on the ground below the frame during dressing. This may include a tarpaulin that can be cleaned on a continuous basis or moving the frame to a clean area;
- (f) sufficient closable containers that comply with regulatory requirements to accommodate –
 - (i) red offal;
 - (ii) rough offal;
 - (iii) inedible material; and
 - (iv) condemned material;
- (g) potable water and facilities for –
 - (i) sterilizing knives and equipment at 82 °C or any other means of sterilization approved by the provincial executive officer;
 - (ii) washing of hands and equipment;
- (h) bactericidal liquid soap;
- (i) artificial light where game is slaughtered at night –
 - (i) with a minimum light intensity of 220 lux for dressing; and
 - (ii) 540 Lux at the inspection point;
- (j) toilet facilities provided per protocol.

2.3. Permanent Depots

2.3.1. Permanent depots must comply with the requirements for temporary depots, but in addition –

- (a) the frame must be fixed on a curbed and drained concrete base;
- (b) roadways and walkways must be dust and mud free and cleanable;
- (c) have an underground effluent disposal system;
- (d) toilets and hand wash facilities must be provided;

2.3.2. Dressing and evisceration facilities in game abattoirs

- (1) The minimum clearance for rails and equipment in dressing areas are –
 - (a) for category B game dressing, from rail to floor is 3.4 m; and
 - (b) for category C game dressing, from rail to floor is 2.2m.
- (2) The clearance between equipment and dressing rails must in all cases be such that carcasses do not touch equipment and is at least 1000mm from walls.
- (3) Rails with hooks fixed to a wall must be 400 mm from the wall, and meat hanging from such hooks may not touch the floor or wall.
- (4) Rails must be at least 700 mm from columns, pillars or the side of a doorway through which carcasses must pass.

3. Throughput and other requirements for grades

3.1. Requirements for rural game abattoirs

Considering the requirements set out in part II B (1), for an abattoir to be graded as a rural game abattoir –

- (a) the throughput may not exceed 10 units per day;
- (b) the premises must be fenced and provided with a gate to control access of people and animals;

- (c) it must consist of a room equipped with hanging facilities where harvested game carcasses or partially dressed game carcasses are dressed and such room must have an air temperature of not more than 12°C when chilled carcasses are handled;
- (d) if windows are not glazed, fly screens must be provided;
- (e) curbed and drained areas, must be provided adjacent to the abattoir for –
 - (i) handling, washing and keeping rough offal; and
 - (ii) to hold containers with inedible products prior to removal.
- (f) doors must be provided –
 - (i) where harvested game carcasses or partially dressed game carcasses are offloaded into the abattoir;
 - (ii) where dressed or partially dressed carcasses and red offal are dispatched this door may be the same as (f)(i) if these functions are done at different times; and
 - (iii) between the dressing room and the adjacent area referred to in (e);
- (g) hand washing facilities must be provided in the abattoir;
- (h) a sterilizer adjacent to a hand wash basin must be provided;
- (i) toilet and hand wash facilities must be provided;
- (j) facilities to store items needed in the daily process must be provided;
- (k) the design must allow for future upgrading of the facility.
- (l) separate chillers must be provided for –
 - (i) partially dressed game carcasses;
 - (ii) dressed carcasses and red offal;
 - (iii) rough offal; and
 - (iv) the proximity of these chillers to the abattoir must be such as not to compromise hygiene standards and be acceptable to the provincial executive officer.
- (m) the chiller referred to in (l)(i) may be substituted with a chiller truck connected to the receiving area by docking seals;
- (n) the chiller referred to in (l)(iii) may be omitted if rough offal is removed from the abattoir on a continuous basis but within four hours after evisceration or receiving; and
- (o) where freezing facilities are not provided for treatment of conditionally passed carcasses affected by parasitic intermediate stages (measles) at the abattoir, such facilities may be arranged elsewhere with the approval of the provincial executive officer.

3.1.1. Meat inspection facilities

- (1) Containers, racks and platforms and any other equipment required for meat inspection must be provided in an abattoir.
- (2) Marked, leak proof and lockable containers or other means to handle and hold condemned and inedible material prior to removal, must be provided.

3.1.2. Chillers

- (1) Chillers must be provided to hold at least the daily throughput.
- (2) The minimum clearance for rails in chillers and freezers –
 - (a) for category B or category C carcasses on cradles with extension rods, is 1000 mm from the wall and 900 mm between overhead carcass rails; and
 - (b) for category C carcasses, if hung separately, is 330 mm from the wall and between overhead carcass rails.

- (3) Spacing of units on the line should be such as to ensure airflow between carcasses or sides with a minimum of 660 mm length of rail per unit.

3.1.3. Dispatch areas

Dispatch areas must be equipped for –

- (a) quartering, marshalling and loading of carcasses;
- (b) collection and transport, avoiding cross or contra flow, of used roller-hooks to the sanitation facility; and
- (c) sterilization of saws and other cutting utensils.

3.2. Requirements for low-throughput game abattoirs

Considering the requirements set out in part II B (1) and (2), for an abattoir to be graded as a low throughput game abattoir –

- (a) a maximum throughput of 30 units per day may not be exceeded, provided that the provincial executive officer may determine a lower maximum throughput for an abattoir on grounds of the capacity of the receiving area, hourly throughput potential relative to available equipment and facilities including hanging space, chiller capacity;
- (b) the premises must be fenced and provided with a gate to control access of people and animals;
- (c) a door equipped with docking seals for offloading harvested game or partially dressed game carcasses and red offal must be provided;
- (d) a facility where transport trucks must be sanitized after dispatch must be provided;
- (e) a receiving area with hanging facilities to accommodate at least 20% of throughput of game carcasses of different categories and red offal must be provided and such area must have an air temperature of not more than 12°C when chilled carcasses are handled;
- (f) a hoist for the hanging of category B game must be provided;
- (g) holding chillers must be provided to accommodate partially dressed carcasses received prior to dressing;
- (h) the chillers referred to in (g) may be substituted with a chiller truck connected to the receiving area by docking seals;
- (i) a room equipped with a dressing rail must be provided where harvested game carcasses or partially dressed game carcasses are dressed and such room must have an air temperature of not more than 12°C when chilled carcasses are handled;
- (j) a side rail or hooks for carcasses and containers for offal, must be provided for condemned or detained carcasses and organs requiring secondary meat inspection;
- (k) a room must be provided where hides, skins, hair, heads, feet and inedible material are kept prior to removal, unless these parts are removed on a continuous basis;
- (l) a room where paunches and intestines are emptied, washed and kept must be provided;
- (m) the rooms mentioned in paragraphs (k) and (l) must –
 - (i) be separate and adjacent to the dressing room and interconnected by means of a hatch, door or walkway; and
 - (ii) have exterior doors for the removal of those materials and in the case of paunches and intestines from animals that were eviscerated in the field, it must be received for inspection purposes through this external door;
- (n) if paunches and intestines are not intended for human consumption, the room mentioned in (l) may be omitted provided that all paunches and intestines are, immediately after evisceration or receiving and inspection, removed from the dressing room to a suitable receptacle via a self closing hatch;
- (o) separate chillers must be provided for the daily throughput of –

- (i) carcasses and red offal, unless the red offal is removed from the abattoir within four hours after evisceration or receiving, and if separate dispatch facilities have been provided for red offal; and
- (ii) washed rough offal, unless washed rough offal is removed from the abattoir within four hours after evisceration or receiving;
- (p) where freezing facilities are not provided for treatment of conditionally passed carcasses affected by parasitic intermediate stages (measles) at the abattoir, such facilities must be arranged elsewhere with the approval of the provincial executive officer;
- (q) a dispatch area equipped to quarter, sort and mark carcasses and red offal as well as a door for dispatch must be provided;
- (r) an entrance for personnel must be provided and must be designed as an ante-chamber for cleaning purposes and must be provided with hand wash-basins, soap dispensers, hand drying facilities, a boot wash, apron wash and hooks, and a refuse container, and separate facilities must be provided for both clean and dirty areas;
- (s) change room, shower, toilet as well as hand wash facilities must be provided on the premises for persons working at the abattoir;
- (t) dining facilities must be provided with tables chairs or benches and must be situated so that personnel do not sit or lie on the ground or soil their protective clothing during rest periods;
- (u) a storage facility for items needed in the daily process must be provided;
- (v) rooms or facilities must be provided for –
 - (i) storage of cleaning equipment and materials; and
 - (ii) cleaning and sterilization of movable equipment;
- (w) a facility where meat transport vehicles must be sanitized must be provided; and
- (x) if required, a separate room must be provided as an office.

3.3. Requirements for high-throughput game abattoirs

Considering the requirements set out in part II B (1) and (2), for an abattoir to be graded as a high throughput game abattoir –

- (a) it must have a maximum throughput which the provincial executive officer may determine on grounds of the hourly throughput potential relative to available equipment and facilities including hanging space, chiller capacity as well as rough offal handling and chilling capacity;
- (b) the abattoir and premises must be designed to separate dirty and clean areas and functions;
- (c) the premises must be fenced to control access of people and animals and provided with separate gates for clean and dirty functions;
- (d) a door equipped with docking seals, which allow the doors of the vehicle to be opened only after docking, and a receiving area for offloading harvested game or partially dressed game carcasses must be provided to accommodate at least 20% of throughput and such area must have an air temperature of not more than 12°C when chilled carcasses are handled;
- (e) a facility where transport trucks must be sanitized after dispatch must be provided;
- (f) inspection facilities to inspect received carcasses and correlating red offal must be provided and must include a room for condemned or detained carcasses and red offal;
- (g) holding chillers must be provided to accommodate partially dressed carcasses received prior to dressing;
- (h) the chillers referred to in (g) may be substituted with a chiller truck connected to the receiving area by docking seals;

- (i) a room equipped with a dressing rail must be provided where harvested game carcasses or partially dressed game carcasses are dressed and such room must have an air temperature of not more than 12°C when chilled carcasses are handled;
- (j) inspection facilities to inspect dressed carcasses must be provided;
- (k) separate rooms must be provided for –
 - (i) handling and holding of hides, skins, hair and inedible material prior to removal; and
 - (ii) handling and holding of skin-on heads and feet;
- (l) a room where paunches and intestines are emptied, washed and kept must be provided;
- (m) the rooms referred to in paragraphs (k) and (l) must –
 - (i) be separate and adjacent to the dressing room and interconnected by a closable hatch only; and
 - (ii) have an exterior door for the removal of these materials and in the case of paunches and intestines from animals that were eviscerated in the field, it must be received for inspection purposes through this external door;
- (n) if paunches and intestines are not intended for human consumption, the room mentioned above in (l) may be omitted provided that all paunches and intestines are removed, and inspected immediately after evisceration or receiving, to a suitable receptacle via a self closing hatch;
- (o) separate chillers must be provided for the daily throughput of –
 - (i) carcasses and red offal, unless the red offal is removed from the abattoir within four hours after evisceration or receiving, and if separate dispatch facilities have been provided for red offal; and
 - (ii) washed rough offal, unless washed rough offal is removed from the abattoir within four hours after evisceration or receiving;
- (p) where freezing facilities are not provided for treatment of conditionally passed carcasses affected by parasitic intermediate stages at the abattoir, such facilities must be arranged elsewhere with the approval of the provincial executive officer;
- (q) separate equipped rooms must be provided to –
 - (i) handle and keep detained carcasses, portions and organs;
 - (ii) keep condemned carcasses and material before removal from the abattoir, provided that if condemned material is removed on a continuous basis during processing or a dedicated chiller is available for condemned material, such a room is not required;
 - (iii) provide hand wash, boot wash and apron wash facilities directly connected to the room mentioned in subparagraph (ii) for persons who handle condemned material;
- (r) a dispatch area must be provided, equipped –
 - (i) to quarter, sort and mark carcasses and red offal;
 - (ii) with a door for dispatch which is such that the doors of the vehicles will only be opened after docking; and
 - (iii) to ensure that the air temperature in this area is not more than 12°C when carcasses are handled and dispatched;
- (s) an entrance for personnel must be provided and must be designed as an ante-chamber for cleaning purposes and must be provided with hand wash-basins, soap dispensers, hand drying facilities, a boot wash, apron wash and hooks, and a refuse container, and separate facilities must be provided for both clean and dirty areas;
- (t) a change room, shower, toilet as well as hand wash facilities must be provided on the premises for persons working at the abattoir and separate facilities must be provided for clean and dirty areas;

- (u) dining facilities must be provided, for clean and dirty areas, with tables and chairs or benches and must be situated so that personnel do not sit or lie on the ground or soil their protective clothing during rest periods;
- (v) office accommodation and ablution facilities must be available for meat inspection personnel;
- (w) office facilities must be separate from the dressing area;
- (x) store room must be provided for items needed in the daily slaughter process;
- (y) suitably equipped rooms and facilities must be provided to sterilize movable equipment;
- (z) a room or rooms for storage of cleaning equipment and chemicals must be provided;
- (aa) facilities for wrapping, packing and cartonning must be provided where applicable;
- (bb) separate storage facilities must be provided for wrapping and packing material, if both materials are kept;
- (cc) access to a laboratory must be possible; and
- (dd) a facility where meat transport vehicles must be sanitized must be provided.

3.4. Requirements for high throughput cutting plants.

Considering the requirements set out in part II B (1) and (2), to be graded as a high throughput cutting plant on an abattoir premises –

- (a) it must have a maximum throughput which the provincial executive officer may determine on grounds of the capacity of the holding chillers, hourly throughput potential relating to available equipment and facilities as well as chiller or freezer capacity;
- (b) the premises must be fenced and provided with a gate to control access of people and animals;
- (c) if meat is intended for sale to the public, separate facilities as required by the provincial executive officer must be provided;
- (d) separate equipped rooms must be provided for –
 - (i) receiving of unwrapped carcasses and meat intended for cutting;
 - (ii) receiving of cartonned meat intended for cutting;
 - (iii) removal of meat from cartons and wrapping and thawing where applicable;
 - (iv) cutting and wrapping at an air temperature below 12°C;
 - (v) packing, marking and labelling at an air temperature below 12°C;
 - (vi) making up of new cartons used for packing meat;
 - (vii) dispatch of wrapped and packed meat at an air temperature below 12°C;
 - (viii) dispatch of unwrapped carcasses and meat at an air temperature below 12°C; and
 - (ix) washing and sterilizing of equipment;
- (e) separate bulk storage facilities or rooms must be provided for –
 - (i) wrapping material; and
 - (ii) packing material;
- (f) separate storage facilities or rooms must be provided for items in daily use, such as–
 - (i) hand equipment;
 - (ii) wrapping material;
 - (iii) clean protective clothing; and
 - (iv) cleaning materials and chemicals;
- (g) separate chillers or freezers must be available for –

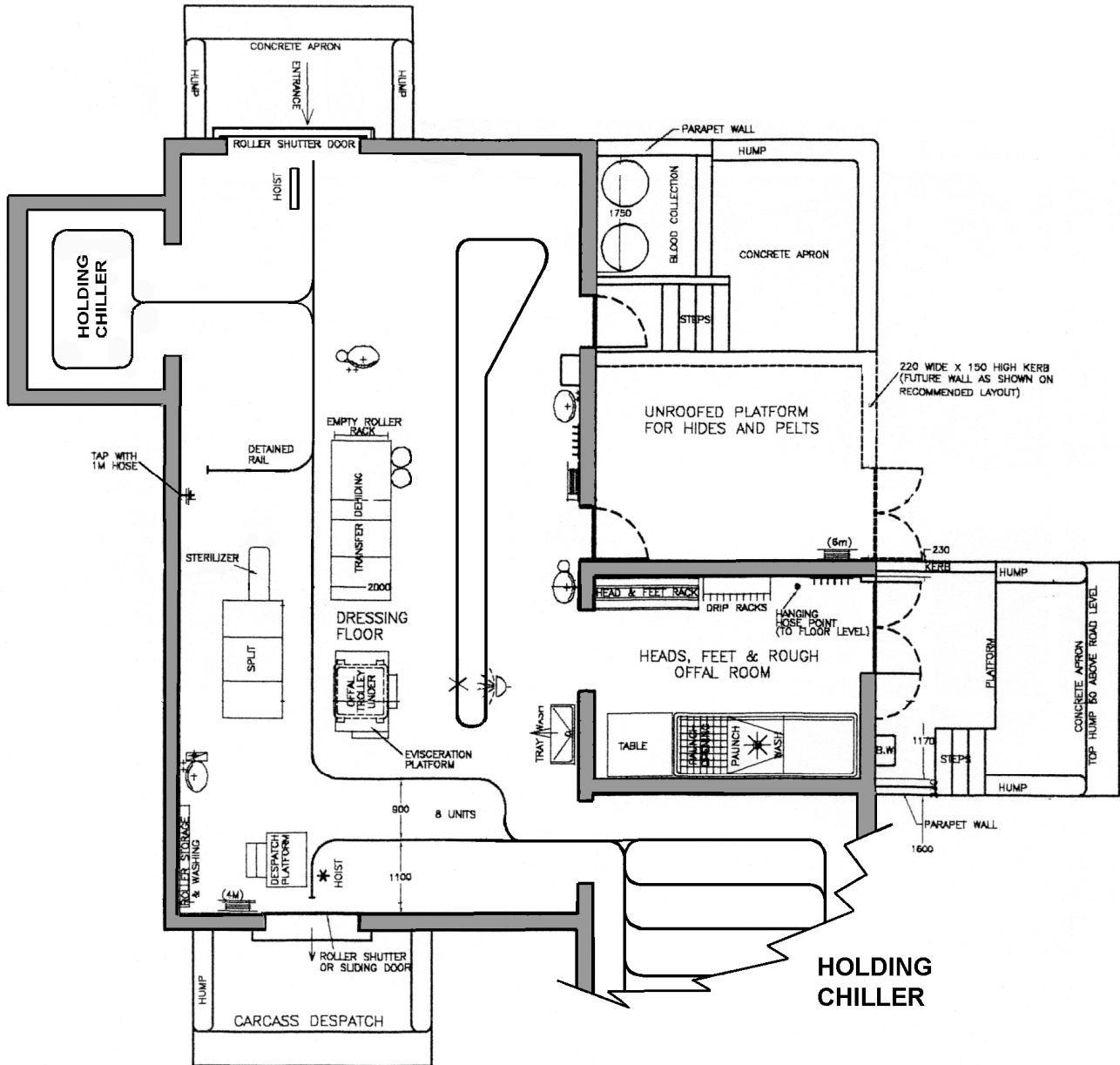
- (i) unwrapped carcasses and meat;
 - (ii) packed meat;
 - (iii) holding frozen meat if required; and
 - (iv) blast freezing meat if required;
- (h) ablution facilities and toilets must be provided and the access routes to the cutting room must be under roof;
- (i) an entrance for personnel must be provided and must be designed as an ante-chamber for cleaning purposes and must be provided with hand wash-basins, soap dispensers, hand drying facilities, a boot wash, apron wash and hooks, and a refuse container, and separate facilities must be provided for both clean and dirty areas;
- (j) sterilizers at 82°C must be provided or as an alternative, a valet system where handheld equipment are collected on a regular basis and sterilized in a central sterilizing facility may be used, with the understanding that strategically placed emergency sterilizers are still required; and
- (k) extraction facilities for vapour control must be provided.

4. STANDARD DESIGN DRAWINGS FOR GAME ABATTOIRS

The following floor plan drawing serves to give some insight into the layout of smaller abattoirs.

LOW THROUGHPUT GAME ABATTOIR

OFFLOADING



MEAT INSPECTORS MANUAL

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PART II MEAT INSPECTION

MODULE 2

SLAUGHTER & DRESSING

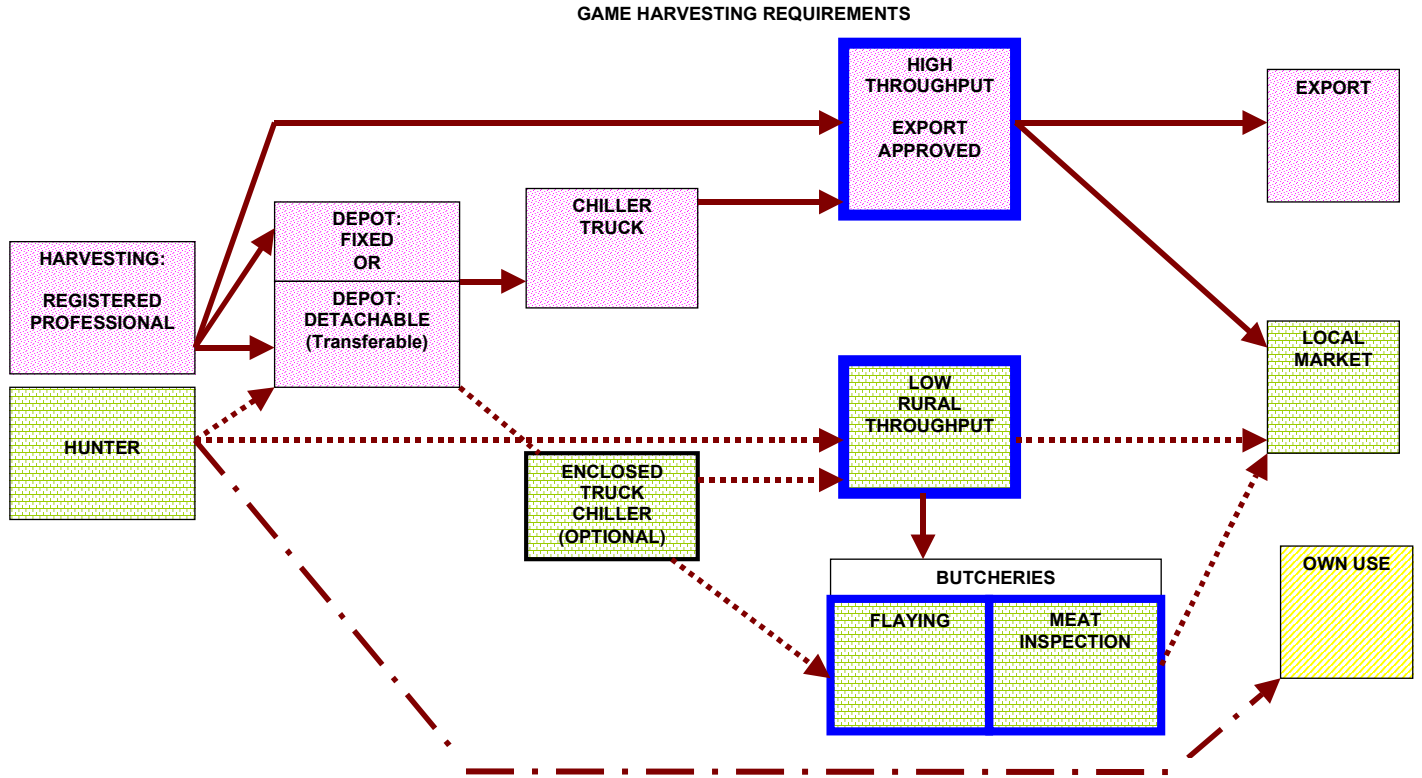
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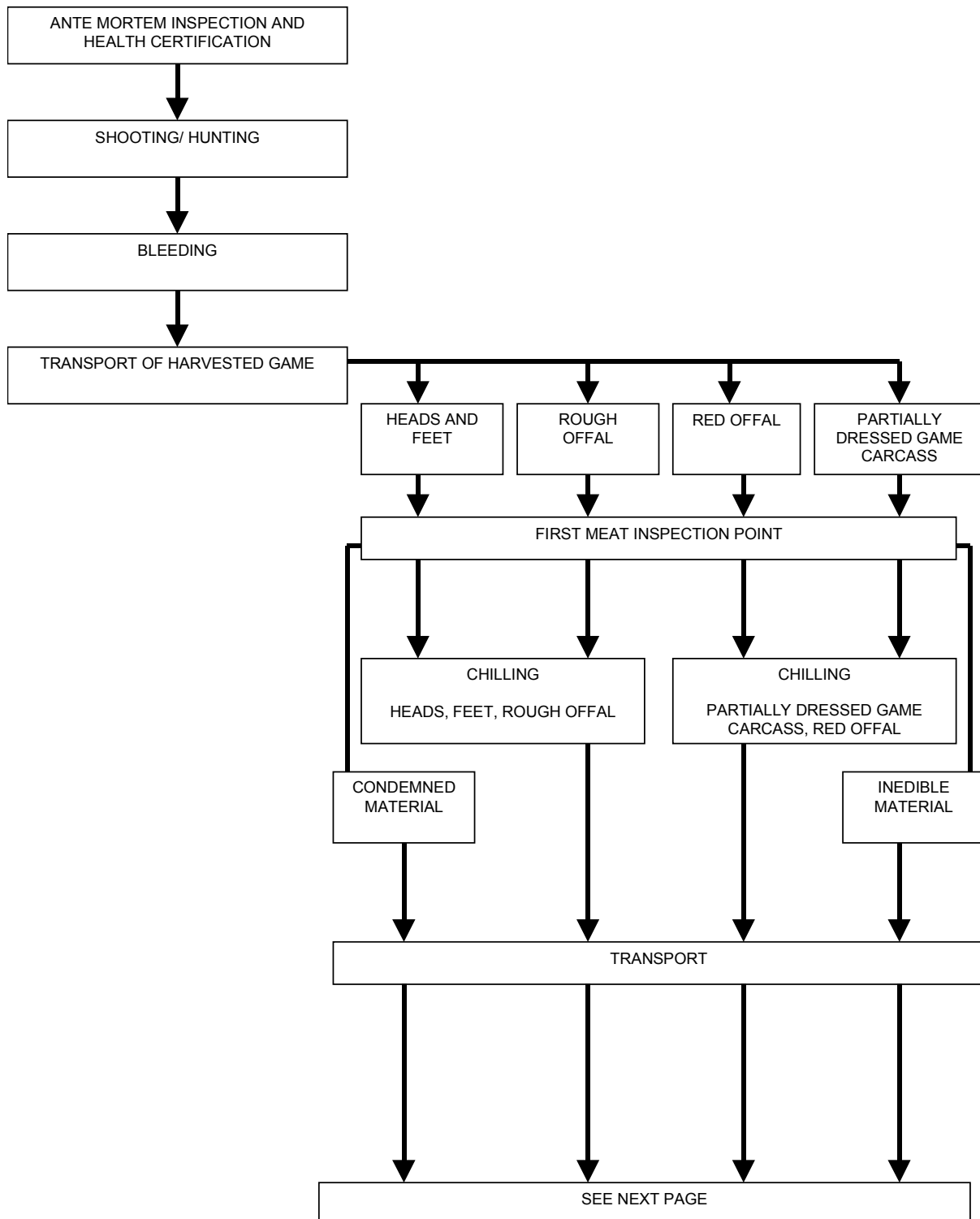
Slaughter & Dressing

Including hunting/ harvesting, bleeding, partial dressing (evisceration), chilling and transport of partially dressed game carcasses (PDGC's):

FLOW DIAGRAM FOR GAME HARVESTING REQUIREMENTS

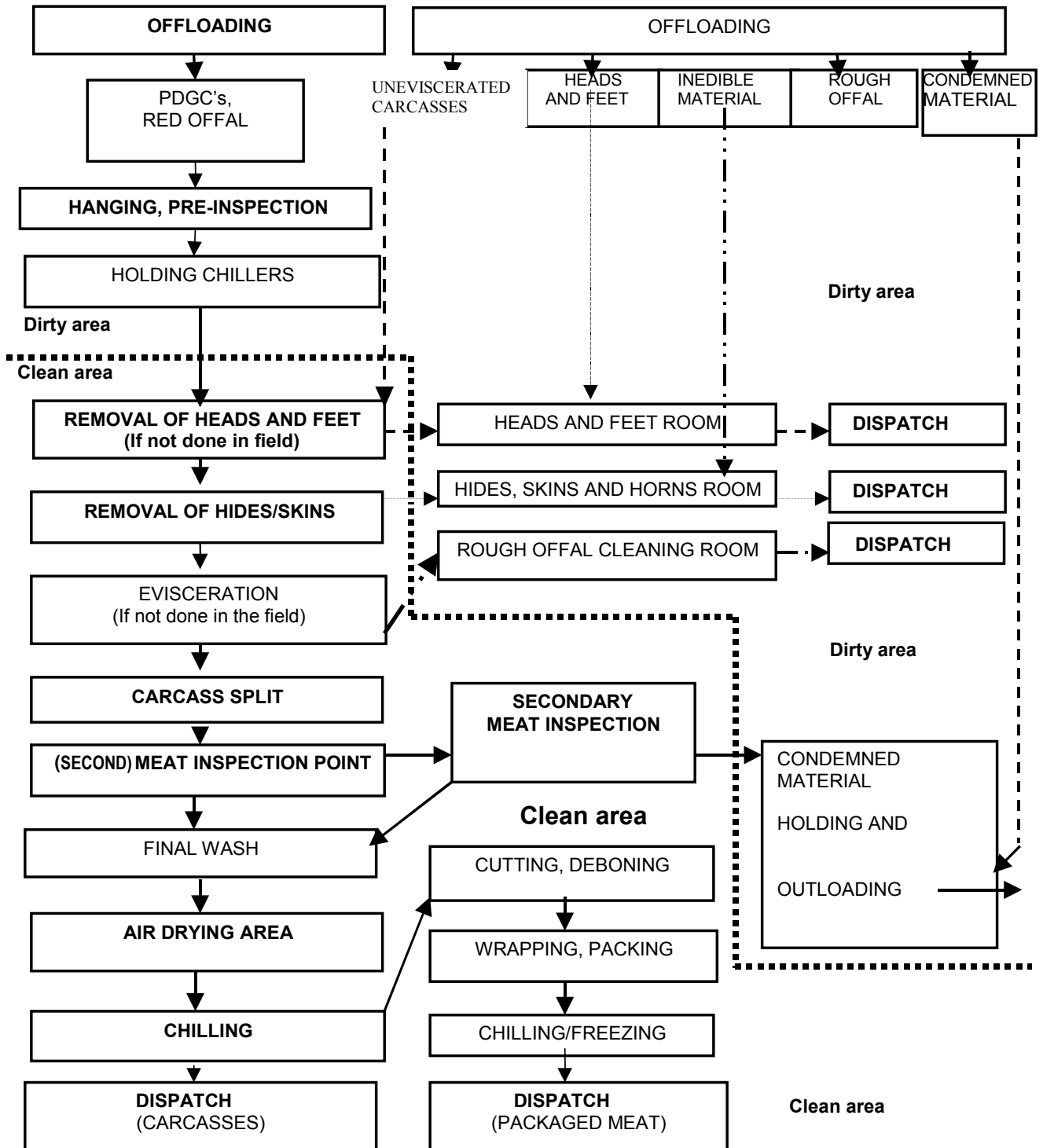


1. **FLOW DIAGRAM OF THE DIFFERENT GAME HARVESTING STEPS AND HANDLING OF GAME AT THE GAME DEPOT**



2. FLOW DIAGRAM OF PROCESS STEPS AT THE GAME ABATTOIR

FLOW DIAGRAM OF PROCESS STEPS AT THE GAME ABATTOIR



3. ANIMAL WELFARE ASPECTS AT ABATTOIRS

INTRODUCTION

At present the slaughter of domesticated wild life game species in R.S.A. is seldom seen. Some game species like Eland, Blesbuck or Impala or even exotic species like deer may in future necessitate regulatory requirements pertaining to transport, lairaging, stunning and slaughter of such domesticated game species. In essence such regulatory requirements will be very similar to those of e.g. sheep and cattle.

3.1 Objectives

- (a) To deliver partially dressed game carcasses from uninjured, unsoiled and rested animals to the abattoirs.
- (b) To aim at positive preventative measures with a view to avoiding the financial loss associated with poor hunting techniques, which could include condemnation due to bruising and contamination.

The detrimental effects of poor hunting techniques can be grouped under three main headings, namely stress, bruising and contamination (blood and intestinal contents).

3.2 Stress factors

If an animal is under stress when slaughtered, the quality and shelf-life of the carcass and subsequent meat will be adversely affected. During transport and handling the game is exposed to unfavourable stimuli causing stress e. g. extremes of temperature, hunger and thirst. As a result of all these stress factors large amounts of adrenaline is produced by the stressed animal and released into its bloodstream.

Glycogen reserves in muscles are reduced and blood sugar increases. There is consequently less lactic acid available, which in turn leads to shorter shelf-life and less tender meat with a higher pH. Blood supply to the musculature is increased and this can result poor bleeding.

The meat of stressed game animals may undergo undesirable changes such as pale discolouring with consequent negative effects on shelf life (see "Capture Miopathy of Game ")

3.3 Categories of game

The following categories of game are recognised and enable us to simplify the slaughter processes.

Category A animals

Elephant, hippopotamus, giraffe and buffalo.

Category B animals

Wildebeest, Kudu, Sable, Roan, Eland etc.

Category C animals

Impala, Springbuck, Blesbuck, Duiker etc.

4. Regulatory requirements for harvesting of game

4.1. Shooting

Shooting must be done so that it is reliably expected to cause immediate death.

4.2. Bleeding

- (1) Game must be bled within 10 minutes of being shot.

- (2) Bleeding is done by means of severing the jugular vein and carotid artery on either side of the neck (throat slitting) with a clean sterilized knife.
- (3) The different categories must be bled in the following ways:
 - (a) Category C or small animals – hanging position;
 - (b) category B or medium animals – on a ramp at 20°; and
 - (c) category A or large animals – may be bled in a lying position.

4.3. Transport of harvested game to abattoir or depot

- (1) Game must be transported to a game depot or game abattoir within 2 hours after being bled.
- (2) Care must be taken not to contaminate the neck slit area when transporting the carcass to the game depot or abattoir.

4.4. Removal of heads and feet

- (1) Heads and feet may be removed at the game depot provided that correlation with the carcass is kept till meat inspection is done.
- (2) Horns may be removed with part of the cranium and stored separately.

4.5. Evisceration

- (1) All harvested game must be eviscerated at a depot within two hours of bleeding provided that if a danger of bloating exists evisceration may take place in the field and intestines must be taken to the depot or abattoir for inspection.
- (2) Carcasses must be transferred from the harvesting vehicle to a clean slaughter frame in such a manner as to avoid contamination or soiling.
- (3) Opening incision lines on a hide or skin must be made with a clean sterilized hand knife from the inside to the outside only (spear cuts).
- (4) Lactating udders, which are regarded as being condemned, must be removed with the skin on, in such a way to prevent milk contamination, leaving the Lnn inguinalis superficialis on either side intact on the carcass.
- (5) Reproductive organs and any part not utilized commercially must be handled as condemned material and placed in appropriate containers.
- (6) Contact of the exposed meat with platforms, slaughter frames, floor, outer surface of the skin or hide and soiled equipment must be avoided at all times.
- (7) Partially dressed carcasses may not be washed, accidental soiling must be cut off.
- (8) Heads, feet, rough and red offal must at all times be identifiable with the carcass of origin till meat inspection is complete.

4.6. Meat inspection at a game depot or abattoir

- (1) The registered inspector at the depot or abattoir must inspect each partially dressed game carcass and matching viscera, head and feet noting any abnormalities in an inspection report to the registered inspector at the game abattoir.
- (2) Lockable fly-proof containers for the collection of condemned material must be used during the slaughter process and the contents must be disposed of in a method approved by the registered inspector or provincial executive officer.

- (3) Identification and data collection for animal disease surveillance must be in a format agreed on with the provincial executive officer.
- (4) If a registered inspector is not available at a depot, then the viscera, head and feet, must be transported with the carcasses to a game abattoir while maintaining correlation between the carcasses and above mentioned organs until inspection is done by a registered inspector.

4.7. Chilling of partially dressed game carcasses

- (1) Partially dressed carcasses and offal must be chilled within 12 hours of killing but when the ambient temperature is more than 15 °C, it must be chilled within 4 hours of being killed.
- (2) A core temperature of 7°C must be accomplished within 24 hours after chilling commences.

4.8. Transport of partially dressed game carcasses

A vehicle used for the transport of partially dressed carcasses must comply with the standards for a meat transport truck according to Requirements for Food Premises under the Health Act but with the understanding that –

- (a) if partially dressed carcasses and associated offal need to be held in a chiller truck for periods exceeding eight hours, the chiller unit must have the potential to chill such carcass to a temperature of less than 7°C within 24 hours of having been loaded;
- (b) partially dressed carcasses must be hung away from the floor in such a way as to ensure optimal airflow within the chiller space;
- (c) partially dressed game carcasses must be handled and hung in such a manner as to avoid contact between skin surfaces and exposed meat or body cavities;
- (d) where edible rough offal and red offal is transported in the same load space as partially dressed game carcasses, it must be packed in separate closable leak proof containers;
- (e) the carcasses of any other slaughtered animal must not be transported with partially dressed game carcasses; and
- (f) no live animal or person may be transported with a game carcass.

4.9. Receiving of partially dressed game carcasses (PDGC) at a game abattoir

- (1) All PDGC arriving at a game abattoir must be accompanied by an inspection report from the registered inspector at the harvesting depot, provided that if an abattoir is situated on the game farm where harvesting is done such report is not required.
- (2) Partially dressed game carcasses received at a game abattoir must –
 - (a) be offloaded and moved to the holding chillers for PDGC without delay; or
 - (b) if a chiller truck, connected to the receiving area by docking seals, is used to hold PDGC before dressing, the doors of the truck must be kept closed when not dispatching.
- (3) Flaying and final dressing of partially dressed game carcasses may only be done in a game abattoir;

4.10. Dressing

- (1) For carcasses that were brought directly to the abattoir and were not eviscerated at a depot, regulation 64 (3) to (8) is applicable.
- (2) All flaying equipment making contact with meat must be sterilized after use on each carcass.
- (3) Opening incision lines on a hide or skin must be made with a clean sterile hand knife from the inside to the outside (spear cuts), mechanical flaying knives must not be used for this purpose.
- (4) Contact of the exposed meat with platforms, walls, floor, outer surface of the skin or hide and soiled equipment must be avoided at all times.
- (5) Carcasses may not be cleaned, wiped or dried with a brush or cloth.

4.11. Meat inspection at the abattoir

Meat Inspection must be done in accordance with part VI of the regulations.

4.12. Final washing

- (1) A carcass may be washed with running water under moderate pressure to remove bone chips from the split sternum and vertebrae and to wash off blood after completion of meat inspection.
- (2) No person may apply to any carcass, meat or animal product any insecticide, antibiotic substance, or any substance which is intended to prevent spoilage by inhibiting the activities of insects, or by preventing the development of bacteria or moulds, or for any purpose whatsoever, provided that this does not apply to a substance which complies with the requirements of the Foodstuffs, Cosmetics and Disinfectants Act, 1972 (Act No. 54 of 1972) and is approved per protocol by the provincial executive officer.

4.12. Quartering

Approved carcasses may be halved and quartered in an abattoir before or after chilling but any further cutting must be done in a cutting plant.

5. GAME PROCESSING

Including hunting/ harvesting, bleeding, evisceration, dressing, washing, chilling and dispatch:

5.1 Introduction

The way in which game animals are killed, the hygiene concerning bleeding and evisceration of harvested game, when this is undertaken in the field, has a major impact on the safety and wholesomeness of game meat. Both the authorities and the owners of game abattoirs and cutting plants must undertake all possible measures necessary to ensure, that hunters and employees are aware of their obligations for the hygienic harvesting of game animals and the hygienic handling of game meat. Game animals are usually shot in the field, and this should be done as humanely as possible. Care must be taken that game animals are not harvested from areas where hazards, which may effect the safety of game meat occur. In this respect areas where "Foot and Mouth disease" and "Swine Fever" are endemic should be avoided when game harvesting for fresh meat are to be undertaken. Where game is harvested in these areas it will require additional requirements regarding the transport and removal of the meat to other areas in the country to prevent the spreading of disease. Likewise, the hunter is expected to accept responsibility for only harvesting apparently normal animals, and for reporting signs of disease.

5.2. Hunting/ harvesting

Head and or neck shots are the preferred method of shooting game. Thoracic shots will result in excessive bleeding into the thoracic cavity with blood "contamination". Abdominal shots will result in

possible contamination of the meat with intestinal and/or ruminal content. Head and neck shots are also more likely to result in instantaneous death, thus preventing unnecessary pain, suffering and stress.

5.3 Bleeding

Where stunning in domesticated animals is performed with a specific aim, namely to render the animal unconscious thereby facilitating hoisting, cutting the throat and bleeding, this does not happen in game. The result is that effective and complete bleeding seldom occurs due to the fact that the heart has stopped pumping after shooting and does not facilitate the bleeding process.

The larger the species the more difficult to hoist and bleed. In category A game it is practically impossible to hoist the animals at all. Category B game should be hoisted partially and at least hung at an angle of $\pm 20^\circ$. Category C game should be suspended by the hind legs in a hanging position.

This should be done as soon as possible after the animal was shot. Preferably within 10 minutes to ensure the maximum bleeding of the carcass possible. Care must be taken that all the blood vessels in the neck are severed.

Although no figures exist regarding the amount of blood to be bled in game species the following can be used to "questimate" the effectiveness when bleeding different species, using cattle as an example for the larger species and sheep for the smaller species:

Cattle: 13 – 15 litres of blood
 Sheep: 1.3 – 2 litres of blood

The equipment on the vehicle is of utmost importance. Knives for cutting the throat and a system for sterilising them must be available. The most ideal would be water at 82°C in a steriliser but since this could prove unpractical; an approved chemical steriliser in an enclosed holder fitted to the vehicle will be acceptable.

The bleeding knife must be washed and sterilised before each animal is cut. Where large numbers of animals are slaughtered, several knives should be in use.

The skin of any animal contains large numbers of bacteria. Knives become contaminated when cutting through skin. All knives must therefore be washed and sterilised regularly in order to prevent a build-up of bacteria and the transfer of these to other carcasses.

Hand wash-facilities must be provided on the vehicle.

Should the game harvesting however be done in capture bomas, the whole process of bleeding and partial dressing will take place in an adjacent depot (field abattoir).

5.4 Transport of harvested game

The following ways of transportation of harvested carcasses can be identified:

Hanging on a frame of the hunting vehicle (eviscerated or un-eviscerated): Category C animals.

Hanging at a slope on a ramp of the hunting vehicle (eviscerated or un-eviscerated): Category B animals.

Lying horizontally as per protocol with the authorities: Category A animals.

Game must be transported to a game depot or game abattoir within 2 hours after being bled.

Care must be taken not to contaminate the neck slit area or opened abdominal/thoracic cavities when transporting the carcass to the game depot.

5.5. Removal of heads and feet

The head and feet should preferably only be removed at the depot or abattoir, where the first meat inspection point is situated. In larger species where the head prevents effective transportation of the carcass, the head may be removed with the consent of the meat inspector but both the carcass and the head must be tagged for positive correlation with the carcass when meat inspection is done.

The head is removed after the bleeding process. The cut must be made in line with the animal's ears. The head may not be removed from the carcass until bleeding is complete. To ensure a hygienic and edible product if the head is sold for edible purposes, the following is required:-

Suitable holders or tables should be provided to keep the heads off the ground. Once the head has been removed it is de-masked; (this is optional and depends on (market requirements). At the same time the tongue is removed, the nasal cavities are rinsed and the head is dehorned where applicable.

As with the head the feet should only be removed at the depot or abattoir where it can be correlated with the carcass for inspection purposes. Feet are especially important for the inspection of Foot and Mouth Disease and should therefore be readily available. Should it be sold as an edible product, suitable containers must be provided.

5.6. Evisceration

Evisceration means the removal of the viscera or internal organs from the carcass.

Evisceration of the carcass should be performed within two hours after bleeding. The rumen and intestines may be removed in the field to prevent bloating.

In game the evisceration is usually performed prior to skinning. This is mainly due to the fact that the skin will protect the meat during transportation.

Facilities must be provided for the person doing the evisceration to do this hygienically. This function will normally be done at the depot (Fixed or detachable) where the necessary hand washing-facilities and sterilisation equipment, frames etc. must be available. If this function is performed in the field due to bloating of the carcass, the necessary facilities for hand cleaning and knife sterilisation must be available on the vehicle. The paunch can then be emptied of its content and kept in suitable containers or plastic bags on the vehicle and tagged for correlation with the carcass for later inspection at the depot or abattoir, as with the red offal if removed simultaneously. Faecal pellets in the rectum may be "milked" back and the rectum cut – this technique is preferable to "ringing the bun".

The red offal must preferably be removed at the depot and be inspected at the depot when still fresh. Any abnormalities must be noted either with a tagging system or with a report attached to the carcass for the attention of the meat inspector at the abattoir. If inspection of the pluck is to be done at the abattoir/processing plant the pluck should be packed in suitable plastic bags (not nets as organs get full of dust, grime and dirt) and attached to the carcass or marked to be later identified with the corresponding carcass.

Important points during evisceration (EV)

Evisceration must take place as soon as possible after killing but should be within 2 hours.

Before evisceration the anus must be loosened from the skin and tissues and removed. The superficial skin must be removed without damaging the muscles.

If EV is done in the field, the rectum can be "milked" clean of faeces and then it can be tied off. This ensures that the more difficult task of cutting the anus loose in the dark in the field is avoided and that faecal contamination does not occur. This also ensures less contamination with dust will occur when the carcass is transported.

Damage to any organs such as the bladder, uterus, gall bladder, paunch or gut must be avoided at all costs. These organs contain bacteria (especially *Salmonella* and *E.coli*), which can contaminate both the inside and the outside of the partially dressed carcass.

The opening incision to remove the paunch must be made as short as possible – the longer the opening the larger the area through which contamination can occur.

It is not possible to clean any contaminated surfaces by washing. These surfaces will have to be cut away in order to remove all contamination. The pleura and peritoneum can be striped or trimmed out.

The person doing the evisceration may not cut into any organ, nor may he remove the gall bladder from the liver. Organs in the carcass must not be separated during evisceration. Only the spleen may be removed. Ensure that all internal organs (excluding the kidneys) are removed. It is of the utmost importance that **hands must be washed regularly** during this process. All knives/saws used for dressing must also be sterilised regularly and must never be put down on the ground.

5.7 Carcasses identification

Preliminary marking of the carcass for identification of origin of farm/owner/species etc. can be done with a tagging system on the leg of the carcass. The same may be done for all parts of the carcass including head, feet, red- and rough offal.

5.8 Chilling of the partially dressed game carcass

Chilling and transporting of partially dressed game carcasses to the abattoir/processing plant can be done as follows: -

1. Ambient temperature can, however, be taken into consideration when managing chilling of carcasses. Partially dressed game carcasses and offal must be chilled within 12 hours of being killed but when the ambient temperature is more than 15 °C, it must be chilled within 4 hours of being killed. Therefore, if carcasses are not pre-cooled at the depots and the ambient temperature is less than 15°C, carcasses should reach the abattoir within 12 hours but within 4 hours if ambient temperature is more than 15 °C.
2. If a chiller truck is available where harvesting is done, carcasses must be loaded as soon as possible but at least within 2 hours.
3. Carcasses should be chilled to < 7°C as soon as possible to limit bacterial growth.
4. Transport of chilled partially dressed game carcasses must be done with a chiller truck capable of maintaining the temperature of the carcasses or at least prevent the increase of the carcass temperature by not more than 2 °C. If this can be achieved with an enclosed insulated truck without a chiller unit it is acceptable.
5. All carcasses must be transported in a hanging position in the case of category B and C game.

5.9 Removal of the hide/skin

Upon reaching the abattoir, partially dressed game carcasses must be stored in a chiller to maintain the carcass temperature or to chill un chilled carcasses.

The factors, which determine the quality of a tanned hide or skin, does not start with the curing process, but with the removal of the hide or skin from the carcass. Once it has been removed from the carcass, treatment of the skin is of vital importance to ensure quality. The final shape of the hide or skin is also more important than most people realise. The value of the processed hide or skin depends on the way in which the opening lines are made.

Factors to be kept in mind during the removal of hides or skins are:

Hygienic, clean techniques will help to ensure the quality of the meat as well as that of the hides and skins.

Contact between the meat and the hide or skin must be prevented at all costs.

Use the flaying knife with care because hides and skins damaged by cuts and flaying marks lower their value.

The hide or skin must be removed while the carcass is still warm in order to make slaughtering easier.

As little blood as possible should come into contact with the hide or skin.

Do not sacrifice the value of the hide or skin for the sake of the carcass. If correct flaying methods are used, neither needs to be damaged.

Do not use a flaying knife if it is possible to pull the hide or skin off the carcass or where the skin can be eased off by hand.

All cuts to the hide or skin must be made from the inside to the outside to prevent contamination.

Contamination of the meat with dirty hands, hooks, rollers and protective clothing must be prevented.

To prevent contamination, lactating udders must be cut off as soon as possible and placed in a container dedicated for condemned material.

No hair or pieces of skin may be left on the dressed carcass.

All sexual organs or parts thereof must be completely removed.

5.10 Halving the carcasses

This action is usually only carried out when animals like eland are slaughtered to facilitate the heat loss from the carcass and if it is suspected that the carcass has TB.

Carcasses must be split without deviating from the centre line of the spinal column to prevent damage to any expensive meat cuts.

5.11 Final trimming of carcass

After inspection and before the final washing, all approved carcasses can be finally trimmed and the following removed:

- Spinal cord
- Left-over bits of skin and intestines
- Portions of male and female genitals
- Bloody membranes on the inside of the neck, and the aorta
- Blood clots
- Visible blood vessels
- Superficial lymph nodes and loose fat
- Bone chips

5.12 Washing the carcass

After a carcass has left the final inspection point, it may be washed with low pressure running water to remove all blood before chilling.

Contaminated meat or fat surfaces cannot possibly be rendered microbe-free by washing it with water. On the contrary, when surfaces, which are already contaminated, get washed this can actually spread the bacteria. Contaminated surfaces must of necessity be cut away and serous membranes removed in order to get rid of visible contamination. Chlorinated water can be successfully applied after the visible contamination has been trimmed or cut off.

It is not advisable to wash carcasses before evisceration, as this encourages workers to attempt to wash their mistakes.

It is generally recommended therefore that only approved, uncontaminated carcasses should be washed with running chlorinated water in order to remove any blood which might be present and preferably only the inside of the carcass. Adequate time and rail length should be available so that the carcasses can drip dry to eliminate excess moisture entering the cold room.

5.13 Slaughter process of game

The detailed slaughter process for game as given below was adapted from the red meat manual. The different categories game correspond with slaughtering techniques for cattle and sheep. In case of warthogs where the skin is removed they are dressed in a similar way to sheep.

5.14. The slaughter process

5.14.1. Slaughter process of category B type game

Bleeding

As soon as the animal is shot, the bleeding knife is removed from the steriliser and the bleeding incision done. Two methods currently in use are the throat cut and sticking. The most common method used is the throat cut from ear to ear. The neck skin is cut through, then the trachea and oesophagus, and then further until the two main arteries have been severed, stopping before damaging the spine. Bleeding should take place as soon as possible after shooting to facilitate maximum bleeding. The whole process from shooting to bleeding, including hoisting, should be carried out quickly and without any delays. Game intended for commercial purposes must be bled within 10 minutes of being shot.

Removal of front and back feet

This action should be carried out at the abattoir or depot. If it is done in the field to make transport easier, the feet must be transported to the first inspection point and must be correlated with the carcass. The correct method is to saw off the leg just below the knee and hock joints. The piece that is left is removed with the hide leaving a clean joint to cut through. With a hand knife sever the front feet at the knee joints and place the feet in the feet container which is usually a plastic bag, which is then tied to the carcass.

Removal and dressing of the head

With a hand knife, make an incision between the head and the first neck vertebra and sever the neck. It may be an advantage to cut a slit in the skin flap of the head to facilitate a handgrip on the head while carrying. Hang the head by the tip of the lower jaw (nearest the teeth) on a hook on the head rail. Remove the tongue by cutting loose the connecting tissues and severing the tongue root including the two cartilage structures at the base of the tongue. If the head is left with skin on, it is regarded as dirty offal, whereas a de-masked head is regarded as clean red offal and it can follow the same route as the other red offal. The head and tongue must remain identifiable with the carcass until the meat inspector has completed his inspection of the carcass.

Evisceration

EV can be done in the field or at the abattoir. In most cases it will be done in the field before the removal of the skin. This is a critical procedure, which must be done with precision to avoid damage to the paunch and intestines causing contamination with its contents. Make an incision in the abdominal wall (on the central opening line) in the inguinal area. Insert the knife into this opening, handle inside and blade pointing outward, extending the incision downwards carefully by applying pressure on the knife. The incision extends to the start of the breastbone. If this action is done before the removal of the skin, it is even more important to avoid contamination with hair on the cut. This incision must be as short as practically possible. Reach inside the abdominal cavity, cut the omentum loose, and place it into a container. Remove the spleen and hang it on a hook. Loosen the rectum while carefully pulling the anus down with the left hand. The "milking" of the rectum to avoid faecal contamination can also be done if this action is done in the field. Be careful not to cut into the rectum, which causes contamination or into the fillet, which will damage a prime cut. Pull the rectum and anus down towards the uterus, loosen reproduction organs and bladder making sure no leakage occurs. Separate the kidney fat and kidneys from the intestines so that they stay in the carcass. Loosen the rumen, which will now fall down, being held only by the oesophagus, which is then severed about 20 cm from the rumen where it passes through the diaphragm. The stomach will now drop down into a container or onto the evisceration table.

If this action is done in the field, the intestines should be transported to the depot or abattoir for inspection. Correlation with the carcass is very important.

Flaying

Flaying of the first hind leg

The first hind leg comprises the hoof, hock and round, which is not attached to the bleeding shackle and is hanging free. With a hand knife, make a cross incision just above the tail brush and with the knifepoint make a spear cut, from under the skin, straight up the tail past the anus, between the legs, past the inguinal area (around the scrotum or udder) on the central opening line. Make a small incision through the skin between the hoof and the first joint. With a sharp hand knife make a spear cut from this incision towards the central opening line between the legs. The hock is flayed (air knife or hand knife) on both sides and the inner leg is flayed first after which the carcass is rotated and the outer leg or "round" is flayed down to below the tail, in the lumbar area. The skin of the anus is flayed to be removed with the hide. Remove the hoof by sawing through and not by snapping it. The area where the hoof is clipped will have no skin. Insert the hook of a dressing roller through the sinew of the hock and hoist the carcass up until the bleeding shackle can be removed, lower the dressing roller onto the dressing rail. The second hind leg will now be hanging free to be flayed. If a bleeding rail is not available, the roller is hooked into the shin, hoisted up and lowered until the weight of the carcass has

been transferred to the line. The bleeding shackle can be removed and the second hind leg will be free.

Flaying of the second hind leg

Make a small incision through the skin between the hoof and the first joint. With a sharp hand knife make a spear cut from this incision towards the central opening line between the legs. The hock is flayed on both sides and the inner leg and flank is flayed from the middle opening line. The carcass is turned around and the outer leg is flayed to below the tail in the lumbar region. The hoof is removed, a dressing hook inserted through the sinew of the hock and the roller hoisted onto the dressing rail.

Flanks

The central opening line is now extended with a spear cut (hand knife) up to the middle of the front legs. Lactating udders and scrotums must, however, be removed before this incision is made. The high flanks are now flayed up to the point where the red meat becomes very thin. The left and right lower flanks are flayed until the elbows are exposed. Take great care at the flank folds as the hide can easily be damaged in this area, when using an air or hand knife incorrectly.

Lumbar region and back

The skin is pulled only half way off the tail in order to carry the weight of the hide being flayed in the lumbar and back region. This method pulls the hide taut, upwards to indicate the flaying line, providing a flat flaying surface which is different to the "double hide" surface obtained when the tail skin is removed completely. Flaying proceeds from left to right down to the middle of the carcass. The tail skin is still left in place.

Neck, shoulders and forelegs

Extend the central opening line with a spear cut down to the end of the hide (throat cut). Flay the brisket area from left to right past the elbows. A spear cut is made on both forelegs. Flay the insides and then the outsides of the forelegs. Proceed to the shoulder and then the neck leaving the forequarter hide hanging loose in the region of the first neck vertebra. Continue flaying up to the area under the shoulders (hump).

Final hide removal

The hide, still being held up by the tail, is pulled firmly upwards while the neck region is flayed. When completely loosened from the carcass, the weight of the hide will pull the skin off the tail and the hide will fall into the hide trough or bin.

Splitting of the breastbone

With a hand knife, make an incision through the fat and meat onto the bone of the brisket. Split the cartilage on the top end of the breastbone with a knife and proceed to split the breastbone with a breastbone saw or handsaw down to the neck area. Sawing is done with short strokes avoiding penetration of the blade into the thoracic cavity where damage and contamination of the organs could occur. As the skin is still on the carcass, splitting of the breastbone must be done so that the dirty side of the skin does not come into contact with the breastbone, saw or knife.

Removal of the pluck

An incision is made into the diaphragm, first on the left and then on the right while pushing the liver to one side to prevent puncturing the gall bladder. Lift the kidneys and kidney fat to cut the liver loose from top to bottom. Grasp the pluck between the liver and the lungs, taking care not to drag it on the floor, and cut the trachea loose up to the furthest point of the neck. Remove the pluck and hang it on a hook for inspection.

Splitting the carcass

This action will only be carried out if it is suspected that TB occurs in the carcass. It is of great value to split the bigger carcasses like Eland, Blue Wildebeest, Buffalo etc. in order to promote chilling. Removal of the spinal cord will also prevent spoilage.

The splitting of the carcass is an exacting task as the two halves must be of equal size and weight for trading purposes, economical cuts and easy handling of the carcass. Band-saws are most frequently used. The operator is positioned behind the carcass and starts sawing by placing the blade on the vertebrae, which is visible between the hind legs. The blade guides should be pressed against the carcass surface while sawing to prevent the blade from bending. Hot water at 82 °C must be available for sterilising the saw, especially after contamination. Always wash contamination off the saw before sterilising.

Final finishing

Final finishing includes removal of pieces of membranes and arteries etc. from the inside neck area.

Final wash

Extensive washing of the carcass should not be necessary. Bone splinters from sawing and possible blood marks on the inside of the carcass may be washed off, but it should not be necessary to wash the outside of the carcass. ***Washing with high pressure hoses must be avoided.***

5.14.2 Slaughter process of category C type game

Bleeding

As soon as the animal is shot, the bleeding knife is removed from the steriliser and the bleeding incision done. Two methods currently in use are the throat cut and sticking. The most common method used is the throat cut from ear to ear. The neck skin is cut through, then the trachea and oesophagus, and then further until the two main arteries have been severed, stopping before damaging the spine. Bleeding should take place as soon as possible after shooting to facilitate maximum bleeding. The whole process from shooting to bleeding, including hoisting, should be carried out quickly and without any delays. Game intended for commercial purposes must be bled within 10 minutes of being shot. After bleeding an animal, the *knife must be rinsed* and placed in a steriliser with water at a minimum temperature of 82°C.

Removal of front and hind feet

This action should be carried out at the abattoir or depot. If it is done in the field to make transport easier, the feet must be transported to the first inspection point and must be correlated with the carcass. The correct method is to saw the leg just before the joint. The piece that is left is removed with the hide leaving a clean joint to cut through. With a hand knife sever the front feet at the knee joints and place the feet in the feet container or bin.

Removal of the head

The head is removed first. Removal of the head is done by pulling the head to one side by the ear and severing the neck between the first and second neck vertebra.

Evisceration

This action can be done in the field especially in the case of Springbuck, which bloats fast. Correlation with the carcass is necessary when the intestines are transported to the first inspection point for inspection.

“Milking” the rectum can be very successful to avoid contamination.

This is a critical procedure, which must be done with precision to avoid damage to the paunch and intestines causing contamination with its contents. Make an incision in the abdominal wall (on the central opening line) between the legs. Make an incision down to the breastbone. Two fingers may be used to press the intestines away from the incision while cutting. An incision is made on either side of the rectum in the pelvic canal. Two fingers of the left hand are pushed into the pelvic canal and the anus and the rectum is pulled down to the bladder and uterus in the case of ewes. These organs are then cut loose together with the large intestine up to the junction between the large and small intestines. Before above mentioned is separated from the small intestine, the intestine should be stroked to move the contents away from where the separation is to be done before cutting. Failure to

do this will result in faecal contamination of the carcass. Pull the omentum together, cut loose and place into a container. Push the paunch down with the left hand and with the same hand take hold of the side of the paunch pulling it out of the abdominal cavity. The oesophagus will now be visible and should be cut off. The total stomach can now be lifted out and placed into a tray for inspection. As an alternative, the intestines and stomach should be removed as a whole if above procedure cannot be accomplished without contamination. The kidneys and kidney fat are not removed from the carcass.

Flaying

First hock and opening line

The loose hanging leg is pulled tight, towards the flayer, and a small cross incision is made just before the heel. With the knife cutting edge facing outward, a spear cut is made from this incision up the leg, past the anus and towards the tip of the tail. The hock is flayed on both sides to reveal the Achilles heel tendon (hamstring). Remove the foot and proceed to hook the leg by the hamstring onto the dressing roller and placing the roller onto the dressing line. The bleeding chain is removed from the second leg and the bleeding roller placed onto the return rail.

Second hock and opening lines

The second leg is pulled taut towards the flayer and held under his right arm. A spear cut is made by inserting the knife just above the scrotum or udder and the incision extended up to the heel laying bare the inside of the heel. The carcass is then rotated to the left and the skin flayed off the outside of the heel up to the point where the hamstring is joined to the leg muscles. The foot is removed and placed in a container. The leg is hooked and placed on the dressing rail. The carcass should now hang spread out by the two heels on the dressing rail with only the two heels skinned.

Left flank and hind leg

The central opening line is made by a spear cut from between the legs down to the beginning of the breastbone. Lactating udders and scrotums must be removed before this incision is made. The left flank is flayed from the central opening line, left towards the flank for a width of \pm four fingers. Flaying extends up to the inner thigh and down to the breast. Flaying should extend slightly to the back to avoid the dirty side of the skin from curling back onto the meat. During the whole process, the skin must be pulled tight in the correct direction to avoid cutting holes in the skin. It is important that the skin is flayed far enough to avoid the dirty side of the skin from flapping back onto the meat.

Flaying of right flank and hind leg

Flaying of the right flank is easier because the left flank has already been exposed. Slaughtering is again from the middle line but to the right hand side. What applied to the left flank applies to the right flank. From the tail, between the hind legs, the remaining skin is cut loose in the direction of the shank, up to the red part of the shank. The skin of the shank is pulled, first up and then down. The muscle and the meat at the thick shank must first be cut loose, otherwise the whole hindquarter can be ruined. The skin is pulled up beneath the tail root. It is often found that the hind legs are slaughtered first and thereafter the flanks which ends in a mess. At the end of this process the skin must be pulled loose from the tail to prevent the skin curling back.

Lumbar region and anus

The skin is cut loose beneath the tail and is carefully pulled down, using both hands, until it is in line with the sternum of the carcass. The advantage of this is that should carcass touch each other, only clean parts will come into contact. The anus is cut loose with the anus skin, but without damaging the rectum. This piece is placed in a container.

Left and right breast and flanks

The middle opening line is now extended from the cartilage part of the thorax, between the front legs, and past the throat cut made for bleeding. The skin is taken with the hand on the left side of the thorax, close to the opening. The right hand thumb is used to separate the skin and the brisket fat. Two separate forces are at work; the left hand picking up the animal's weight, and the right hand and thumb pressing in the opposite direction. In this way the skin is removed from the brisket without using a knife, avoiding damaging the skin and carcass. The right hand side of the thorax is done in the same

way. After exposing the thorax, the skin is pulled hard in the direction of the worker with one hand, while the other hand is used to make “punch and turning” motions to loosen the skin up to the shoulder. An opening line is made from the upper part of the front leg up to the joint. The fist is punched in between the neck and the shoulder and back to the shin with the forearm. The skin is cut loose at the shank joint. The same procedure is repeated on the other side of the carcass by the same person (after washing hands), or another person, to avoid cross-contamination.

Front legs, neck, hump, and shoulder area

The skin is cut loose on the inside of the front legs and the underside of the neck. Thereafter, the skin is pulled taut in the direction of the worker to loosen the skin with the fist in the shoulder and neck areas on the left side. The same procedure is repeated on the other side of the carcass by the same person (after washing hands), or another person, to avoid cross contamination.

Final skin removal

The skin is taken with both hands and pulled down and loose from the neck. The skin is then placed in a skin trough or chute.

Removal of the pluck

With a hand knife, make an incision through the fat and meat onto the bone of the sternum. Split the cartilage on the top end of the breastbone with a knife and proceed to split the breastbone with a breast saw or handsaw down to the neck area. Sawing is done with short strokes, avoiding penetration of the blade into the thoracic cavity where damage to organs or contamination could occur. Pull the thoracic cavity open and cut loose the diaphragm on both sides. Push the liver to one side to prevent puncturing the gall bladder. The pluck is cut loose along the spine and pulled down and out of the thoracic cavity, while cutting loose the oesophagus and trachea right down to the beginning of the neck (bleeding cut). The pluck is placed in a container or hung up for inspection.

5.14.3. Slaughter process of wild pigs

Wild pigs are skinned and are not scraped and left with the skin on like domesticated pigs.

1. Evisceration
2. Final trimming and washing

Removal of the head

The head is removed first on the slaughter line. Removal of the head is done by pulling the head to one side by the ear and severing the neck between the first and second neck vertebrae.

Evisceration

This process must be completed as soon as possible.

Cut the anus loose by making an incision next to it. Hook a finger in this cut and ring the anus while pulling it. Do not sever the rectum. Release the anus and let it drop into the carcass. Cuts must be as small as possible to prevent unnecessary damage to the hindquarter of the carcass. Care must be taken not to rupture the anus and soiling the carcass.

- Remove any lactating udders.
- Make an incision through the fat from the testes up to the thorax on the mid line of the carcass, taking care not to rupture the intestines.
- Make a small incision and pop the testes out of the scrotum.
- Cut the penis off up to the navel.
- Cut open the carcass from the abdominal cavity up to the thorax.
- Cut loose the intestines and pull the anus through
- Remove the spleen and take off the omentum
- Remove the intestines followed by the stomach, cutting loose just behind the stomach. Avoid soiling during this procedure.
- Saw through the sternum (breastbone).

- Cut loose the diaphragm while holding onto the liver. Take care not to rupture the gall bladder.
- Remove the liver together with the heart and lungs. Remember that the gall bladder may not be emptied on the slaughter floor.

It is important that damage to internal organs, (*bladder, uterus, gall bladder, stomach and intestines*) be avoided at all costs. These organs contain bacteria, and can contaminate the carcass. Washing **cannot** remove this contamination and they must be trimmed off. Workers must wash their hands frequently during evisceration.

Flaying

Contamination of exposed meat by contact with hair from the skin must be avoided.

First hock and opening line

The loose hanging leg is pulled taut, towards the flayer, and a small cross incision is made just before the heel. With the knife cutting edge facing outward, a spear cut is made from this incision up the leg, past the anus and towards the tip of the tail. The hock is flayed on both sides to reveal the Achilles heel tendon (hamstring). Remove the foot and proceed to hook the leg by the hamstring onto the dressing roller and placing the roller onto the dressing line. The bleeding chain is removed from the second leg and the bleeding roller placed onto the return rail.

Second hock and opening lines

The second leg is pulled taut towards the flayer and held under his right arm. A spear cut is made by inserting the knife just above the scrotum or udder and the incision extended up to the heel laying bare the inside of the heel. The carcass is then rotated to the left and the skin flayed off the outside of the heel up to the point where the hamstring is joined to the leg muscles. The foot is removed and placed in a container. The leg is hooked and placed on the dressing rail. The carcass should now hang spread by the two heels on the dressing rail with only the two heels skinned.

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thorax with the left hand, close to the opening. The right hand thumb is used to separate the skin and the brisket fat. Two separate forces are at work; the left hand picking up the animal's weight, and the right hand and thumb pressing in the opposite direction. In this way the skin is removed from the brisket without using a knife, avoiding damaging the skin and carcass. The right hand side of the thorax is done in the same way. After exposing the thorax, the skin is pulled hard in the direction of the worker with one hand while the other hand is used to make "punch and turning" motions to loosen the skin up to the shoulder. An opening line is made from the upper part of the front leg up to the joint. The fist is punched in between the neck and the shoulder and back to the shin with the forearm. The skin is cut loose at the shank joint. The same procedure is repeated on the other side of the carcass by the same person (after washing hands), or another person, to avoid cross-contamination.

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Final skin removal

The skin is taken with both hands and pulled down and loose from the neck. The skin is then placed in a skin trough or chute.

Final trimming and washing

After meat inspection of carcasses and offal has been completed, remove:

- Spinal cord of split carcass
- Pieces of skin and intestinal remains
- Remainder of reproductive organs
- Loosened hanging blood vessels, fat, and blood that cannot be washed off

After the carcass has been trimmed, it is washed with running water to remove blood, sawdust and loose marrow. Enough time and adequate rail length must be available, so that carcass can drip dry to prevent excessive fluid accumulation in the chillers.

6. TEMPERATURE CONTROL AND STORAGE OF MEAT

The main reason for chilling meat is to control the proliferation of bacteria and certain other microbes such as yeast and moulds. In this way slowing down the multiplication of organisms that cause meat to spoil and lengthens its shelf life and decreases microbes which cause food poisoning.

Other reasons for chilling meat are to reduce the rate of harmful chemical changes such as rancidity of fats, and to improve handling qualities.

The number of microbes found on the surface of the meat immediately following slaughter would depend on how hygienically the work in the abattoir has been done. Unpleasant odours and sliminess, indicating that the meat is going bad, are present when bacteria have increased to 10^7 bacteria/cm².

Number of days needed for an unpleasant smell and slime to be apparent on the surface of meat

STORAGE TEMPERATURE(°C)	TIME FROM CUTTING(DAYS)
0	20
5	10
10	5
15	5
20	3
25	2 TO 3

6.1. Bone taint

This condition is restricted to the deep muscle tissues of heavy or excessively fat carcasses where cooling takes place very slowly. It is most frequent among animals, which had been under stress, and generally occurs in the vicinity of the hip-joint or sometimes in the shoulder of bigger game. A characteristic sewage smell is unique to this condition, which is associated with high levels of volatile fatty acids. It is caused by the growth of mesophiles (mostly **Clostridium spp**) arising from a source of infection in the animal.

6.2. Chilling

Chilling is used for short-term storage, while freezing is used for the long-term preservation of meat. During chilling meat must be kept as close to 0°C as possible without freezing it.

In practice we find that low air temperatures together with high air speed leads to a lower nett weight loss.

The ideal chilling room will:

- (a) Inhibit the growth of surface bacteria by chilling the meat
- (b) Creating a firm, dry carcass surface with a minimum mass (weight) loss of the carcass.

Both air temperature and humidity must be carefully controlled. Humidity must be maintained at about 90%-95%. If the humidity is too high, the carcasses will not dry out properly, and if it is too low excessive dehydration and darkening of the meat will take place.

Both the humidity and the temperature is high when fresh meat is brought into the chiller. These are reduced by freezing the moist air when it comes into contact with the chiller fan blades. Effective equipment and the correct use thereof is important to reduce the temperature and the humidity.

6.3. Chilling speed

The speed at which a carcass is chilled depends on:

- (a) Certain properties of the carcass such as species, size and fat coverage; and
- (b) chilling conditions such as the difference in temperature between the product and the air and the rate of movement of the surrounding air.

In order to increase the speed of chilling, the following steps can be taken:

- (i) Increase the difference in temperature.
- (ii) Increase the air speed.
- (iii) Reduce the thickness of the meat.

6.4. Freezing

(a) Aim

To extend the shelf life from weeks to months. Below -12°C bacterial growth ceases, so the shelf-life of the meat is limited only by the actions of enzymes, which cause fat to become rancid.

No figures are currently available for game, but in general terms it may be accepted that the shelf-life will be less than that of domesticated animals because of the following: -

1. Game is shot and killed and therefore less efficiently bled out.
2. Game may be stressed more during chasing in the hunt, resulting in less muscle glycogen resulting in overall higher muscle pH and shorter shelf-life.

(b) Factors affecting freezing time

- (1) Air temperature
Lower air temperature reduces the freezing time.
- (2) Air speed
High air speed places a great working load on the refrigeration system, but reduces freezing time.
- (3) Wrapping
Covering the carcass with cheesecloth or polythene can double the freezing time. Cartons, which are used for packing meat, serve as insulation and freezing takes longer than if metal containers are used.
- (4) Thickness of the product
A golden rule is that the thicker a cut, the longer it takes to freeze.

(c) Important factors to be considered in connection with the chilling/freezing facilities

A refrigeration unit, which has been well designed and well maintained, may still not function effectively because:

- (1) The refrigeration unit cools the air, but the air does not circulate effectively around the carcass

Cold air must be distributed evenly through the room, following a circular flow pattern. The fan of the condenser must not direct the cold air directly on to the carcasses, as a deflection of the air movement will affect the effective cooling of other parts of the room. The more the air is forced to move around the product, instead of through open spaces, the better. It is preferable to have the air blown at right angles to the rails instead of along their lengths.

Carcasses must be spaced evenly in the chiller. The capacity of the chiller, which is determined by the rail lengths, must not be exceeded. This will overload the refrigeration unit and lead to inefficient cooling, with the possibility of faster spoilage. Since no information on game is available, the figures for domesticated species can again be used .

The recommended rail spaces for the different species are 660-750 cm per:

category B game carcass,
6 category C game carcasses.
2 wild pigs.

A minimum spacing of 5 cm between carcasses should be the rule of thumb.

As a result of the risk of condensation, warm carcasses must not be put into a cold room with chilled meat. It is not advisable to hang different kinds of carcasses or carcasses, which differ considerably in size in the same room because the rate at which they cool down, will differ.

- (2) Ice on the evaporation unit insulates the refrigeration mechanism

It is normal for ice to form on the evaporation coil. The ice must therefore be thawed and removed from the spiral at regular intervals. Water that freezes on the spiral comes from:

- Losses from the carcasses by evaporation;
- warm, moist air coming in through open doors;
- the insulation, especially if this is damaged; and
- cleaning activities, which leave water behind in the room.

Excessive ice formation, which necessitates more frequent defrosting, can be avoided by:

- Not overloading the chiller;
- closing the door;
- repairing damaged insulation; and
- mopping up all water during the cleaning process.

(3) Heat loss exceeds the chilling capacity

When the refrigeration unit is overloaded, the temperature rises and remains higher than it should be until the unwanted cause is removed.

In cold storage rooms the heat load includes:

- Motors of fans
- Lights
- Machinery/equipment
- Poor insulation of walls/floors
- Staff
- The product load being greater than was provided for in the design
- Warm air coming in through the doors

In the last case, air curtains can be useful to prevent warm air from entering the chiller. If this is not possible, the fans must be switched off whenever the doors are open.

Another possibility is to use plastic curtains to reduce the loss of cold air while the doors of the cold storage room or freezer are open. ***These should preferably not be used where unwrapped/unpacked meat is moved.*** These curtains can become very contaminated and are not easy to clean and sterilise. Cross contamination will occur which will lead to the contamination of all unprotected products moving in and out. The doors of the chillers must be kept closed when not in use to prevent cold air from escaping and hot air from entering.

Loading periods must be as brief as possible. The doors of the cold-storage room must be closed as soon as the loading is completed. Avoid condensation on partly chilled carcasses at all costs.

Factors to be considered during chilling/freezing on the quality of the meat

Although there are many factors in favour of chilling meat, there are others, which can have a deleterious effect on the quality of the meat. If the principles of refrigeration are correctly applied, however, the disadvantages can be kept to the minimum or eliminated.

Losses through evaporation

During initial cooling and cold storage lasting up to a week the total weight lost by a carcass is usually 2%-2,5%. Most of this loss takes place during the hanging and chilling period, and represents the loss of water coming directly from the surface tissues.

Weight loss resulting from evaporation during chilling and cold storage is unavoidable. It can be limited by rapid cooling.

Drip loss

An additional loss of weight can take place for about the first two days of the chilling process in the form of drops from the cut surface. Rapid cooling reduces this loss as well. It is however well known that freezing causes more drip loss than chilling.

The rate of cooling should be monitored carefully so as to limit weight loss through evaporation and drip loss. It should be slow enough to preclude toughness (cold shrinkage) which is associated with too rapid chilling where electrical stimulation has not taken place.

Cold shrinkage

When rigor mortis sets in, the muscles contract somewhat. This is normal.

If chilling take place too soon after slaughter and the meat is still in the pre-rigor mortis stage, serious muscular contraction will take place. When rigor mortis does take place the muscles will remain in this contracted state. This happens when the meat is chilled within 10 hours to under 10 °C, that is before the pH can get down to less than 6.2. The meat will therefore be excessively tough when it is cooked and eaten.

Defrost shrinkage

When muscles are frozen before the onset of rigor mortis, that is within 10 hours of death and before the pH has fallen to 6.2 the chemical reactions, which give rise to rigor mortis, are ended until the muscle thaws again. The reaction is then resumed at a much faster speed, and toughness can be caused in the same way as with cold shrinkage.

Freezer burn

Freezer burn is the name given to the white or amber spots, which appear on the surface of frozen meat; it arises when the meat is stored unprotected in air with low RH (relative humidity). When unprotected meat surfaces are blast-frozen, a considerable amount of freezer burn usually occurs.

The discoloured spots are caused by the sublimation of ice crystals. This forms small air pockets on the surface of the meat; they diffuse incident light and give the tissues a lighter colour. These changes in the dried tissues on the surface are irreversible even after thawing.

The sublimation of the ice crystals takes place because the water vapour pressure over the spirals of the refrigeration units are much lower than that above the surface of the meat. This phenomenon results in a thickened layer of muscle tissue forming near the surface. This in turn prevents water from passing through it from below. Maximum freezer burn occurs when meat is frozen and then stored under conditions, which prevent evaporation. The reverse also applies.

7. OFFAL HANDLING

7.1 Red Offal

- (1) Red offal must be washed with clean running water, hung on hooks or placed in containers and chilled in a red offal or carcass chiller, to reach a core temperature less than 7° C within 16 hours, but it need not be chilled at the abattoir if dispatched on a continuous basis to the chilling facilities, the proximity of which must not compromise hygiene standards and be approved by the provincial executive officer and on condition that a separate route for dispatch is provided.
- (2) Red offal may not be stored, or come into contact, with rough offal.
- (3) Further separation, cutting and packing of red offal must be done in a separate area or room.
- (4) Where red offal is packed in cartons, containers or plastic bags for dispatch, chilling or freezing –
 - (a) it may only be done in a separate area or room and equipment must be provided for this function;
 - (b) storage facilities for clean empty bags or containers, for a day's use, must be provided; and
 - (c) bulk storage facilities must be provided for packing material.
- (5) Cartoned offal may not be stored in the same chiller as carcasses or uncartoned offal.

7.2 Washing of rough offal

- (1) Rough offal must be removed from the dressing room to the offal room directly adjacent and connected thereto, after being passed, where paunches and intestines must be –
 - (a) separated and emptied of its contents;
 - (b) washed with clean running water; and

- (c) hung on hooks for cooling and drip drying before and during chilling.
- (2) Equipment must be provided for the emptying of rumens and intestines and the ruminal and intestinal content must be removed continuously.
- (3) Where washed paunches or intestines are packed in containers or plastic bags for dispatch, chilling or freezing, a storage facility for clean bags or containers, for a day's use, must be provided.
- (4) Edible washed rough offal must be stored in a chiller at an air temperature not exceeding minus 2 ° C, but it need not be chilled at the abattoir if dispatched on a continuous basis to the chilling facilities, the proximity of which must not compromise hygiene standards and be approved by the provincial executive officer.

7.3 Cleaning of rough offal

- (1) The process as well as the equipment used to clean offal must be approved by the provincial executive officer.
- (2) A room, which is so large and so arranged, that the hygiene of the operation is assured, must be provided to clean paunches.
- (3) Separate containers must be used for pre-scalded paunches, and those that have been cleaned.
- (4) Cleaned offal must be removed after cleaning.
- (5) Separate rooms must be provided for –
 - (a) de-hairing of heads, hooves and feet; and
 - (b) skinning, de fleshing and splitting of heads and the recovery and packing of brains.
- (6) Where clean products derived from the heads are packed in containers or plastic bags for dispatch, chilling or freezing –
 - (a) it may only be done in a separate room or area and equipment must be provided for this function; and
 - (b) a storage facility for clean bags or containers, for a day's use, must be provided.
- (7) Where cleaned rough offal is packed in containers or plastic bags for dispatch, chilling or freezing –
 - (a) it may only be done in a separate room or area and equipment must be provided for this function; and
 - (b) a storage facility for clean bags or containers, for daily use, must be provided.
- (8) Cleaned offal and clean head meat must be stored in a chiller at an air temperature not exceeding minus 2 ° C, but it need not be chilled at the abattoir if dispatched on a continuous basis to the chilling facilities, the proximity of which must not compromise hygiene standards and be approved by the provincial executive officer.

8. Chilling and freezing at abattoirs

8.1. Requirements

- (1) All chilling, freezing and cold storage facilities for meat must comply with the structural requirements for all abattoirs contained in Part II B(1).

- (2) Chillers and freezers must be equipped with dial thermometers or where required by the provincial executive officer, continuous thermo-recorders, to give an accurate indication of the air temperature within the room.

8.2. Temperature capability

- (1) A chiller used for chilling warm carcasses, sides, quarters or portions must be capable of providing uninterrupted cooling to reduce the core temperature of the meat to 7 °C before dispatching.
- (2) Meat, carcasses, portions and offal being frozen may not be removed from the freezer before a core temperature of minus 12 °C has been reached.
- (3)
 - (a) The defrost mechanisms for freezers and chillers must prevent the build-up of ice on the evaporator coil surfaces to levels detrimental for temperature maintenance.
 - (b) Where a chiller or freezer contains meat during a defrosting cycle, defrosting of each evaporator coil must be completed within 30 minutes.
 - (c) Drainage connections of ample size must be provided from drip trays of air cooling units and must lead to ground level outside of the room or directly into the drainage system.
- (4) A chiller or freezer must have a visible permanent notice fixed to the outside, stating –
 - (a) the cubic capacity of the room;
 - (b) the type of product which may be chilled, frozen or stored in it;
 - (c) the maximum permissible product load in kilograms or number of carcasses for that room;
 - (d) the final temperature required for the meat in degrees Celsius and the minimum period of time, in hours, which is necessary for this temperature to be achieved; and
 - (e) in the case of a storage chiller or freezer, the maximum permissible mean temperature value at which meat may be introduced.

8.3. Loading practices for chillers and freezers

- (1) Meat must be chilled in a hanging position ensuring air circulation or, if packed in containers, stacked so as to ensure air circulation.
- (2) No meat may be stacked directly on the floor.
- (3) Warm carcasses may not be loaded into a chiller containing chilled meat.
- (4)
 - (a) No carcass or meat which is unfit for human consumption or may have a detrimental effect on other meat may be stored in a chiller or freezer containing edible products.
 - (b) A carcass or meat must be removed immediately if it deteriorates to such a state as determined by the registered inspector.
- (5) No exposed meat may be stored in a freezer or chiller containing cartoned products.
- (6) Rough offal may not be stored in a holding freezer which contains carcasses, meat or red offal, unless all these products, including the rough offal, are wrapped and packaged.

- (7) No non-food item or product other than meat may be stored in a chiller or freezer except in the case of holding freezers, where approval has been granted by the registered inspector.

8.4. Ice

- (1) The use of ice as a coolant in an abattoir is subject to prior approval of the system by the provincial executive officer.
- (2) Ice incorporated in any system or equipment which is utilized for the chilling of meat must be made from potable water.
- (3) Equipment or systems incorporating ice as coolant for meat must be designed and operated in such a manner that water melting off the ice will not adversely affect the product or adjacent areas.

8.5. Sanitation and vermin control

- (1) Equipment used in chillers, freezers or cold storage facilities that may come into direct contact with the meat must be kept in a clean and hygienic condition, and provision must be made for cleaning and sterilizing such utensils directly after use.
- (2) Ice formation in freezers must be prevented and freezers must be defrosted and sanitized as frequently as may be required by the registered inspector.
- (3) Freezers and chillers must be free from vermin, mould and bacterial growths.
- (4) Chillers, freezers and cold storage facilities must be free from odours which may be absorbed by meat.
- (5) Chillers in regular use must be sanitized immediately after dispatch of all meat.

8.6. Records

- (1) Thermo-control records must be available on request by the provincial executive officer or national executive officer.
- (2) Checks must be done according to the requirements of the Hygiene Management System in practise.

9. Loading of carcasses and meat for transport

9.1. Loading and transport in general

- (1) A vehicle used for the transport of meat must comply with the requirements set in the Requirements for Food Premises under the Health Act.
- (2) Rough offal may not be loaded in the same loading space as carcasses, portions or red offal, unless such rough offal is kept in clean, waterproof containers with tight fitting lids, complying with specifications for equipment as set in Part II B(1).
- (3) No cartoned products may be loaded in the same loading space as exposed meat.
- (4) Chilled game carcasses, sides and quarters must be suspended without touching the floor.
- (5) No unwrapped meat may be loaded directly onto the floor.
- (6) Where required by the provincial executive officer, the driver of a vehicle transporting meat must provide the name, address and contact details of the owner of the vehicle.

- (7) Meat returned to an abattoir or cold storage facility may be received only after re-inspection by the registered inspector, and may only be sorted and salvaged for human consumption under conditions determined by the registered inspector.
- (8) Loading of meat by informal traders must be regulated by a protocol approved by the provincial executive officer but without compromising hygiene or safety standards.

10. Sanitation

10.1 Water and equipment

- (1) There must be available for sanitation purposes –
 - (a) potable or drinking water;
 - (b) hot water at 82°C in sterilizers for disinfecting hand equipment;
 - (c) water at 40°C at hand wash basins for washing of hands; and
 - (d) water at 40°C for general cleaning purposes.
- (2) The abattoir owner must supply all the necessary sanitation equipment.

10.2. Sanitation programmes

- (1) Sanitation programmes must be approved by a registered inspector.
- (2) A detailed post slaughter sanitation programme must be in place containing –
 - (a) a list of all areas and rooms to be cleaned;
 - (b) the frequency of cleaning;
 - (c) step by step cleaning procedures for each area, room or equipment including ablution facilities, meat transport vehicles and lairages;
 - (d) technical sheets of the chemicals used must be available with reference to accredited approval for use in meat plants, active ingredients, dilution rates and applications;
 - (e) results, including microbiological monitoring, to be obtained as the objective of the sanitation programme; and
 - (f) job descriptions and a training programme for all cleaners.
- (3) Programmes must be in place for continuous cleaning during –
 - (a) work periods;
 - (b) breaks;
 - (c) shift changes.
- (4) Sanitation must commence immediately after production for the day or shift has ended but, no sanitation may commence in any area before all edible meat and animal products have been removed to prevent contamination.
- (5) A new shift may not commence before all areas, rooms and equipment have been cleaned and disinfected and an effective pre-production monitoring programme must be in place to ensure cleanliness of all facilities before production commences.

10.3. Chillers and Freezers

- (1) Chillers must be sanitized before a fresh load of meat is loaded.
- (2) Chillers may not be sanitized if it contains meat.
- (3) Freezers must be defrosted and thoroughly sanitized at least once a year or more often if required by a registered inspector.

11. MARKING CARCASSES

The application of identification, classification and approval marks must be done in such a way as to do no harm to the appearance of the carcass. These marks must never be placed on the parts of the carcass where the cuts are expensive, but preferably on the cheaper parts.

11.1. General

(1) No person may place a stamp of approval on, or remove such mark from, any carcass, part thereof, meat or a wrapping, packing or container, except under the supervision of a registered inspector.

(2) The registered inspector may at any time re-inspect a carcass or meat, in an abattoir, notwithstanding that it may already have been passed for consumption and, if upon re-inspection he or she is of the opinion that it is no longer fit for human or animal consumption, he or she must remove the stamp of approval by trimming, and such meat must be condemned.

11.2 Specifications for stamps, marks and ink used

- (1) All stamps or roller marks used to mark any carcass or meat must be constructed of a non-toxic, non corrosive material and must be so constructed as to be readily cleanable.
- (2) The following stamps are required:



(Rural)



(High throughput)



(Low throughput)

- (3) The stamps must contain –
 - (a) the abattoir registration number; and
 - (b) the wording shown in sub-regulation (2) which must be in at least two official languages, one of which must be English.
- (4) The minimum sizes of stamps are 60 mm in diameter for the round mark shown in sub-regulation (2)(a).
- (5) The letters on the stamps must be readable and may not be less than 8 mm high.

- (6) Marks printed on wrapping material may be smaller than the sizes stated in sub regulations (4) and (5) to suit particular circumstances provided they are approved by the provincial executive officer.
- (7) A purple coloured ink is required where stamps are applied to carcasses or meat and must be manufactured of harmless, edible ingredients approved for use on foodstuffs as described in the Foodstuffs, Cosmetics and Disinfectants Act, 1972 (Act No. 54 of 1972).
- (8) The marks must be placed, in case of –
 - (a) all game, on each quarter of the carcass; and
 - (b) on heads of game if skins are removed.

11.3. Wrapping, packing and labelling at export approved cutting plants

- (1) All labels used on meat must –
 - (a) be printed on food grade paper or plastic printing material and treated in the same hygienic way as in contact wrapping material; and
 - (b) include the information required by regulation 89(3) as well as any other information required by the provincial executive officer.
- (2) Where products are individually wrapped, food grade wrapping material on which the mark of approval is printed or a label, printed with such mark, must be used and wrapping bearing the mark of approval may not be re-used after opening.
- (3) In the case of bulk packing, containers or cartons must be clearly marked with a facsimile of the mark of approval clearly visible and of readable size.
- (4) A container must be clearly marked on both ends with information required by the Agricultural Products Standards Act, 1990 (Act No.119 of 1990), as well as –
 - (a) the name, address and registration number of the establishments in which the meat was packed;
 - (b) the net weight of the contents;
 - (c) an accurate description of the contents;
 - (d) the date packaged or a code which enables the date of packaging to be determined; and
 - (e) directions regarding the temperature at which the product must be stored.

11.5. Security of stamps

- (1) The stamp of approval must be kept and used under control of a registered inspector;
- (2) When not in use the stamp must be secured by a registered inspector and kept in safe custody;
- (3) A stamp of approval must never be used at an abattoir where the abattoir number differs from the number on the stamp.

11.6. Use of marking equipment

- (1) Stamps and roller marking equipment must be cleaned and sterilized regularly during use;

- (2) All marking equipment must be kept hygienically, away from the floor and other dirty surfaces;
- (3) Marks must be applied in such a manner that it is clearly legible on the carcass or meat.

11.6. General

- (1) No person may place a stamp of approval on, or remove such mark from, any carcass, part thereof, meat or a wrapping, packing or container, except under the supervision of a registered inspector.
- (2) The registered inspector may at any time re-inspect a carcass or meat, in an abattoir, notwithstanding that it may already have been passed for consumption and, if upon re-inspection he or she is of the opinion that it is no longer fit for human or animal consumption, he or she must remove the stamp of approval by trimming, and such meat must be condemned.

12. Cutting procedures at cutting plants producing for the export market.

12.1. General

- (1) Only carcasses or meat that was inspected and passed may be presented for cutting.
- (2) If carcasses or meat is received from a source other than the abattoir on the premises, the registered inspector must verify that –
 - (a) documentation pertaining to the origin of such meat is available;
 - (b) meat inspection was done on such meat and that it was passed;
 - (c) the cold chain was maintained and that the meat core temperature is 7°C or less;
- (3) All meat presented for cutting must be free of contamination; and
- (4) No meat that exhibits signs of spoilage may be cut.
- (5) A registered inspector may at any time require any packed meat to be re-opened for inspection, and may authorize the resealing of such opened container or carton with meat.
- (6) A linear production flow must be followed by avoiding cross flow, backtracking and accumulation or congestion of meat at any stage of the production process.

12.2. Cutting

- (1) All the cutting, dicing or mincing must be so arranged that the hygiene of all the operations is assured.
- (2) Bones derived from cutting procedures must be removed regularly to a suitable room or container provided specifically for this purpose.
- (3) Meat obtained from cutting and found unfit for human and animal consumption must be collected in properly marked containers or facilities and removed from the premises in accordance with Part VIII.
- (4) Despite regulation 34 (2), meat may be cut while warm if –

- (a) meat is transferred directly from the dressing room to the cutting room in a single operation, the cutting room being in the same building or on the same premises as the dressing room;
- (b) cutting is carried out immediately after transfer;
- (c) meat that has been cut is chilled, or freezing starts, within one hour; and
- (d) this procedure is done according to a protocol approved by the provincial executive officer.

12.3. Wrapping

- (1) Wrapping materials may not be kept in a cutting room in quantities greater than the daily requirement, and must be so stored and handled as to maintain them in a clean condition up to the moment of use.
- (2) Exposed meat may not come into contact with cartons, except where waxed cartons are used.

12.4. Temperature control

- (1) The air temperature of a room where meat is cut and packed, must be maintained at or below 12°C.
- (2) During cutting, wrapping, portioning and packing the core temperature of unfrozen meat must be kept at 7°C or less.
- (3) Meat that is packed for freezing must be placed in a freezer within one hour of being packed. The freezer must be capable of reducing the temperature of the meat to at least minus 12°C within 24 hours and must thereafter be maintained at or below that temperature and frozen meat may not be dispatched at core temperatures warmer than minus 12 °C.

12.5. Sanitation

- (1) The cleaning and sterilization procedure of portable and other equipment must comply with Part II C. (5).
- (2) Sanitizing and sterilizing of hand and other equipment must be done during working hours.

12.6. Further processing

Further processing must comply with the requirements set in the Requirements for Food Premises under the Health Act.

**MEAT INSPECTORS MANUAL
GAME**

**PART II
MEAT INSPECTION**

MODULE 3

ANATOMY

Index**ANATOMY**

1. THE SKELETON
2. THE MUSCULAR SYSTEM
3. BLOOD AND VASCULAR SYSTEM
4. RESPIRATORY SYSTEM
5. THE DIGESTIVE SYSTEM
6. THE URINARY TRACT
7. THE NERVOUS SYSTEM
8. FATTY TISSUE
9. GENITAL SYSTEM
10. THE LYMPHATIC SYSTEM
11. GLANDS OF THE BODY

ANATOMY AND PHYSIOLOGY

It is necessary for the Meat Inspector to recognise the normal form and appearance of any organ or structure in order to recognise and evaluate the abnormal.

1. THE SKELETON

The skeleton supports the body and consists of bones and cartilage, that is either blended together or joined by way of joints to allow movement. It protects the internal organs and the ligaments that control movement. The skeleton can be subdivided into the following:

1.1 Skull

The skull houses the brain, nose, eyes and ears and is connected to the cervical vertebrae. The bones of the maxilla (upper jaw) are fused and form sheathing for the upper teeth. The mandible (lower jaw) holds the lower teeth and hinges on the maxilla.

1.2. Spinal (vertebral) column

The spinal column reaches from the skull to the tail and consists of:

- Cervical or neck vertebrae Abbreviated as - N
- Thoracic or chest vertebrae Abbreviated as - T
- Lumbar or loin vertebrae Abbreviated as - L
- Sacral vertebrae Abbreviated as - S
- Coccygeal or tail vertebrae Abbreviated as - C

Each vertebra consists of a bony body, a central canal, which accommodates the spinal cord, two lateral wings and one dorsal protuberance. The protuberance of the thoracic vertebra is very long and that of the lumbar vertebra very short. The spinal column is flexible. To manage this, there are cartilage discs between the vertebrae. The number of vertebrae is more or less constant for different animal species.

1.3. Thorax or chest

The thorax is formed by the thoracic vertebrae on the top, by the ribs on the sides and by the sternum (breastbone) at the bottom. The first 8 ribs are known as sternal ribs and the rest are known as asternal ribs (all real ribs). The first 8 ribs all articulate with the sternum by means of their cartilages.. They are known as false ribs. The space between the ribs is filled with muscles that help with breathing. The thorax is lined with a membrane called the pleura.

1.4. Foreleg

This consists of the following:

- Scapula or shoulder-blade (connected to the body with 5 muscles)
- Humerus, radius and ulna
- Carpal bones (knee/toggle-joint)
- Metacarpal bones
- Phalanges (toes or hoof)

1.5. Hind leg

It consists of the following bones from top to bottom:

- Pelvic bone (consists of three bones fused into each other)
- Femur
- Patella (Knee/stifle-bone)
- Tibia and Fibula

- Tarsal bones (heel)
- Metatarsal bones
- Phalanges

1.6. Joints

Two or more bones and cartilage and other tissue form a joint. Bones are a fundamental part of joints. Cartilage forms a covering over the articular surfaces of bones in joints – articular cartilages.

(a) Fixed joints

Examples of fixed joints are those of the skull and the pelvis.

(b) Slightly movable joints

This is where two bone surfaces are joined by hyaline bodies (glassy/transparent bodies), cartilage and a fibrous cartilage cushion. Examples are the joints of the vertebrae

(c) Movable joints

These joints consist of the following tissue:

- Cartilage known as articular cartilage covers the surface of part of the bone that forms the joint.
- The capsule, that consists of strong fibrous tissue, is joined at the edge of the articular cartilage. The capsule encloses the joint cavity.
- The synovial membrane, consisting of endothelium cells provides a lining on the inside of the joint cavity. It secretes an oily liquid, synovial fluid that lubricates movement.
- Blood vessels, ganglions and nerves serve the joint.

(d) Moveable joints are classified according to the type of movement:

- Ball- and socket joints for example hip-joint.
- Glide joints that allow limited movement between two flat surfaces for example joints between articular processes of two vertebrae.
- Hinge joints allow movement on one level for example the elbow.
- Protuberance joints (knob-joints) allow movement on two levels for example the joint between the skull and the mandible.
- Axial joint allows rotation of the joint for example Scapulo-humeral joint (shoulder-joint).

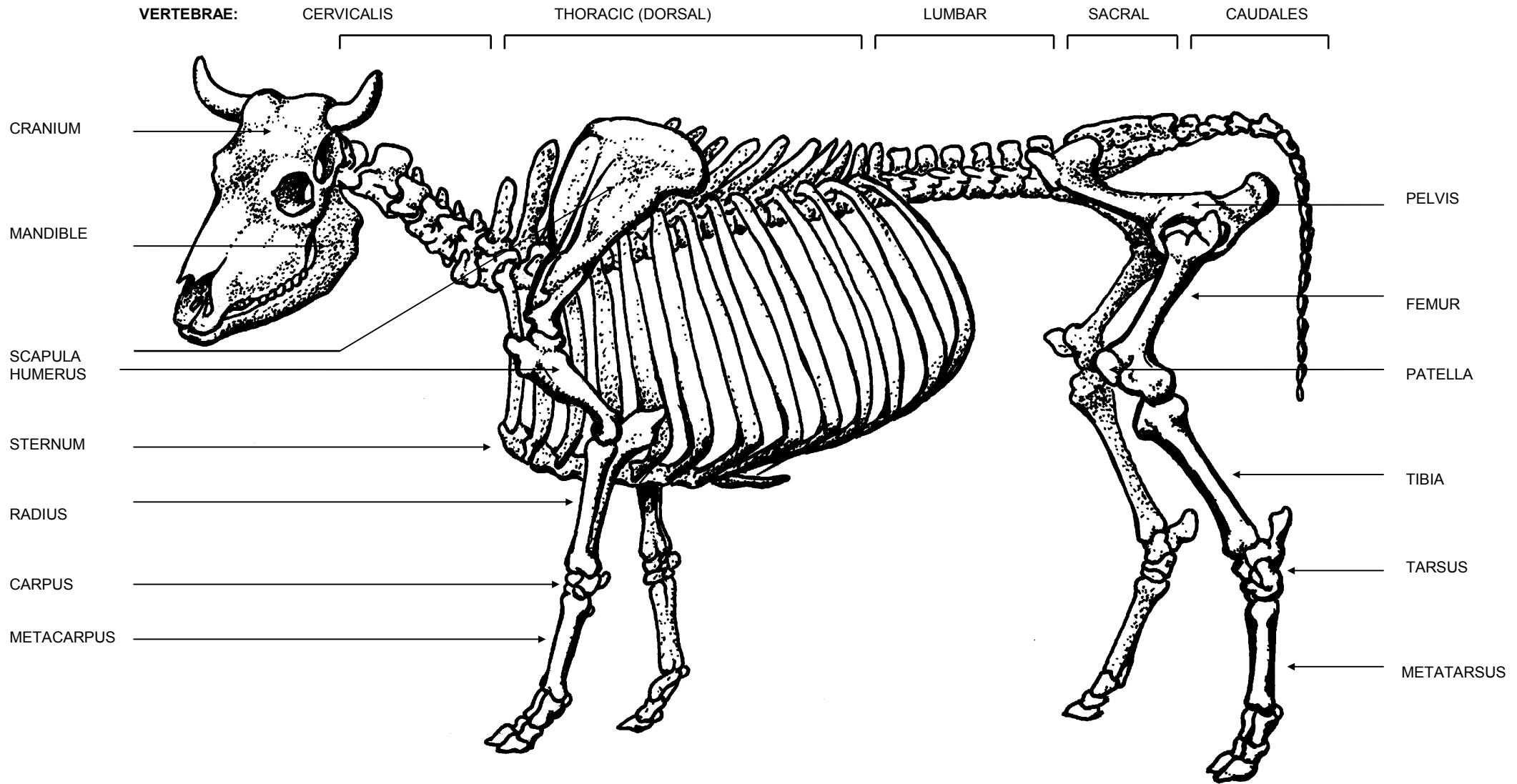
1.7. The body cavities

- The thorax is enclosed by the thoracic vertebrae dorsally (top) by the ribs laterally (from the sides) and by the sternum ventrally (from the bottom side) and is separated from the abdomen by the diaphragm. The thorax holds the heart, lungs and part of the oesophagus, trachea, thymus (contains or secretes NO hormones and is associated with lymphocyte production and antibodies in the young animal – also known as the sweetbread), Thyroid (secretes 3 hormones) and the large blood vessels.
- The abdomen is formed by the lumbar vertebrae caudally, abdominal muscles on the lateral and ventral sides and the diaphragm in the front. The abdomen contains the stomach, intestines, liver, spleen, pancreas, kidneys and bladder.
- The pelvic cavity is formed by the sacrum caudally and the pelvic bones on the lateral and ventral sides. The pelvic cavity contains the rectum, the bladder and in the case of early stages of pregnancy (gestation), the uterus (womb) and ovaries.

Skeleton of a bovine

SKETS VAN SKELET

SKELET VAN 'N BEES



2. THE MUSCULAR SYSTEM

2.1 There are three kinds of muscles

(a) Striated muscles

They form most of the muscles and are responsible for movement and are controlled voluntarily.

(b) Smooth muscles

They are autonomic muscles and are mostly found in the internal organs. They control among other things, the movements of the intestine.

(c) Heart muscles

This is a striated muscle, but autonomically controlled.

The colour of muscles differs from species to species and is also influenced by age. In adults, muscles are usually red and firm; in young calves pale and grey-red, in most game species dark red and in pigs pale and greyish. In Zebra the muscles are a very dark red and when subjected to exposure, blackish.

2.2 Muscle Proteins

Muscle proteins determine meat tenderness.

A muscle consists of various kinds of proteins of which two in particular play an important role in determining the toughness or tenderness of meat. They are called connective tissue proteins and contraction proteins. The former are responsible for the strength of a muscle and the latter for its ability to contract and relax, which can enable limbs to move.

Connective tissue proteins

The muscle is surrounded by a layer of connective tissue (the epimysium) from the inside of which partitions of fibrous tissue (the perimysium) enclose various groups of primary, secondary and tertiary muscle bundles and give the meat its texture.

Connective tissue proteins affect the tenderness of the meat as a result of the amount occurring in the muscle and the degree of cross-binding or solubility of the collagen in the connective tissue.

Amount of connective tissue

Strong shin muscles contain large amounts of connective tissue and weaker loin and fillet muscles contain less; this is why meat differs in tenderness according to where it comes from on the carcass.

Solubility of connective tissue

The younger an animal, the fewer cross-connections (polymerisation) there are between the collagen fibres of the connective tissue. These collagen fibres are more soluble during cooking, are more easily transformed to soft gelatine and shrink less during heating than collagen from older animals. This is why the meat of younger animals is more tender than that of older ones.

Contraction proteins

The two contraction proteins which cause contraction and relaxation in muscle proteins are actin and myosin, the thin and thick protein bundles respectively, which move over and past each other during muscle movement.

2.3 Muscle Movement

Muscle movement

A nerve impulse moves to the muscle and activates the contraction process. This impulse causes the release of calcium ions from the sarcoplasmic reticulum. This increased concentration of calcium ends the inhibiting effect of troponin and tropomyosin on the formation of actomyosin.

MgATP serves as a filler which keeps the actin and myosin filaments apart (so the muscle is in a relaxed state).

The higher concentration of calcium ions causes the bonded ATP to be released from the MgATP. The ATP releases energy when it changes to ADP.

Now the actin and myosin filaments bind (using this released energy) to form actomyosin bridges, which are physically shorter than the myosin filament and consequently the actin filaments are drawn together and may even overlap - the stronger the contraction, the tougher the meat.

Muscle relaxation

For the muscle to relax it is necessary to remove the calcium ions (which happens when there are no more nerve impulses) and to provide ATP so that more MgATP filler can be formed.

Stored glycogen is the immediate source of energy for muscle activity.

The glycogen is broken down by glycolytic enzymes to pyruvic acid, which is in turn broken down in the presence of oxygen (supplied by the blood) to carbon dioxide (removed by the blood) and water. During this process ATP is made available to form MgATP.

The result is muscle relaxation.

When an animal is slaughtered, it is bled until it dies. When it stops breathing, oxidation of the limited amount of blood still remaining in the lungs can no longer take place.

Rigor mortis

Muscular relaxation can therefore no longer take place in a dead animal, as the blood is naturally unable to provide oxygen for the oxidation of pyruvic acid to release ATP. There is no ATP with which to form MgATP filler, so the actomyosin filaments remain.

This permanent closure of the actomyosin filaments is called rigor mortis.

In anaerobic conditions (where oxygen is lacking e.g. during maximum exercise or stress), glycogen in the muscles will, however, change to lactic acid which accumulates and lowers the pH of the muscle to as little as 5.4.

This lactic acid in the muscle fibres will in due course lead to saturation of the muscle protein; together with the release of proteolytic enzymes from the lysosomes of the cells to assist in this breakdown of muscle protein, this will cause the meat to become tender. We refer to this as "ripening" of the meat.

Healthy animal

The course of rigor mortis in rested animals in good health which were slaughtered according to normal procedures may be represented as follows:

In a freshly slaughtered carcass with sufficient muscle glycogen at a pH of 7.2, rigor mortis will start developing slowly after 3-5 hours. After a further 3 hours the carcass will begin to stiffen and the development of rigor mortis will accelerate until it has developed completely by 24 hours after slaughter. The pH of such carcasses will drop to around 5.4.

What happens if the animal is sick, excited or exhausted before slaughter?

All three of these conditions cause depletion of muscle glycogen reserves, which in its turn gives rise to a reduction in the formation of lactic acid. In other words the pH of the carcass will not fall so much - to about 6,5 instead of 5,4.

These conditions have the following effects:

1. The meat is more prone to decay since certain pathogenic organisms grow more easily at a higher pH.

Certain anaerobic bacteria in the lymph nodes can also multiply and spread to the surrounding meat. This will reduce the shelf-life of the meat.

In the case of large, fat animals which are cooled inadequately or too slowly, a similar multiplication of anaerobic bacteria takes place, especially in the vicinity of the hip joint and sometimes the shoulder. This is known as "bone taint".

2. The higher pH causes the meat to lose its water retention ability, so water is not retained within the muscles. This causes what is known as DFD (dark, firm, dry) meat, also known as "dark cutters".

2.4 Nutritional Value Of Meat

Definitions

Dietetics – is the practical application of nutrition to keep a community healthy. It entails the planning of meals according to the individual's physiological and psychological needs – selection, care, preparation and presentation thereof.

Correct nutrition is characterised by a healthy body. The status of good nutrition is characterised by change in bodyweight.

Nutrition – refers to the process of utilisation and assimilation of food. In short, it entails the taking in of the correct food for body use; digestion of food so that the body can utilise the nutrients; absorption of nutrients in the bloodstream; utilisation of the different nutrients by body cells and the excretion of waste products.

Nutrients – are the chemical ingredients in food needed by the body. Plus minus 50 types are known and can be divided into six classes namely:

- * Protein and amino-acids
- * Fat and fatty acids
- * Carbohydrates
- * Mineral components
- * Vitamins
- * Water

Muscle proteins

Muscle proteins determine meat tenderness.

A muscle consists of various kinds of proteins of which two in particular play an important role in determining the toughness or tenderness of meat. They are called connective tissue proteins and contraction proteins. The former are responsible for the strength of a muscle and the latter for its ability to contract and relax, which can enable limbs to move.

Connective tissue proteins

The muscle is surrounded by a layer of connective tissue (the epimysium) from the inside of which partitions of fibrous tissue (the perimysium) enclose various groups of primary, secondary and tertiary muscle bundles and give the meat its texture. Connective tissue proteins affect the tenderness of the meat as a result of the amount occurring in the muscle and the degree of cross-binding or solubility of the collagen in the connective tissue.

Amount of connective tissue

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Solubility of connective tissue

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Contraction proteins

The two contraction proteins which cause contraction and relaxation in muscle proteins are actin and myosin, the thin and thick protein bundles respectively, which move over and past each other during muscle movement.

2.4 Cold shrinking

During the first few hours after slaughter the carcass muscles still contain enough energy in the form of ATP and glycogen to enable the muscles to contract. The muscles try to retain their normal status as it was in life by means of energy consumption. This means that the calcium pumps in the muscles still try to keep the calcium concentration in the muscle cells low, preventing contraction. When the muscle temperature drops to below 15-12°, the calcium pumps are slowed by the cold. Their output falls, so less calcium is pumped out of the barrier cells. This causes the calcium concentration in the muscle cells to start to rise. The result is that the increased calcium concentration removes the inhibiting effect which actin and myosin have on muscle contraction. Actomyosin forms as a result of the binding of actin and myosin which move over each other, and the muscle contracts. This contraction continues for as long as ATP is available as a source of energy. No muscular relaxation occurs, and the muscle goes into rigor mortis while in a contracted state. The consequence is extremely tough meat. This problem is referred to as cold shrinking, and can also be termed "abnormal" toughness (Locker, 1976).

2.5 Defrost shrinking

If meat is frozen shortly after slaughter while the muscles still have sufficient reserves of energy, rigor mortis will not take place because of the inhibitory effect of freezing on many of the chemical processes concerned. Freezing damages many of the muscle organ structures such as the sarcoplasmic reticulum and the mitochondrial membranes. These two structures are among those responsible for the storage of calcium. When the muscle thaws, the calcium pours into the muscle sarcoplasm and releases the inhibitory effect of troponin and tropomyosin, so shrinking takes place which is called defrost shrinking. This differs from cold shrinking in that the calcium concentration rises much faster in muscle cells during defrost shrinking, so that the muscular contraction is far stronger and the meat is exceptionally tough.

2.5 Chemical Composition Of Muscle

The composition of muscle before changes have occurred in the tissue can be summarised as follows:

COMPONENTS	%
Water	75.5
Protein	18.0
Myofibrillar protein (10%)	
Sarcoplasmic protein (6%)	
Other protein (2%)	
Fat	3
Soluble no protein substances	3.5
Traces of minerals, vitamins, etc	0.10

2.6 Meat Quality

Components Of Meat Quality Characteristics

(i) **Appearance** – which is seen by consumer and trader.

Muscle, Fat : Bone ratio
Visible marbling
Muscle and colour
Fat hardness
Muscle texture
Water bending capacity

(ii) **Palatability** – which the consumer taste

Tenderness
Chunkiness
Flavour
Aroma

(iii) **Nutritional value** – that which the consumer expects.

Proteins, Vitamins, etc.

(iv) **Processability** – what the processor wants.

Ability to: retain water
be processed
retain attractive colour

(v) **Hygienic status and shelf-life** – that which everyone wants.

- No micro organisms, unpleasant odours, changes in colour, slime
- Prolonged shelf life

3. BLOOD AND VASCULAR SYSTEM

This consists of the following:

3.1. Blood

This consists of a fluid (plasma) and cells. It transports oxygen and carbon dioxide, removes waste products from tissue for elimination from the body and controls the body temperature.

- **Plasma**
A fluid consisting of different mineral salts (electrolytes), blood proteins, metabolites (metabolic products) and waste products. Prothrombin and fibrinogen are two important materials in the blood, that controls blood coagulation.
- **Red blood cells**
These are round biconcave discs with an iron pigment, known as haemoglobin, and are red in colour. They are therefore called red blood cells. They transport oxygen from the lungs to the rest of the body and carbon dioxide from the tissues to the lungs. Red blood cells are manufactured in the bone marrow of long bones.
- **White blood cells**
They are bigger than red blood cells and have a clear nucleus. They protect the body from disease causing organisms. They play an important role in immunity. They are manufactured in the spleen, lymph nodes and also the bone marrow.
- **Thrombocytes (blood platelets)**
These help with blood coagulation.

3.2. Blood vessels

a. Arteries

They normally have thick, muscular and elastic walls. They transport the blood from the heart to organs and tissues and the blood is normally rich in oxygen and has a bright red colour.

b. Veins

These are vessels with thin walls and have one-way valves to prevent the back-flow of the blood. They transport blood from the tissue to the heart.

c. Capillary vessels

These are small subdivisions of blood vessels, as fine as hair. They bring about the gaseous interchange between blood and tissue cells.

3.3. The heart

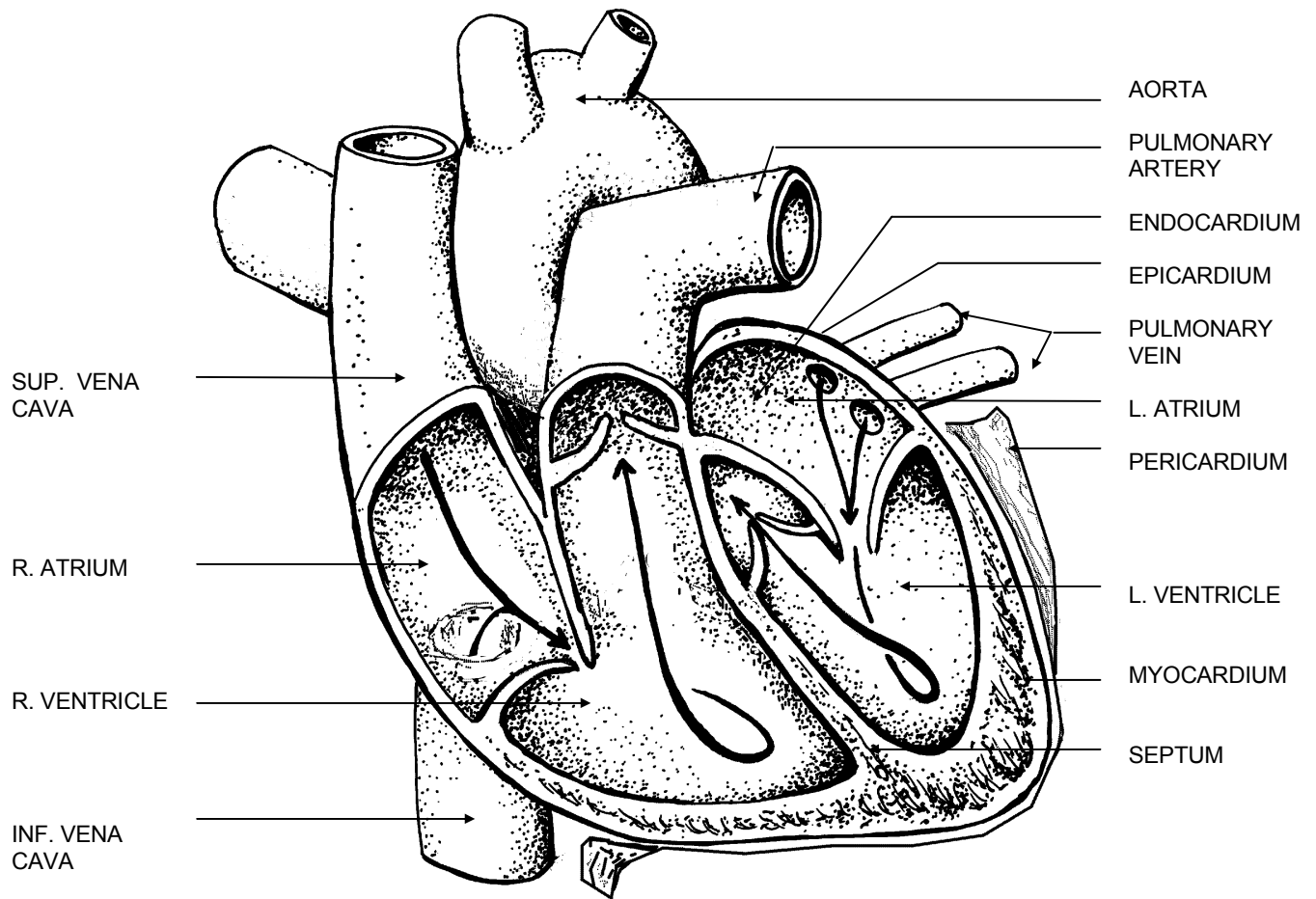
Located in the thorax, anchored by the big blood vessels and surrounded by the pericardial sack, that contains a small amount of fluid.

- The Epicardium or outer surface of the heart.
- The Endocardium or inner surface of the heart.
- The Myocardium or cardiac muscle between the membranes.

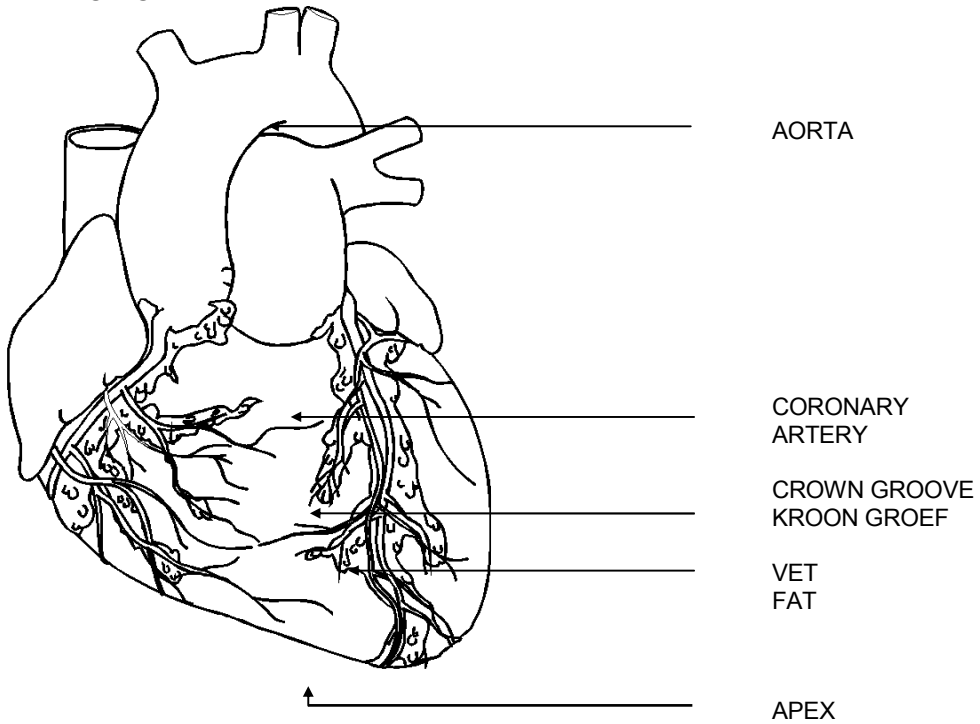
The heart is divided into a left and right side by a layer of muscle known as the septum that contains nerve-bundles. Each side is divided into an upper and lower heart chamber by a cardiac valve. The upper heart chambers are known as the atria (vestibules) and the lower heart chambers as the ventricles.

- The right atrium is a small cavity with thin walls and receives blood from the body through two big vessels.
- The right ventricle is a large cavity with medium thick walls and receives blood from the right atrium through the tricuspid (3 cusps) valve. It then pumps the blood via the pulmonary artery to the lungs for gas interchange. The pulmonary artery is thus the only artery carrying oxygen-poor blood.
- The left atrium is a small cavity with thin walls that receive blood from the lungs via the pulmonary vein. The pulmonary vein is the only vein that carries oxygen rich blood.
- The left ventricle is a large cavity with thick walls and receives blood from the left atrium through the bicuspid (2 cusps) valve. It then pumps the blood via the aorta (main artery) to all parts of the body.

SCHEMATIC VIEW OF THE HEART -



EXTERIOR OF THE HEART



4. RESPIRATORY SYSTEM

Anatomically the system is divided as follows:

4.1. The nasal cavity

This cavity is lined with a mucous membrane and divided in the middle by the septum.

4.2. The larynx

The larynx consists of five cartilaginous structures, that make it more flexible and contains the vocal cords. The epiglottis is attached to the larynx and closes the trachea, when the animal swallows.

4.3. Trachea

The trachea consists of circular, cartilaginous rings and is lined with mucous membranes. In Cattle a dorsal ridge can be found on the dorsal side.

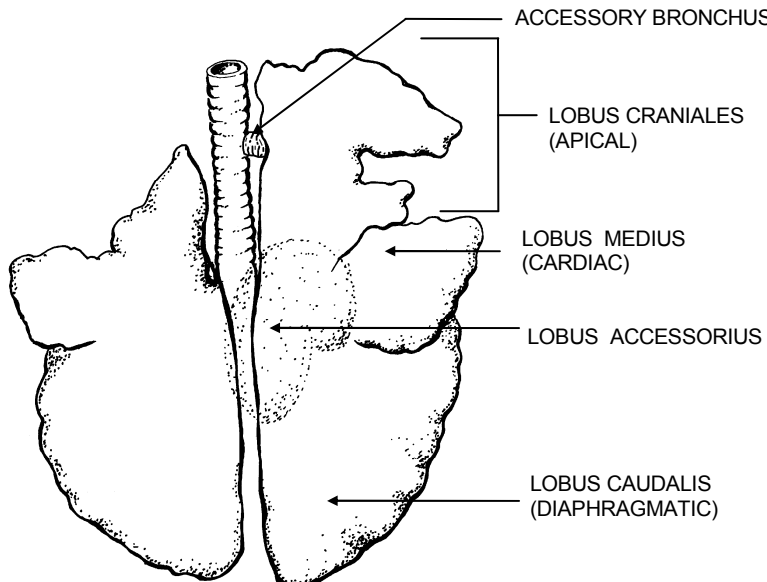
4.4. Lungs

The lungs consist of lobes that divide into smaller lobules. They differ from animal to animal and this can be used to distinguish between species. The membrane between the lungs is known as the mediastinum and contains the important mediastinal lymph nodes. The trachea divides into two bronchi one to each lung. In Cattle, Pigs and Sheep, a third accessory bronchus goes to the right lung. The bronchi do not have cartilaginous rings and divide into smaller branches called interlobular bronchi which in turn divide into lobular bronchioles and then into alveolar ducts until they end in alveoli (air cells) where gaseous exchanges occur. The lobes are known as the apical (front) lobe, cardiac (middle) lobe and the diaphragmatic (rear) lobe.

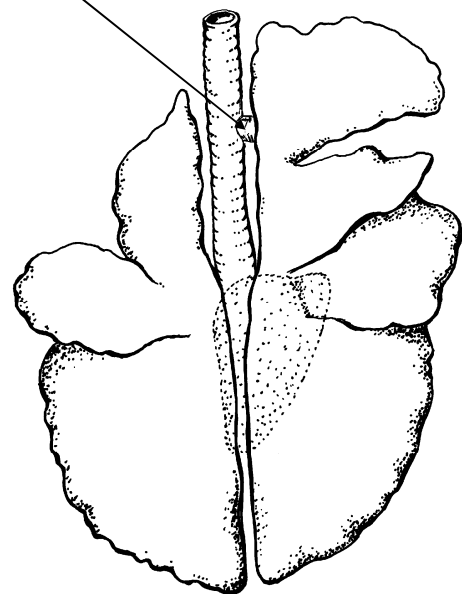
Lungs of Game species

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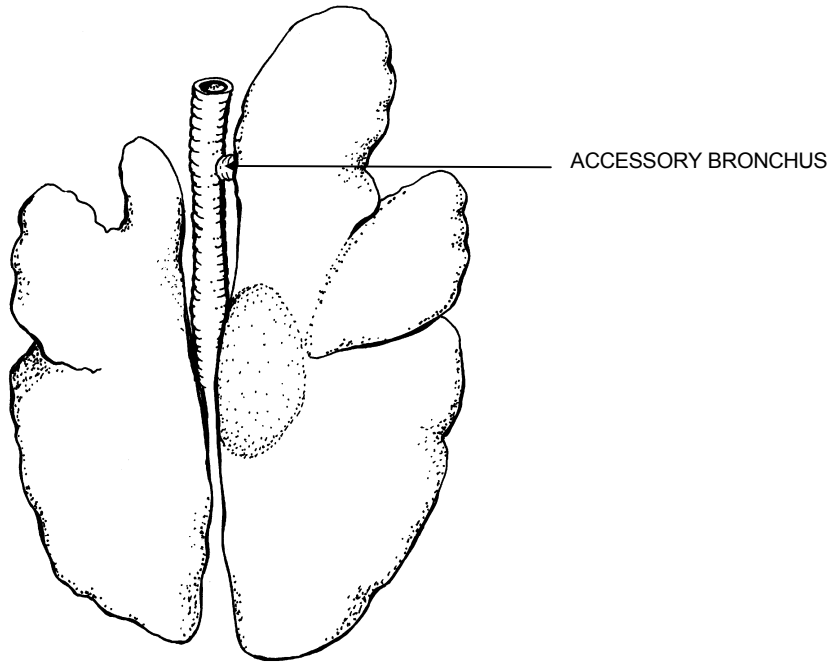
CATEGORY C SPECIES LUNG



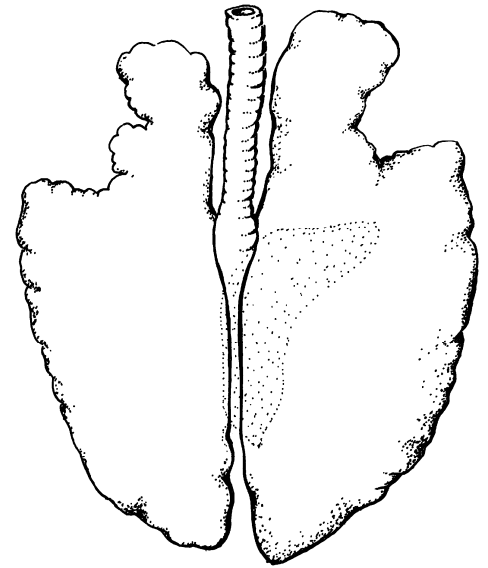
CATEGORY B SPECIES LUNG



PIG



ZEBRA



5. THE DIGESTIVE SYSTEM

The digestive system consists of:

5.1. The mouth

The mouth is bordered by the lips, hard (bony) palate and the soft palate (velum).

5.2. The tongue

The tongue is a muscular, flexible organ attached to the mandible on the ventral side and to the lingual-bone (hyoid) caudally.

5.3. Oesophagus

This is a muscular tube that runs from the pharynx to the stomach. The first part of the oesophagus is joined to the trachea.

5.4. Stomach

Pigs and Horses have simple, single stomachs where primary digestion takes place. (See sketch)

- (a) The stomach of the Pigs is simple and crescent-shaped. It is pale grey on the heart's side and brown-red in the middle and is more pale and rippled towards the pylorus.
- (b) The stomach of the Horses is simple and is a sharp u-formed sack of which the right side is shorter than the left side. It is relatively small.
- (c) Ruminants have a complex digestive system, which consists of the following:
 - (i) The rumen (paunch) is the first and the biggest sack.
 - (ii) The reticulum (honeycomb stomach) is the smallest sack and lies just ahead of the rumen. The inside of the reticulum looks like a honeycomb. This controls the flow of food from the rumen.
 - (iii) The omasum (leaf-stomach) lies just to the right of the reticulum and consists of numerous folds that look like leaves. The food is dried here before it goes through to the abomasum.

- (iv) The abomasum is the last sack and is the same as the stomach of single-stomached animals. The lining is pale red with numerous small folds. From the stomach, the food goes through the pylorus to the duodenum (small intestine).

5.5 Small intestine (See sketch)

(a) Duodenum

This is the first short part of the small intestine with openings for the pancreatic juice from the pancreas and bile from the gall-bladder.

(b) Jejunum

This is the largest part of the small intestine.

(c) Ileum

This is the last short part of the small intestine that empties into the caecum (blind gut). The primary function of the small intestine is the final digestion and absorption of nutrients.

5.6. Colon

- (1) The caecum forms part of the colon and are saccate in shape with an opening to the large colon.
- (2) The colon is the largest part and its form varies from specie to specie. Its primary function is the absorption of water and salt to control the fluid balance in the body.
- (3) The rectum (and then the anus) is the last part and open to the outside.

5.7. Mesenterium (mesentery)

This is the peritoneum (intestinal abdominal membrane) that hangs on the spinal column. A chain of important lymphatic glands, the mesenteric glands are found here.

5.8. Omentum (abdominal plexus/net)

This is part of the abdominal membrane that encloses the intestines. The mesenterium and omentum are richly supplied with fatty tissue and are a very important source of edible fat.

5.9. Liver

This is the second largest organ of the body after the skin. It is divided into lobes and is richly supplied with blood. The gall-bladder lies more or less centrally on the vertical surface. Near the gall-bladder lies the important hepatic lymph node. In healthy animals, the liver is smooth and dark brown, however, it may be light brown in the case of fat animals. The primary functions of the liver include the following:

(a) Metabolism

This is the breaking down of food absorbed from the small intestine into sugars for body energy. The liver also stores sugar in the form of glycogen.

(b) Production of bile

Old, worn-out and broken down red blood cells are transformed into bile, that is excreted into the duodenum. Bile is necessary in the digestion of fat.

(c) Detoxification

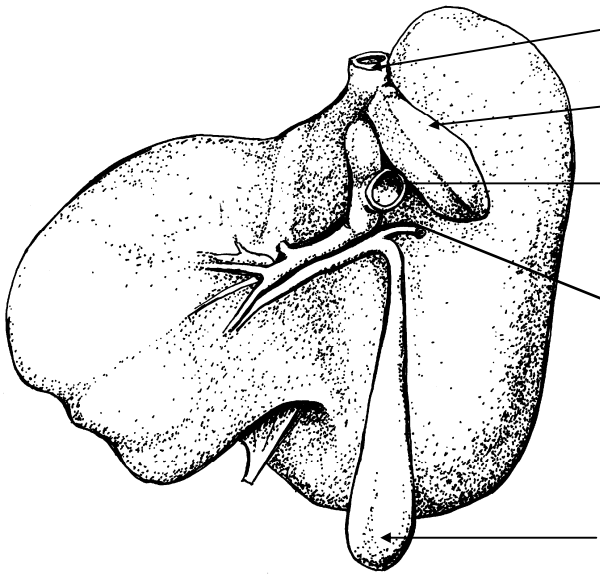
The liver breaks down and eliminates toxins in the body.

5.10. Pancreas

This reddish gland is situated in the fold of the duodenum. It secretes pancreatic fluids into the duodenum and insulin into the blood stream. It is responsible for sugar metabolism.

ANATOMY OF THE LIVER

CATEGORY C SPECIES



POSTERIOR VENA CAVA

CAUDATE LOBE

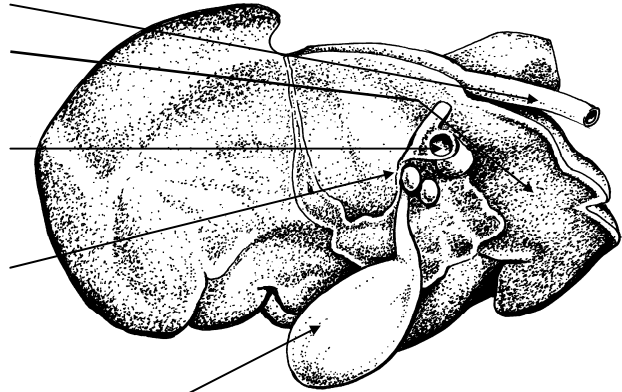
PORTAL VEIN

Ln. HEPATICUS

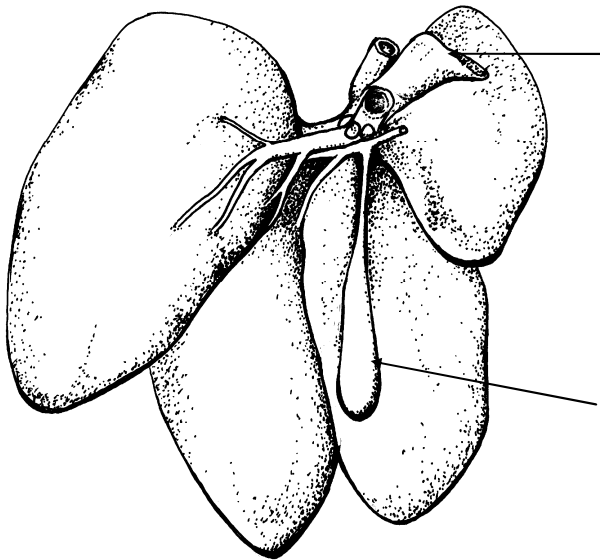
BILE DUCTS GALBUISE

GALL-BLADDER GALBLAAS

CATEGORY B SPECIES



PIG LIVER



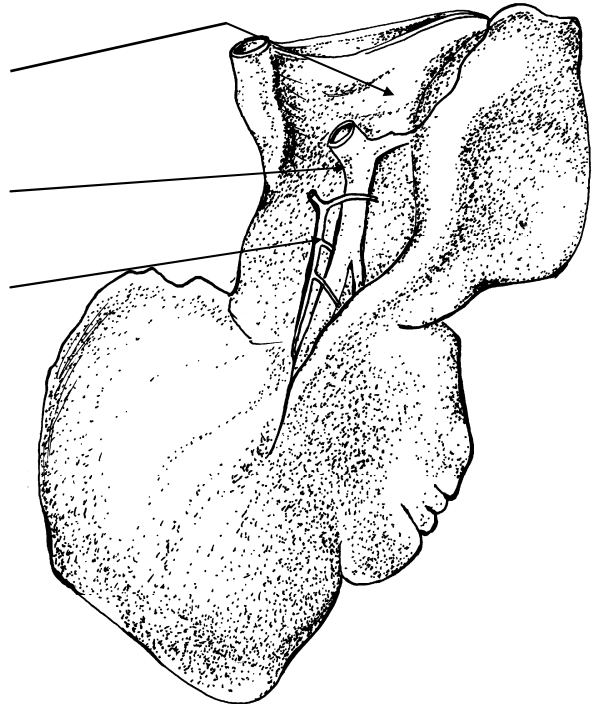
CAUDATE LOBE

PORTAL VEIN

BILE DUCT (NO GALL BLADDER)

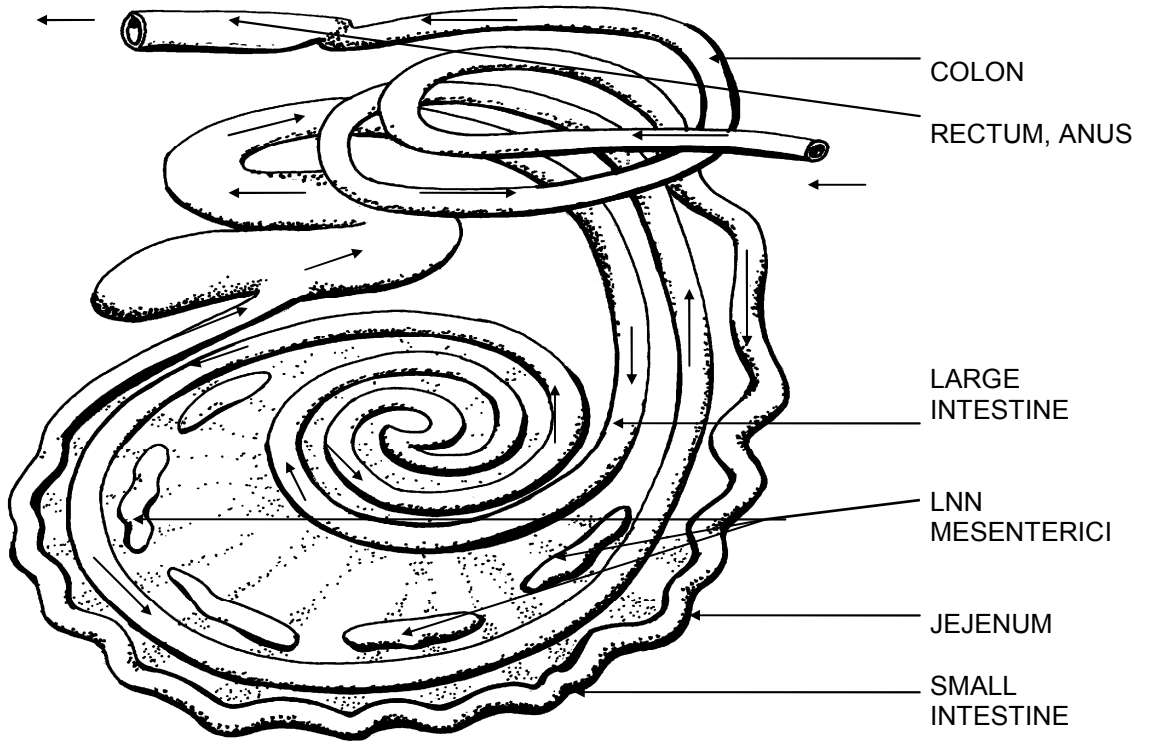
GALL BLADDER

ZEBRA LIVER

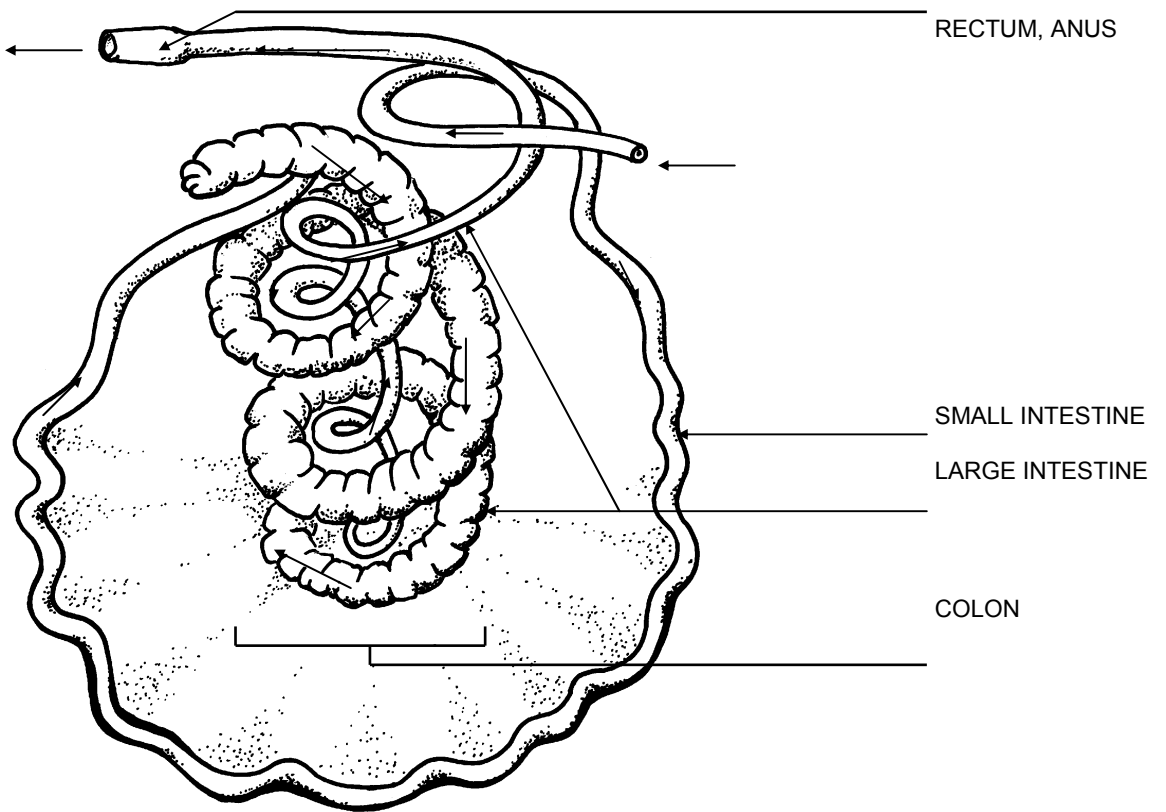


SCHEMATIC LAYOUT OF THE INTESTINES

RUMINANTS

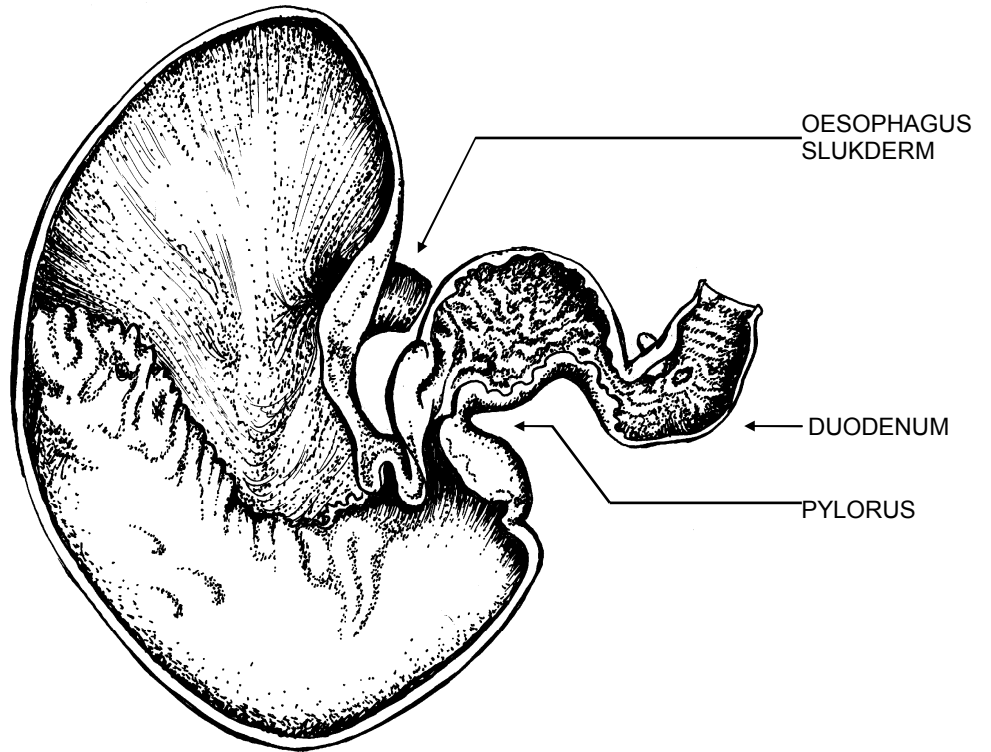


NON RUMINANTS-PIGS

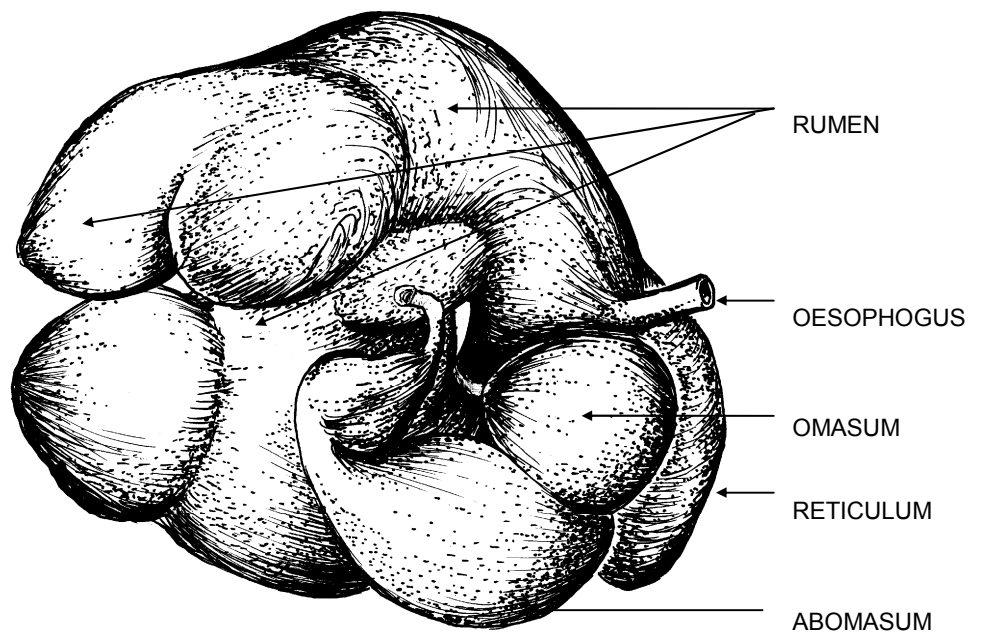


COMPARATIVE ANATOMY OF THE STOMACH

STOMACH OF THE ZEBRA

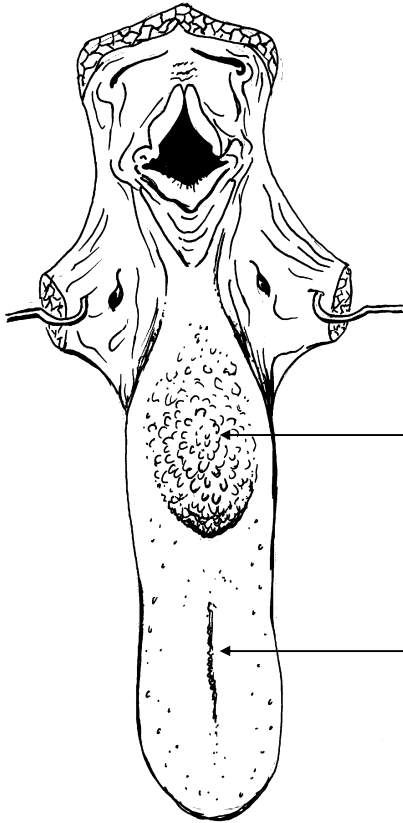


RUMINANT STOMACH

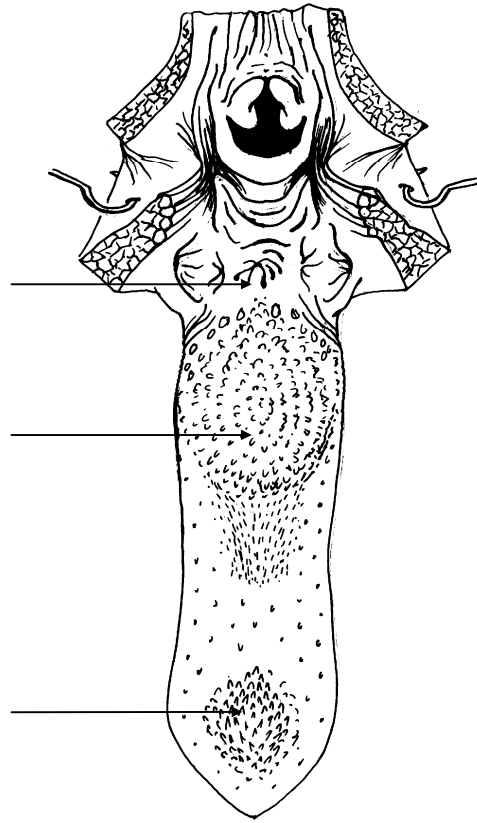


COMPARATIVE ANATOMY OF THE TONGUE

CATEGORY C SPECIES TONGUE



CATEGORY B SPECIES TONGUE



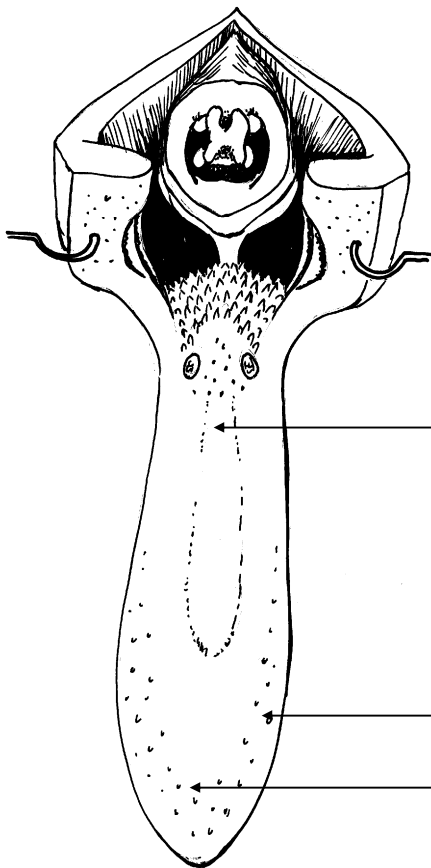
PAPILLAE VALLATAE

DORSAL RIDGE

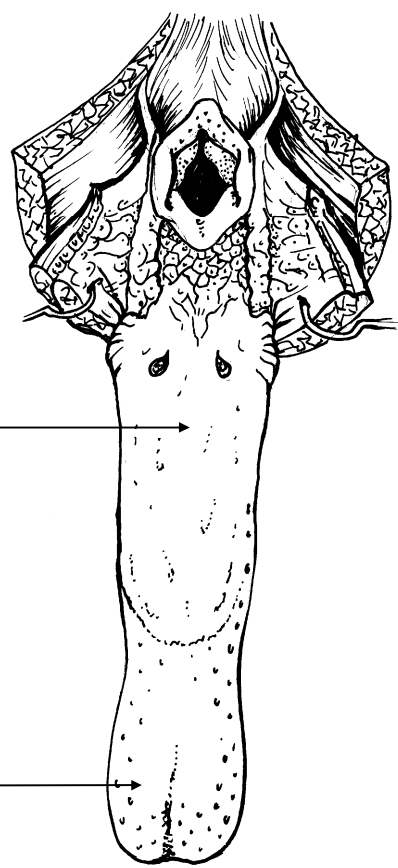
CENTRAL GROOVE

HORNY PAPILLAE

PIG TONGUE



ZEBRA TONGUE



NO DORSAL RIDGE

FUNGI SHAPED PAPILLAE ARE PROMINENT

SMOOTH SURFACE

6. THE URINARY TRACT

Consists of two kidneys, two ureters, the bladder and the urethra.

Each kidney is covered with a thin capsule. The kidney consists of an outer part or cortex and an inner part or medulla (see sketch). Each kidney is provided with an excretion tube, the ureter, through which the urine flows from the kidneys to the bladder.

The urethra is the tube through which the urine flows from the bladder to the outside.

The function of the kidneys are mainly:-

1. Controlling the concentration of substances (Minerals, vitamins etc.) in the body.
2. Act as a filter to remove unwanted substances from the body e.g. toxins, by products of cell debris etc.

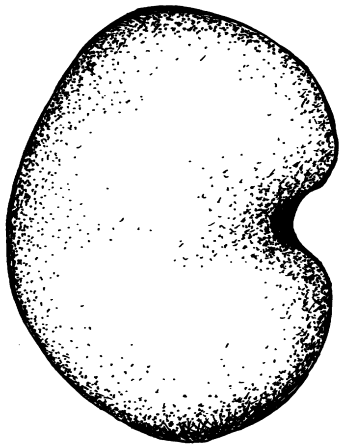
This are done by filtering the blood through a system of tubes in the kidney. Malfunctioning of the kidneys will result that unwanted substances will build up in the body or that abnormal amounts of substances will be secreted into the urine.

The result could be that there will be a build up of by products (uraemia) in the blood with a resultant bad smell of the carcass. An abnormal color of the urine (E.g. red) may occur when red blood cells are secreted into the urine or even a toxemia when toxins are not secreted from the blood.

Comparison of the kidneys of the different animal species:

COMPARATIVE ANATOMY OF THE KIDNEY

KIDNEY



INTERNAL VIEW

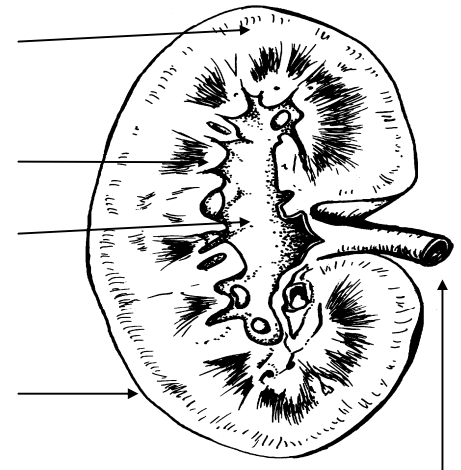
CORTEX

MEDULLA

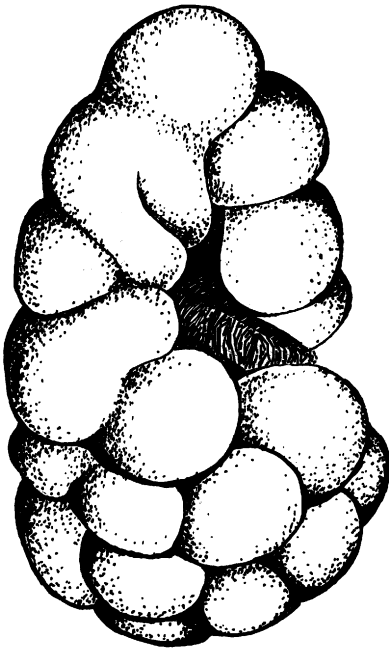
PELVIS RENALIS

CAPSULE
KAPSEL

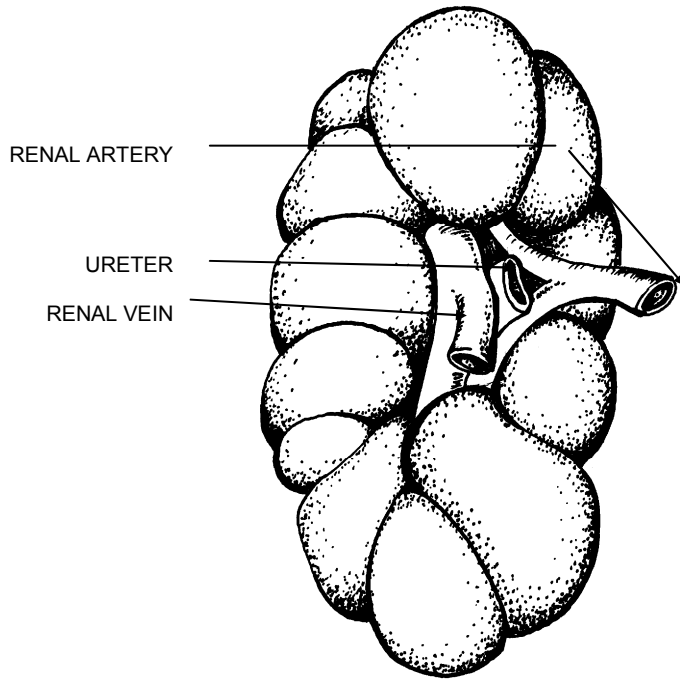
URETER



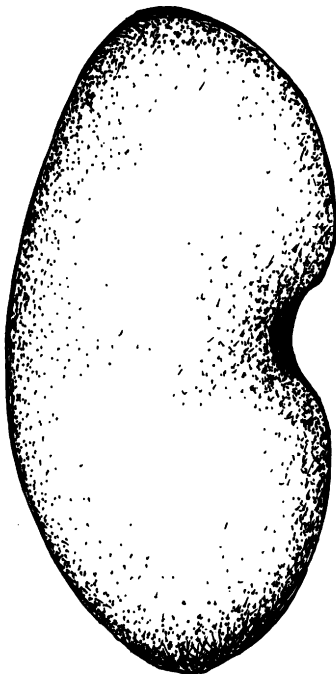
LEFT KIDNEY-CATEGORY B SPECIES



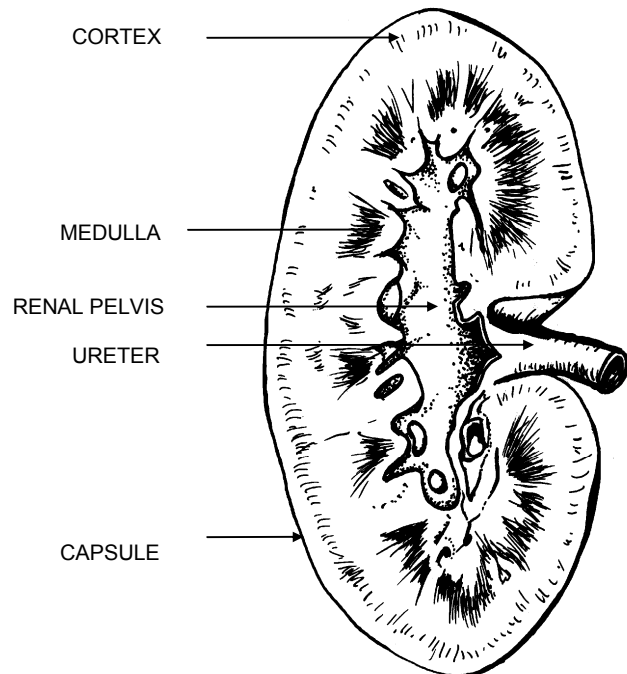
RIGHT KIDNEY -CATEGORY B SPECIES

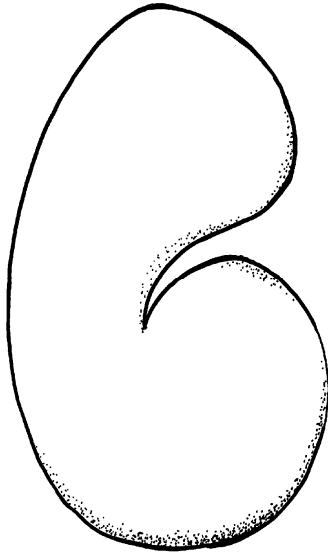
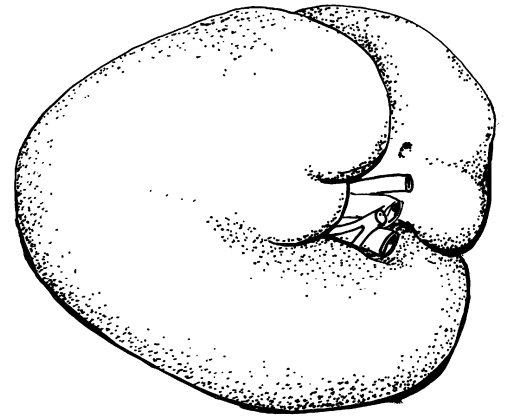


PIG KIDNEY



INTERNAL VIEW



LINKER NIER VAN DIE PERD**RIGHT KIDNEY OF THE ZEBRA**

7. THE NERVOUS SYSTEM

Can be divided into:

- (1) The central nervous system consisting of the brain and the spinal cord
- (2) The peripheral nervous system is made up of all nerve tissue outside the brain and spinal cord with their motor (muscular movement) and sensory (feeling) ends.

7.1. Spinal cord

The spinal cord is tube shaped and lies in the spinal canal of the vertebral column, thus being protected by the bone. On the top part, it enlarges to form the brain that is protected by the skull. The spinal cord and the brain form the central nervous system.

Between the bone and the central nervous system there are three membranes known as the meninges (cerebro-spinal membranes):

- (i) The Piamater (inside membrane) attached to the brain and the spinal cord. It contains small blood vessels running to the central nervous system.
- (ii) The Arachnoid (cobweb) is a serous membrane and secretes cerebrospinal fluid.
- (iii) The Duramater (outer membrane) is a round membrane covering the inside of the skull and the neural canal.

The functions of the spinal cord are to carry messages from and to the brain.

7.2. The brain

The brain consists of:

- (i) The Medulla Oblongata
This contains the centra, controlling breathing, heart rate, swallowing, etc.
- (ii) The Cerebrum or front part of the brain consists of two big cerebral hemispheres. The cerebrum contains the higher centres for consciousness, reasoning, memory, voluntary movements, vision, hearing, etc.

(iii) The Cerebellum

This has a corrugated surface and is divided into the left and right hemispheres and controls muscular co-ordination.

The cerebellum and the medulla oblongata form the rear part of the brain.

(iv) The middle part of the brain is the centre for the eye reflexes.

7.3. The Eye

Consists of:

- The eyeball
- The optic nerve
- Conjunctiva
- Lachrymatory system (tears)

7.4. The ear

Consists of three parts:

- (i) The external ear.
- (ii) The middle ear.
- (iii) The internal ear.

The external ear consists of:

- (i) The pinna is a conical organ and picks up sound waves.
- (ii) The external auditory meatus transmits sound waves to the tympanic membrane (eardrum) which divides the external and internal ear.

8. FATTY TISSUE

Fatty tissue is made up of special fibrinous cells containing large fat globules. The main component of animal fat is stearin, olein and palmitin. Body fat is derived from the intake of fats, carbohydrates and also protein.

The most common fatty acids are:

1. Palmitic acid.
2. Steoric acid.
3. Oleic acid.

In the live animal fat is soft but will harden quickly after death. It occurs sub-cutaneously, as well as around the heart and kidneys. Also in the pleura and peritoneum in the mesentery and in smaller amounts in the tissues and most organs in the body.

Fat is an energy reservoir of the body. It is a poor conductor of heat and will protect the body from heat loss. It also functions as an elastic cushion between organs. Well-fed animals contain some fat in the muscle – known as “marbling”.

Fat varies in composition, colour and distribution in different species of animals.

Cow	Yellow	Quite firm
Bull / heifer	White / Yellowish white	Firm
Calf	White / greyish white	Soft and gelatinous
Sheep	Very white	Very firm and brittle
Pigs	Yellowish white	Quite firm and oily
Horses	Yellow	Soft and oily never marbling

9. GENITAL SYSTEM

9.1. FEMALE GENITAL ORGANS

Consists of

1. Two (2) ovaries – reproductive “glands” producing ova.
2. The fallopian tubes conveying the ova to the uterus.
3. The uterus where the ovum will develop.
4. The vagina: connecting the uterus to the vulva.
5. The vulva: being the outer facet of the genitalia.
6. The udder – in essence a gland of the skin, but functional part of the reproductive system.

Cow uterus

1. Consists of a small body (25 mm) and two uterine horns, each approximately 37 cm long.
2. Double ridge at the base of the horns.
3. Cotyledons (100). During pregnancy up to 1125 mm x 12 mm in size with a spongy consistency.

Sow uterus

Body 5 cm in length, uterine horns very long and flexible.

9.2. THE MALE GENITAL ORGANS

1. Consists of

- a. Two testicles (testes) where spermatozoa are produced.
- b. Ductus deferens – tubes from the testicles.
- c. The vesicula seminalis.
- d. The prostate.
- e. The two bulbo-urethral glands.
- f. Urethra – a tube.
- g. The penis, which lies in the prepuce.

2. Wildebeest testicle

- a. Elongated oval shaped and weighs approximately 300g.
- b. Parenchyma – yellow in colour.
- c. Copious blood vessels.
- d. Epididymis – narrow and attached to the testis. The head is long and curves over the upper third of the testis.

3. Small antelope spp. testicle

- a. Similar to that of the bull but relatively much larger more pear-shaped and rounded (weighs approximately 280g).
- b. Fewer veins.

4. Pigs testicle

- a. Large and elliptical.
- b. Parenchyma – grey.
- c. Branched veins.
- d. Distinctly lobulated.
- e. Epididymis, poorly developed, cone shaped, on both sides of the testis.

10. THE LYMPHATIC SYSTEM

10.1. THE SPLEEN

It is part of the blood and lymph system and as such rich in blood and lymphatic tissue. It is an important organ with the following functions:

1. Removes foreign material including organisms causing disease as well as old blood cells out of the circulatory system.
2. Produces lymph cells and other blood cells.
3. Produces anti-bodies.
4. Reservoir for iron.
5. Reservoir for blood and maintains blood volume levels in the circulatory system.

10.2. LYMPHATIC SYSTEM

Mentor should concentrate on Schedule 2 lymph nodes (See control list for primary meat inspection).

This system is closely related to the circulatory system and consists of:

a. Lymph

A clear fluid similar to blood plasma, but more watery, due to lower protein content. This fluid is the eventual contact medium between blood and the tissue cells to:

- i. Transmit oxygen and nutrients to the tissue cells.
- ii. To remove metabolic by products from the tissue cells, filter it through lymph nodes and discharge it back into the bloodstream.

All body tissue cells are bathed in lymph fluid, which gather in small thin walled tubes known as lymph vessels that lead to lymph nodes.

b. Lymph Capillaries

They are thin walled vessels criss-crossing the tissues of the body drawing the lymph out of the tissues. There are two types:

- i. Afferent vessels transporting lymph from the tissues to their lymph nodes.
- ii. Efferent vessels transporting lymph from the lymph nodes to the bloodstream.

c. Lymph nodes

They are the filters of the lymphatic system, cleansing the lymph of any unwanted substances and are therefore very good indicators of pathology during meat inspection. They are oval to round in shape with a firm consistency enfolded by a strong capsule. When cut they appear moist. Colour may vary from grayish white to black red. They are usually much larger in younger animals.

When foreign particles or lymphocytes are "digested" by lymph nodes, it will cause an irritation if it is harmful. The reactions may vary, depending on circumstances, but can be identified by one or more of the following:

- (i) Swollen. Lymph nodes are larger and more vascularised (bloody).
- (ii) Bleeding may occur e.g. with African Swine Fever and Anthrax.
- (iii) Tissue destruction – e.g. abscess formation as seen in Tuberculosis. If the lymph nodes are unable to destroy the infectious agent it will end up in the blood stream causing septicaemia (Blood Poisoning).

Lymph nodes drain specific areas / organs and are therefore good indicators of pathology in its area of drainage. All lymph will pass through at least 1 lymph node on its way back to the blood, normally through several. The following Lymph nodes are important for meat inspection purposes:

(i) *Lymph nodes of the thorax*

Four lymph centra are found in the chest cavity:

- The Lc. thoracicum dorsales drain the chest wall on both sides (left and right).
- The Lc. thoracicum ventrales drain the chest wall.
- The Lc. Mediastinales drain the mediastinum and lungs.
- The Lc. Bronchiales drain the lungs and hart.

The Ln. thoracales dorsalis:

Two groups of lymph nodes belong to this centrum. They lie against the dorsal body wall below the vertebral column and are separated by the *sympathetic chain* :

- Lnn. Intercostales - situated near the costo condral junction of the ribs in the intercostal space.
- Lnn. Thoracici aortici - situated dorsal to the aorta.

Drainage area: Muscles of the shoulder, chest wall, back, diaphragm, heart, ribs thoracic vertebrae and sometimes the spleen.

Lymphocentrum thoracales ventrales:

These lymph nodes are found on the sternum and there is a cranial and caudal group:

- Lnn. Sternales craniales
- Lnn. Sternales caudales

Drainage area: Muscles of the chest, shoulder girdle muscles, abdominal muscles, ribs, oesophagus, trachea, diaphragm. In the Zebra, also the liver and in the sow, the thoracic mammae (teats).

Lymphocentrum mediastinales:

Three groups of Lnn. are distinguished:

- Lnn. Mediastinales craniales lie in the cranial mediastinum, near the entrance to the chest cavity - Occurs in all spp. In the Zebra there are 40 – 100 small lymph nodes spread throughout the mediastinum. In wildebeest there are a few Lnn. near the origin of the larger arteries of the heart.
- Lnn. mediastinales mediales - Found at the base of the heart to the right of the aortic arch, trachea and oesophagus.
- Lnn mediastinales caudales – In the caudal mediastinum, between the aorta and oesophagus.

In Zebra – may be absent.

In ruminants – quite large (up to 15 cm).

Drainage area: Sternum and ribs, inner muscles of the chest, diaphragm, heart, oesophagus and trachea.

Lymphocentrum Bronchiales:

Includes the following : Lnn. Tracheo-bronchiales sinistri, dextri and medii. In the ruminant and Pigs we also find the trachea bronchiales craniales at the origin of the bronchus trachealis. In the zebra we find a bunch of small lymph nodules

- Ln. tracheo bronchiales sinistra – lies cranial to the left bronchus and is present in all animals.
- Ln. tracheo bronchiales dexter – lies cranial to the right bronchus.

Wildebeest – only in approximately 75% of animals and in small antelope spp. – absent.

(ii) The lymphatic system of the abdomen

The dorsal abdominal wall and the abdominal viscera has four lymph centra:

Lympho centra:

- a. lumbar
- b. celiacum
- c. mesentericum cranialis
- d. mesentericum caudalis

Each centrum has various Lnn. draining a specific area.

Most organs have their own lymph nodes and they lie next to the major blood vessels of the particular organ.

Efferent of the four centra drain into the lumbar duct (next to the aorta) or into the cisterna chyli.

Lymphocentrum lumbales

These Lnn. lies next to the abdominal aorta and includes the renal Lnn.

Drainage area: Kidneys, adrenal gland, lumbar vertebrae, lumbar muscles, testes / ovaria.

Lymphocentrum celiacum

This centrum includes the following Lnn:

- *Lnn. gastrici* lies next to the branches of the A. gastrica sinistra on the inner curvature of the stomach.

These Lnn. should be incised with meat inspection in Zebra and Pigs.

- *Lnn. portales* (hepatici) lies at the porta hepatis. Must be incised during meat inspection.
- *Lnn. lienalis*: In ruminants these Lnn. drain the lymph of the fore stomachs. The portal Lnn. drains the abomasum. These Lnn. must be incised during meat inspection and are situated between the atrium ruminis and the left leg of the diaphragm on the cranio-dorsal edge of the spleen.

Efferent drain into the Cisterna chyli

Lymphocentrum mesentericum craniales

This centrum includes the jejunal, colonic and caecal Lnn. The Lnn. jejunales is by far the most important Lnn. in this group and is important during meat inspection. In the Zebra the Lnn. jejunales lies close to the origin of the jejunal blood vessels. In Wildebeest they form a chain between the jejunum and last turn of the spiral. In Small antelope spp. they lie between the last centrifugal and first centripetal turn of the spiral. In the Pigs they form a chain next to the jejunal blood vessels.

Efferent drain into the Cysterna chili.

Lymphocentrum mesentericum caudalis

Lnn. belonging to this centrum lie next to the branches of the A. mesenterica caudalis in the mesocolon, must be incised in meat inspection and TB suspected or TB positive animals. Efferent lymph vessels join with the Lnn. iliaci mediales as well as with mesentericum craniale and eventually with the Cisterna chyli or with the lumbar tubes.

- *The Cysterna chyli*

The cysterna lies to the right and dorsal to the Aorta, between the origin of the diaphragmatic crura. Caudally it receives *Trunci lumbales* and cranially it is continued as the *Ductus thoracicus*. The rhythmic pulsation of the aorta probably enhances the flow of lymph in these tubes.

(iii) Lymph drainage of the pelvis:

- (a) The testes are drained by the Lumbar Lnn. and not by the Lnn inguinales superficiales.
- (b) The Lnn. iliaci mediales drains the pelvis and hind leg.
- (c) The Ln. ischiadicus in Wildebeest is incised during meat inspection because some lymph from the hind leg is drained through it.
- (d) The Ln. inguinalis superficialis (mammarius) in the cow drains not only the udder but also the vulva. Malignant tumours in the vulva area can metastasise (spread) to these Lnn.
- (e) The anorectal Lnn. of the Zebra drains the anus, perineum and tail. Tumours in this area may involve this Lnn. and it should be inspected.

(iv) Lymph drainage of the head

- (a) Ln. parotideus : In the Zebra it is embedded in the posterior edge of the salivary gland ventral to the mandibular joint. In antelope spp. it is large and must be incised during meat inspection.

Drainage area: Sinuses of head, eye, ear, lips and superficial muscles of the dorsal and nostril areas. Drain mainly the caudal areas of the head.

Efferent to the Lnn. retropharyngei

- (b) Lnn. mandibulares : In the Zebra they lie in the V between the jaws. In other animals at the curvature of the jaw. Palpable in all animals.

Drainage area : Much of the lymph from the nasal area, hard palate, tongues and jaws as well as facial and masticatory muscles. It drains mainly the nostril areas of the head.

Efferents drain to the Lnn. retropharyngi and to the Lnn. cervicales profundi craniales.

- (c) Lnn. retropharyngi lateralis : In the Zebra they form a chain of small Lnn. next to the A carotis externa. They lie medially to the caudal aspect of the mandibular salivary gland. These Lnn. often form abscesses.

In Wildebeest it is a large Ln. lying cranio-ventral to the wing of the atlas and covered by the edge of the mandibular salivary gland.

Drainage area: Deeper parts of the head. In ruminants all the lymph from the head passes through these Ln.

Efferent Lnn. retropharyngi mediales or Lnn. cervicales profundi craniales or truncus trachealis.

- (d) Lnn. retropharyngi mediales -

In all species they lie on the pharynx.

Drainage area - Receives virtually all the lymph from the head, except in Wildebeest where it flows through the Ln. retropharyngeus lateralis.

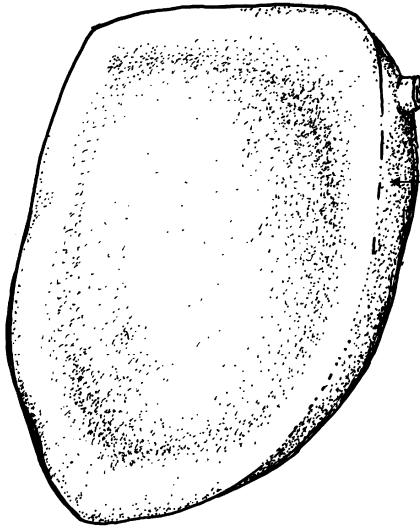
Efferent eventually from the Truncus trachealis.

- (e) Lnn. Cervicales profundi : We find cranial, middle and caudal groups. They lie next to the trachea from the thyroid gland up to the first rib. Cranial and medial groups often absent in smaller antelope spp.

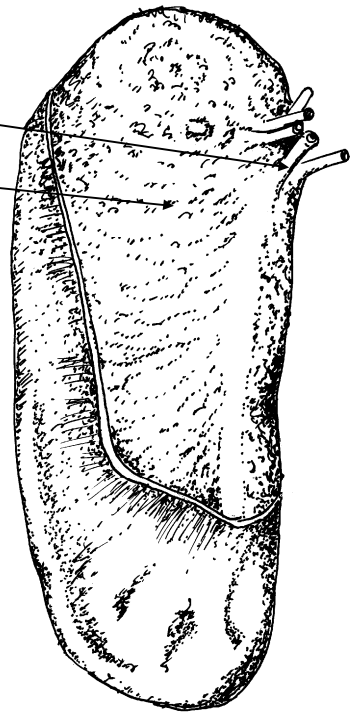
Efferent drains into the Truncus trachealis.

COMPARATIVE ANATOMY OF THE SPLEEN

CATEGORY C



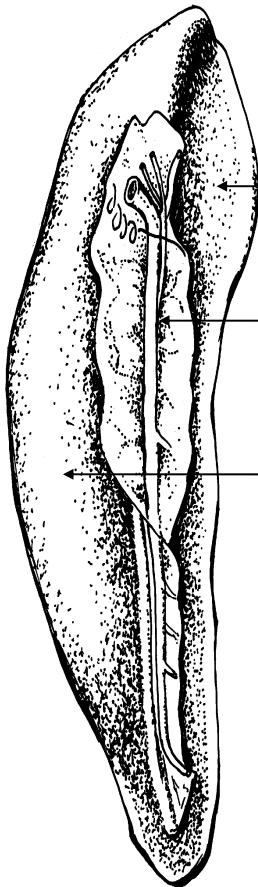
CATEGORY B



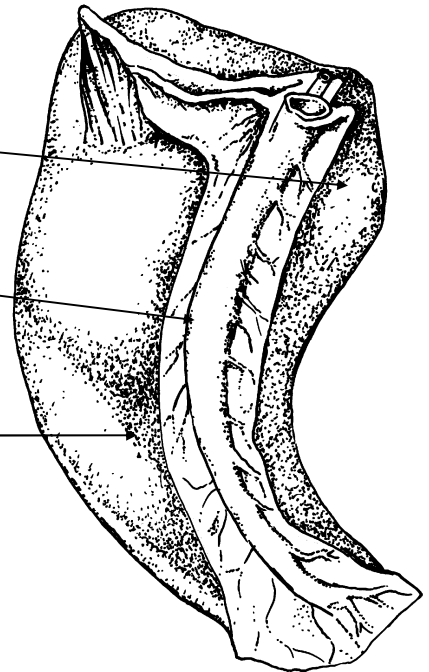
HILUS

FACIES GASTRICA
(VERGROEIING MET
RUMEN)
(ADHESION TO
RUMEN)

PIG



ZEBRA

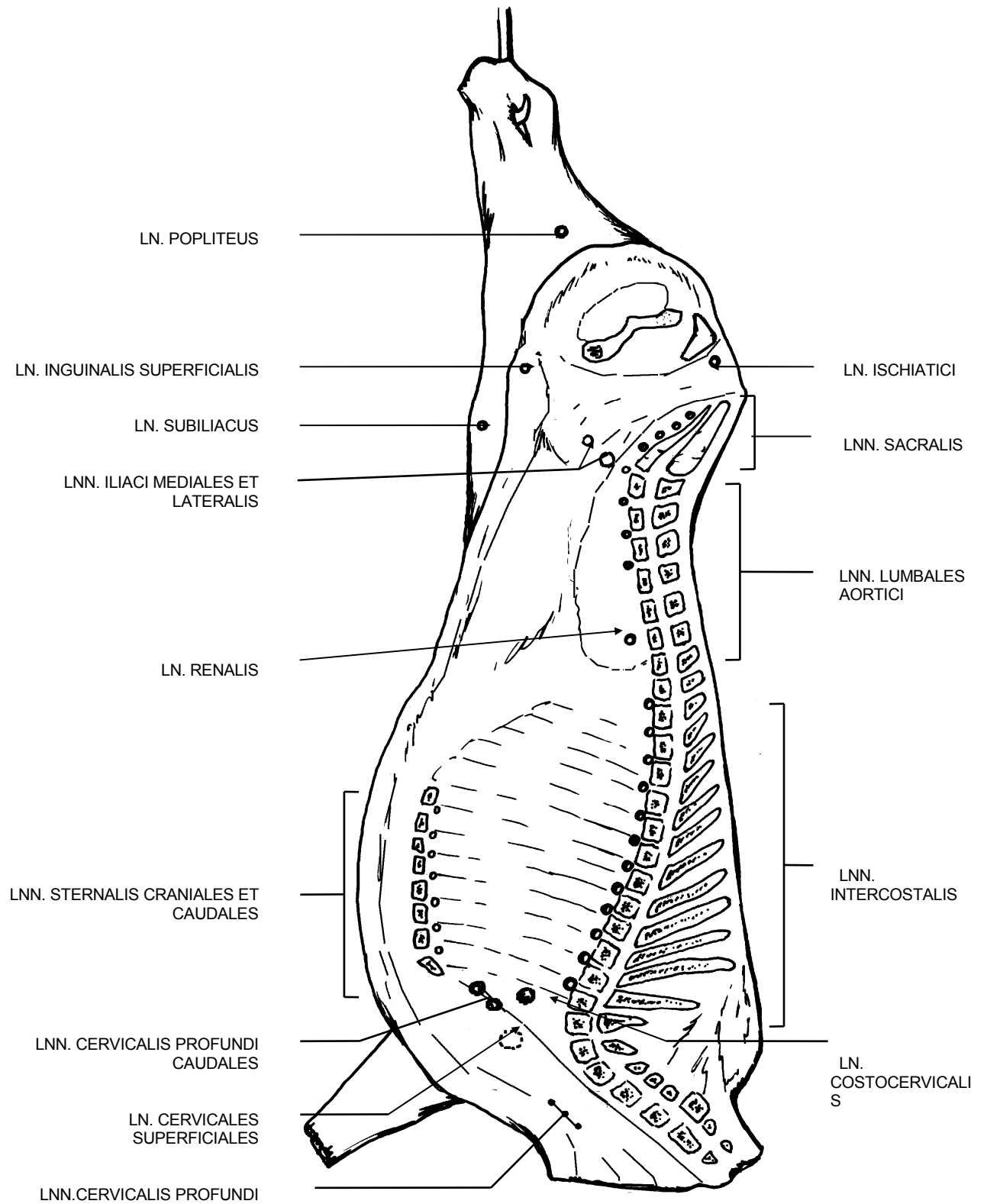


FACIES GASTRICA

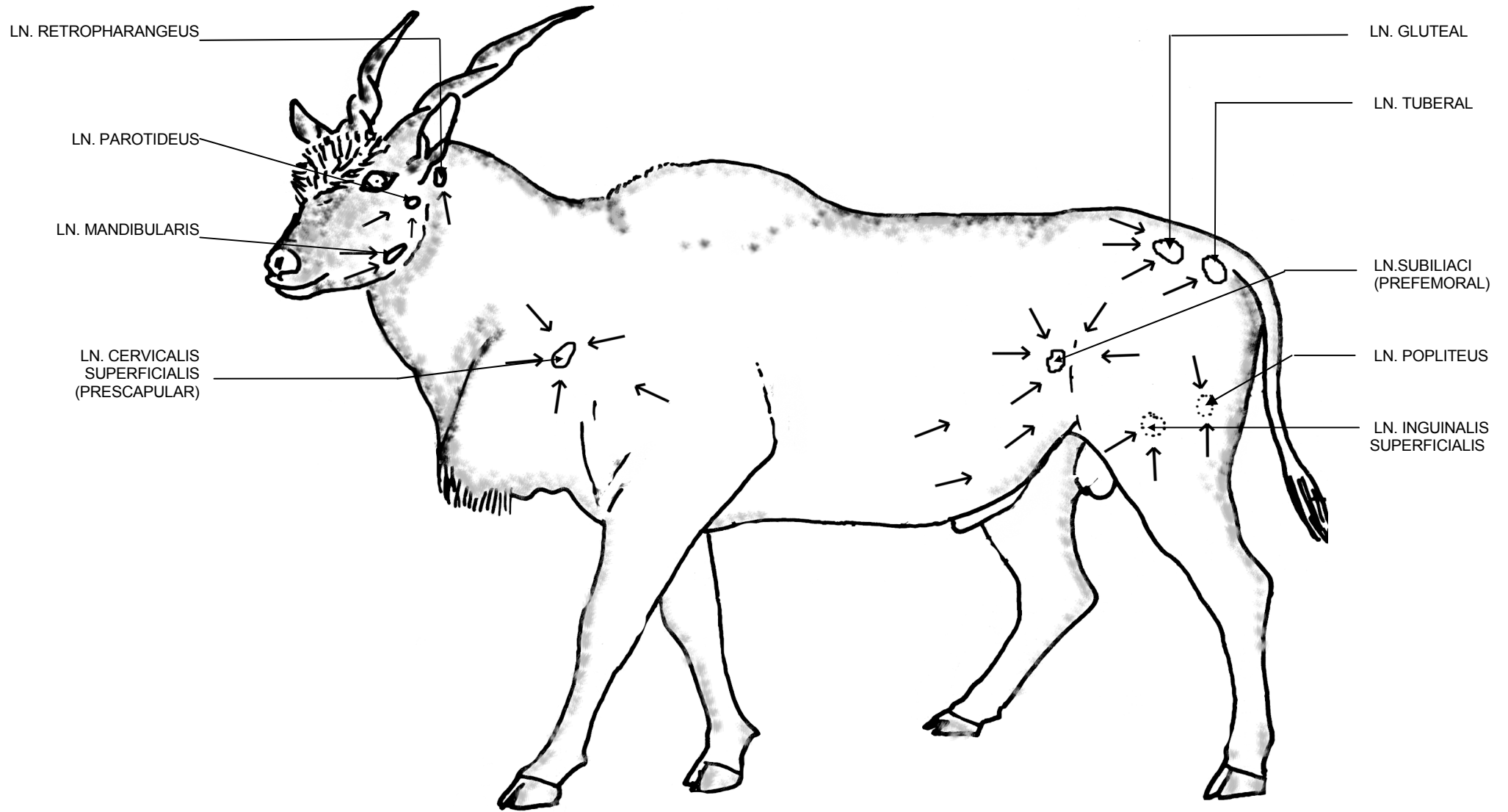
HILUS

FACIES INTESTINALIS

INTERAL LIMFSYSTEM



SUPERFICIAL LYMPH SYSTEM



11. GLANDS OF THE BODY

11.1 Pituitary gland (hypophysis)

Situated at the base of the brain. It produces hormones that stimulate bone growth, the udder, ovaries and testes as well as the muscles of the uterus.

11.2 Thyroid

Consists of 2 lobes either side of the side of the trachea. It produces 3 hormones including thyroxin, which increases metabolic activity. In young animals it stimulates growth.

11.3 Thymus

Consists of two lobes and extends from the heart up to the neck on either side of the trachea. Large in young animals but atrophies with age. It stimulates the development of the immune system but up to now no hormones have been isolated from the Thymus.

11.4 Adrenaline glands

Situated in the immediate proximity of the kidneys. Consists of a cortex and medulla. The medulla produces adrenaline, which has wide effect in the body including glycogen metabolism and the formation of lactic acid in the muscles. Factors such as excitement, stress and pain cause secretion of adrenaline resulting in reduced levels of muscle glycogen. Known as the "fight or flight reflex". Cortisone is produced in the cortex of the adrenals and has a anti-inflammatory effect.

11.5 Pancreas

Produces insulin, which regulates blood sugar levels as well as tripsin and pepsin, the enzymes for digestion.

**MEAT INSPECTORS MANUAL
GAME**

**PART II
MEAT INSPECTION**

MODULE 4

PATHOLOGY

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GENERAL PATHOLOGY

1. DESCRIPTIONS

ABSCCESS

A localised, encapsulated collection of pus in a cavity formed by disintegrating tissue. In size abscesses may vary from microscopic to almost unlimited dimensions. Pus is a collection of dead disintegrating tissue cells and the body's own inflammatory cells. The general appearance of pus can be described as viscous, cream coloured fluid. Inspissated pus has a dry cottage cheese appearance.

Causes

Invasion of tissue by bacteria, fungi, protozoa and even helminths.
 Poor hygiene technique during injection procedures (leg muscles).
 Penetrating wounds.
 Pyemia (pus forming bacteria in the blood)
 Pyogenic bacteria – *Corynebacterium* and *Pseudomonas* spp.

Judgement

A single abscess may be removed if no further spread of infection or contamination with pus to the rest of the carcass can be determined.
 In case of multiple abscessation in various organs – total carcass condemnation.

ANAEMIA

Is a condition where the quantity of red blood cells in a given volume of blood is less than normal (quantitative) or a deficiency of haemoglobin in the red blood cells (qualitative) exists. Clinically it is recognised as weakness, exercise intolerance and paleness of the mucosae.

Causes

Regenerative:

Post Haemorrhagic

- trauma (cuts)
- haemorrhagic enteritis
- haemolytic – breakdown of red blood cells by bacterial toxins, parasites etc. (redwater – Babesiosis or Gallsickness – Anaplasmosis)

Non regenerative:

Nutritional

- deficiency in protein and minerals (chronic emaciation, cachexia)

Aplastic

- suppression of red blood cells synthesis in the bone marrow.

Judgement

Depends on severity or cause. Condemn in case of an infectious disease or extreme anaemia.

ARTHRITIS / ARTHROSIS

Arthritis – Inflammation of the joint (suffix–itis) and arthrosis degeneration of the joint (suffix – osis). Inflammation results in conformation changes of articular cartilage. Usually occurs in joints where weight bearing is the greatest or where there are abnormal movements.

Causes

- Bacterial – haematogenous spread (by blood). (septicaemia, bacteremia)
 – penetrating wounds, faulty transport.
 – from surrounding infected tissue (osteomyelitis, hoof abscess)

Abnormal weight bearing and conformation of joints.

Judgement

Judgement will be determined by the extent of the lesions, and the condition of the animal. Conditional or total condemnation may be done.

BACTERAEMIA

The presence of bacteria in the bloodstream that may give rise to septicaemia and pyemia.

BRUISING

Discoloration and actual haemorrhage at the site of injury. In the first 12 hours after injury the bruise is bright red, at 24 hours it is dark red, at 24–36 hours it loses its firm consistency and becomes watery and at 3 or more days it is an orange – red colour and has a soapy feel. This is one of the most common conditions seen during meat inspection and is a serious disadvantage in the meat trade.

Causes

- Trauma – during incorrect transport
 – improper handling
 – stay in inadequate lairages

Judgement

Bruising should in all cases be removed and special attention should be given to deeper damage that may not be very prominent. Extensive bruising could merit the total condemnation of the carcass.

EMACIATION

A profound and marked state of constitutional disorder; general ill health and malnutrition.

Advanced and generalised atrophy of skeletal muscle and certain organs with associated serous atrophy of fat deposits, often associated with oedema. The animal may also be anaemic. The kidney fat diminishes. The heart may lose all of its fatty tissue and the ventricles also tend to become thin.

Cause

Malnutrition
 Chronic debilitated animals
 verminosis

Judgement

Total condemnation of the whole carcass.

CACEXIA

The above process will also happen when an animal become acutely sick and it stops eating. The difference however is that the fat becomes jelly-like and will not coagulate during chilling in this case however the animal is acutely sick with sometimes signs of fever but sometimes not.

This condition is more dangerous because the animal may harbour micro organisms in the blood stream that may be harmful to the consumer

Cause

Bacteria, viruses

Judgement

Total condemnation of the whole carcass.

CALCIFICATION

Chronic lesions often become calcified. – It is the deposition of calcium (lime) salts in dead and degenerating tissues – also known as dystrophic calcification.

Parasitic infections and Tuberculosis lesions when they occur in the animal, show a marked tendency to undergo calcification. Calcification of the brisket occurs after degeneration of the fat due to pressure (animal resting on hard surfaces)

Judgement

Removal and condemnation of the affected parts if localised. If widespread condemn whole carcass. Condemnation due to aesthetic reasons.

CASEATION

This degenerative change is manifested by the conversion of firm, dry necrotic tissue into a cheesy, pasty mass composed of fine fat droplets and protein.

Where the defensive mechanism of the body is adequate the caseated material tends to become encapsulated, and eventually calcified. Diagnostic of TB

CIRRHOSIS/ FIBROSIS

Pathology of the liver whereby the normal lobular architecture is damaged and replaced with fibrous strands of connective tissue. This connective tissue can constrict and partition the organ into irregular nodules. The liver often has a lighter colour with a distinctive cobblestone appearance on the surface (hobnail liver)

Causes

Chronic heart failure
Bile duct inflammation – migrating parasites
Toxicosis – poisonous plants
Chronic inflammation

Judgement

Condemnation of the liver with careful examination of the rest of the carcass.

DEGENERATION

Damage to cells leading to reversible changes. It is a dynamic process where tissue changes are to a lower or less functional / active state. Organs with degenerative changes may have a parboiled appearance and are slightly swollen and have lost their healthy looking appearance.

Fatty changes are intracellular accumulation of fat and is a degenerative process (fatty degeneration). it is mostly seen in the:

- Liver – light brown colour and soft / friable / crumbly.
- Kidneys – slightly swollen, light brown colour.
- Myocardium – light dull brown colour.

Causes

- Hypoxia – insufficient oxygen supply to the tissues
- Toxic – plant toxins, mycotoxins and chemical toxins
- Metabolic – stress related causes

Judgement

Condemnation of affected organ or muscle group.

EMPHYSEMA

A pathological accumulation of air in tissues. This can be seen as air bubbles between the muscle fibres, or under the skin or in the lung tissue. When palpated the affected areas has a “crackling” like consistency.

Causes

- Trauma – penetration through sharp wounds, rupture of the alveoli.
- Bacterial – gas producing organisms (E coli, Clostridia)-black quarter (sponssiekte) in cattle.

Judgement

Affected areas are condemned due to aesthetic reasons. If it is due to an infectious cause with systemic or generalised lesions, total condemnation of the carcass is suggested.

ENTERITIS

Inflammation of the intestinal mucosa resulting in clinical signs of diarrhea, sometimes dysentery, abdominal pain and dehydration coupled with electrolyte loss / imbalance. The intestines are usually very red, inflamed and swollen. The contents may be catarrhal to haemorrhagic. Enteritis is most commonly seen in young animals less than three months of age.

Causes

1. *Poisoning*. Either plants or minerals. There are large numbers of these, which irritate the bowel and cause enteritis.
2. *Stress*. When animals are subjected to stress factors, their resistance is lowered and normal germs in the intestines that otherwise would not cause any harm, attack the membrane of the intestines and cause inflammation, and possibly even septicaemia. Such stress factors include transportation, strange holding pens, mixing with strange animals, cruelty, starvation, thirst, etc.
3. *Contagious diseases*. Many diseases cause a serious inflammation of the bowels - diseases such as Paratyphoid, Swine Fever, Anthrax, Colibacillosis, Johne's disease, etc.
4. *Worms*. Especially in sheep and young animals many parasites cause injury and irritation

during their life cycles.

5. *Dietary changes* : Young animals are especially prone to develop enteritis especially due to changes of diet. This dietetic enteritis is in itself not serious but due to irritation of the bowel, germs often penetrate the damaged intestinal wall and cause septicaemia.

Enteritis like most inflammations may be either acute or chronic. In arsenical poisoning for example the inflammation is usually so severe as to cause massive haemorrhage in the bowels, whereas in Johne's disease the intestinal wall becomes thickened due to chronic inflammation.

Judgement

There are so many factors to be taken into account in judging a carcass with enteritis that it is not always easy. In general if only the intestine is affected and the rest of the carcass is normal, only the intestines are condemned. If, however, the enteritis is coupled with general disease signs such as fever, enlargement of the lymph glands, hepatitis or nephritis etc., then the whole carcass is condemned.

FATTY DEGENERATION

Is a condition in which globules of fat become deposited in the cells of a tissue. It is commonly found in the liver, kidneys, heart, and muscles-which have sustained serious injury. It is known to follow mild inflammations when it is usually preceded by a condition known as cloudy swelling, and it is also very often seen in organs from animals which have been affected with chronic tuberculosis and glanders. Certain poisonous substances such as arsenic and phosphorous also bring about fatty degeneration when ingested for long periods in considerable doses.

FATTY INFILTRATION

Is found in fat animals with fat accumulation around the kidneys and in the mesentery, which shows up as white areas as if small pieces of chalk have been strewn therein. This condition is not of any pathological consequence and is caused by crystals of fatty acids.

FEVER

Fever is an abnormally high body temperature. It is a cardinal sign of acute inflammation caused by a noxious agent. Other signs of inflammation are redness, swelling, pain and loss of function.

Causes

Infectious agents – viruses, bacteria, fungi, protozoa, parasites.
Chemical and physical trauma

During a post mortem inspection, certain changes in the carcass will give an indication that the animal live, was suffering from a fever

1. An abnormal redness of the carcass
2. Meat darker than usual
3. Blood filled intercostal blood vessel and peritoneal capillaries
4. The onset of rigor-mortis is more rapid
5. Blood vessels generally are more injected with blood
6. Poor bleeding out

Judgement

Due to the possibility of underlying disease and the fact that the high level of blood in the meat reduces shelf life drastically, total condemnation of the carcass is suggested.

GANGRENE

The death of body tissue (necrosis), generally in considerable mass, usually associated with loss of vascular supply and followed by bacterial invasion and putrefaction. It occurs most frequently in tissues susceptible to contamination, e.g. skin, lungs, intestine, vagina, uterus and those in penetrating wounds. Although it usually affects the extremities, gangrene sometimes may involve the internal organs. Signs are fever, pain, darkening of the skin, and an unpleasant odour of the affected site.

Two forms are known: dry and wet (gas).

- Dry gangrene – little to no blood supply to the area, lesions are dry, light brown in colour and have a leathery appearance.
- Gas or wet – Anaerobic spore forming bacteria (Clostridia) form gas. Lesions which are gas filled may also contain blood tinged serum. Putrefaction of necrotic tissue causes foul smelling – colour is purple-green-brown to black colour.

Causes

- Mainly poor blood supply (hypoxia) – Freezing, snares etc.
 - Foreign body drawn into the lungs
 - Torsion of organs
 - Contaminated wounds

Judgement

Unless the gangrene is very localised and there is no evidence of toxæmia the carcass and offal is rejected.

HEPATITIS

Inflammation of the liver. If severe there can be liver dysfunction. On inspection the liver may be swollen, with rounded borders.

Causes

- Infections – viruses, bacteria, parasites.
- Toxins – plant or chemical toxins.

Judgement

Condemnation of the liver with careful scrutinising of the rest of the carcass for signs of associated pathology.

HYDRONEPHROSIS

Caused by the mechanical obstruction to the flow of urine along the ureters. Common in pig but seen in all animals. The ureter and pelvis of the kidney are dilated and urinary pressure may lead to eventual obliteration of the kidney tissue, with the formation of a large thin-walled cyst containing urine.

HYPOSTATIC STAINING (Hypostasis)

Animals that are sick or dying and lying down for some time may suffer from poor or stagnant circulation in parts of the body or organs nearest to the ground. This is usually seen as an affect of gravity and is more pronounced in large animals. The lungs and thoracic abdominal peritoneum nearest to the ground, will be engorged with blood and stained red.

Causes

Gravity induced in animals where the blood circulation is extremely poor or non-existent.

Judgement

Carcass condemnation as the animal was moribund (dying) or dead before slaughter.

ICTERUS

Icterus is the yellow discoloration of tissues (notably white tissue - e.g. membranes, serous surfaces, cartilage, fat as well as the endothelial lining of blood vessels) by an excess of bilirubin, a pigment derived from red blood cell breakdown (destruction) in the blood.

Causes

Haemolytic - Severe haemolysis (break down) of red-blood cells due to chemical, toxic or physical causes as well as blood parasites (Babesia or Anaplasmosis) gives rise to excessive production of bilirubin in the blood stream.

Obstructive - Parasites or other obstructions, usually of the bile ducts, cause damage to the liver impairing its ability to remove bilirubin from the blood.

Hepatic disease - excessive liver damage from disease or parasites resulting in the inability of the liver to remove these pigments from the blood.

Judgement

Condemnation due to aesthetic reasons. Feed or plants with a high carotene content may cause animals to have very yellow fat. This yellow fat is normal and must be distinguished from the yellow fat caused by icterus. The phase test can be used to differentiate.

INCOMPLETE BLEEDING

Incomplete bleeding can be caused by stress, disease conditions & ineffective stunning techniques (stun time too long or short, the stun to bleeding time too long) or an ineffective bleeding cut (throat cut or thoracic "sticking").

All the visible blood vessels may be blood filled causing the carcass to have an overall darker red colour. This is also true for organs such as the liver which may be dark purple-red in colour.

Judgement

Meat from such a carcass will have poor lasting qualities and is condemned.

IMMATURITY

The Standing Regulations prescribe that no person shall slaughter a calf, lamb, kid, pig or any other animal unless it is at least 21 days old and is in a well-nourished condition. Meat of very young animals is less valuable because (a) water content is high, (b) there is very little fat and (c) there is more bone than meat. Signs of immaturity include:

- (a) *Meat*
- (i) Watery, soft can be torn with the fingers
 - (ii) Greyish pink
 - (iii) Muscle development is weak. Jelly between muscles
 - (iv) Little or no fat round kidney, plus Oedema.

- (b) *Animal (calves)*
- (i) Eight teeth not all at same height
 - (ii) Navel cord still attached.

INFARCTS

Usually seen in kidneys. Cone-shaped, yellow or white areas of necrosis. Base of cone on the surface of organ and slightly raised. Apex of cone extends into tissue. The cause of infarction is obstruction of capillaries and starvation of the cells and tissue area serviced by those capillaries resulting in the death of the cells and tissue in a conical shaped area. The term “embolism” is also associated with this condition. This can also be seen in Lumpy skin disease and “Diamond skin disease” of pigs.

INFLAMMATION

Inflammation is a localized protective response, which serves to destroy, dilute or wall off (isolate) both the injurious agent and the injured tissues. Inflammation is both a cellular and vascular response. The classic signs of inflammation are heat, redness, swelling, pain and loss of function.

There are three major components of this process:

1. Changes in the calibre of blood vessels and the rate of flow through them.
2. Increased capillary permeability.
3. Leucocytic exudation.

An inflammatory lesion is indicated by the suffix- “itis” e.g. Hepatitis or tonsillitis.

Causes

Physical damage	– injuries
Thermal	– heat or cold, radiation (sun burn) etc
Chemical agents	– caustic agents, toxins etc.
Biological agents	– bacteria, viruses, protozoa, parasites e.g.

The inflammatory changes seen have one or more of the following characteristics:

- Discolouration** – When the injury occurs, small blood vessels relax and more blood flows to the area, giving a red appearance.
- Heat** – Due to increased blood flow the area becomes warmer than the surrounding tissues.
- Swelling** – Increased blood flow and relaxation of the blood vessels in the inflamed area, allows more fluid to escape from the blood vessels into the surrounding tissues causing swelling.
- Pain** – Due to above mentioned processes nerve endings are irritated, pressure is brought to bear on nerves and also chemicals are released by the system which evoke pain.
- Lack of function** – Pressure on organs, nerves and blood supply may cause temporary and in severe cases, permanent loss of function of an organ. For instance swelling may cause a gland to stop secreting as ducts from the gland is blocked. General impairment of the body's function in the effected areas can be experienced.

Inflammation can be classified as acute or chronic:

In **acute inflammation**, the typical symptoms of redness, swelling, heat, pain and loss of function

are severe.

In **chronic inflammation** a great deal of connective tissue has been deposited, manifested by adhesions and hardening of organs as in chronic inflammation of the liver or also known as cirrhosis of the liver.

Judgement

Condemnation of the affected organs or tissue. Total condemnation if the inflammatory response is wide spread through the whole body.

MASTITIS

Inflammation of the udder, more often seen in dairy cows. The udder is swollen, hot and painful to the touch and changes are noted in the normal colour and consistency. The milk usually contains small lumps, which can be seen when the milk is drained through a sieve. Mastitis can occur in **chronic** as well as **acute** forms which may be gangrenous and involve systemic changes.

Cause

Primary as well as secondary infections involving:-

Bacteria

Fungi

Yeasts

Judgement

In chronic cases the udder is removed and condemned. As chronic mastitis is not easily identified on the slaughter floor, it may be assumed that all adult udders, which have lactated, may be infected and should as a rule be condemned. Bear in mind that an udder with any grade of infection constitutes a source of contamination through exuding milk and fluids. Acute or gangrenous mastitis warrants the condemnation of the whole carcass if systemic changes are indicated or the lymph nodes indicate spreading of the infection.

METASTASIS

This is the transfer of disease from one organ or part to another not directly connected with it. It may be due either to the transfer of pathogenic (disease causing) bacteria or of abnormal cells, as in malignant tumours.

Causes

Pathogenic bacteria.

Fungi or foreign material.

Emboli of tumour cells.

Judgement

Condemnation of the affected part or whole carcass (abscessation)

MEAT ODOURS

Each species has a natural distinctive smell, which in male animals, especially billy goats and boars are very strong. Other unnatural odours may be caused by feed or foreign substances or systemic reasons.

Causes

- Feed ingredients – Fishmeal, sojameal, other plants (Karoo succulents).
- Medications – Turpentine, iodoform.
- Metabolism – Abnormal metabolism – acetomia.
- Environment – Paint, insecticides, decomposing matter, freezer burn etc. will affect stored meat.

Judgement

- Detainment of carcass for 24 hours – Aesthetic reasons condemn or pass.
- Medications – Condemn. (Withdrawal periods not adhered to).
- Test procedures – Detain the carcass or meat for 24 hours. Boil a piece including some fat and test if smell or taste are still present and objectionable.

MEAT OF UNBORN ANIMALS

Not for human consumption because

- (a) aesthetic reasons;
- (b) could carry infection, e.g. C A;
- (c) very watery.

The unborn foetus has:

- (a) Shiny wet skin, yellow hooves, not worn;
- (b) navel is open, with large blood vessels;
- (c) lung is solid - sinks in water (Atalectasis).

MELANOSIS

Melanin is a natural pigment, which occurs in the skin, hair, nails and membranes. The excessive abnormal deposition of Melanin in a carcass is called Melanosis. It is most common in the lungs where it should be distinguished from anthracosis, which is an abnormal accumulation of dark carbon pigment (smoke).

There are two types of conditions, which involves an excess of melanin:

- Melanoma – a benign deposition of melanin in an organ or part of the body.
- Melanosarcoma – a malignant tumour which undergoes metastasis to other parts of the body

Judgement

Organs with an excess of melanin can be condemned for aesthetic reasons.

METRITIS

Inflammation of the uterus caused by a bacterial infection.

Judgement

Carcasses are condemned if it is affected with acute metritis which is associated with septicaemia or toxaemia. In chronic cases where no toxaemic signs are present, the carcass may be passed after being detained and a thorough secondary inspection done.

MYOPATHY

It is any disease or pathological process that causes changes to the muscle fibers such as degeneration, necrosis, hypertrophy, atrophy, and fibrosis. The muscles may show distinctive changes in colour i.e. chicken flesh coloured areas in red meats or steaks or white calcified areas. The muscle fibers may also be very swollen accompanied with various discolouration of red to black or excessive infiltration of fibrous connective tissue in a chronic process.

Causes

Capture Myopathy / trauma – Excessive or poor handling on the farm.
 Nutritional – Vit E / Selenium deficiency (chicken flesh colour)

Judgement

Affected areas should be carefully evaluated and severely affected carcasses totally condemned due to aesthetic reasons. Smaller areas can be trimmed.

NECROSIS

Necrosis is the death of cells while the body as a whole is still alive. Cells are irreversibly damaged. Normal tissue is shiny and translucent while dead tissues become dull, opaque with a loss of colour and is usually sunken from the surrounding tissue.

Causes

Infection – certain pathogenic bacteria and viruses.
 Disturbance of blood supply – thrombus, pressure
 Pressure – over extended period of time (sternum necrosis in cattle)
 Toxins – organic / inorganic
 Trauma – injuries etc.
 Thermal – excessive heat or cold (cooking or frost bite).
 Interference with a nerve supply – due to injury, pressure etc.

Judgement

Condemnation of the affected part or total condemnation if pathogenic or zoonotic organisms are involved.

NEPHRITIS

Infection of the kidneys causing swelling and bulging and red discoloration of the organ.

Cause

Disease – Bacteria, fungi, viruses

Judgement

Will depend on level of infection and whether the carcass is uraemic or otherwise affected.

NEPHROSIS

Due to blockages, enlarged water filled areas (cysts) form within the kidney. This condition is not necessarily associated with infection and the unaffected parts of the kidney may appear and function normally.

Cause

Build up of urate crystals causing damage to the organ.

Judgement

Will depend on complications affecting the rest of the carcass. E.g. Pulpy kidney

NEOPLASM (TUMOUR)

The term is derived from a Latin word meaning “new growth” or “new formation”. A neoplasm is an abnormal mass of tissue, the growth of which exceeds and is uncoordinated with that of normal tissues. It persists in the same excessive manner after the cessation of the stimuli which evoked the cause.

Tumours are either malignant or benign. Malignant tumours grow quickly and expansively and infiltrate the surrounding tissue usually causing severe damage. They may undergo metastasis. Benign tumours like warts usually stay in one area and may disappear after time.

Types of tumours:

- Adenoma – growing in connection with a gland.
- Angioma – formed by a mass of small blood vessels, or spaces in which blood or lymph circulates.
- Chondroma – mainly composed of cartilage.
- Osteoma – mainly composed of bone etc.

Causes

- Toxins – Industrial, plant, organic / inorganic.
- Viruses

Judgement

Trim or condemn affected part due to aesthetic reasons. If wide spread (metastatic), total condemnation.

OEDEMA

An excessive accumulation of fluids in the intercellular spaces and body cavities

- | | |
|---|--------------------------------|
| Accumulation of fluid in the thoracic cavity - | hydrothorax |
| Accumulation of fluid in the abdominal cavity - | ascites |
| Accumulation of fluid in the intercellular subcutaneous tissues - | anasarca |
| Accumulation of fluid in the pericardium - | hydropericardium |
| Accumulation of fluid in the kidney - | hydronephrosis (Cystic kidney) |

Causes

1. Malnutrition
2. Internal parasites e.g. worms
3. Heart failure in all species
4. Liver cirrhosis (excessive connective tissue laid down in liver—common with chronic abuse of alcohol in man)
5. Chronic nephritis
6. Infectious diseases like pulpy kidney in sheep and horse sickness, etc.
7. Anaemia

Tests for oedema

The alcohol flotation test on bone marrow determines the percentage of water in the bone marrow.

Judgement

Depending on the cause—partial or total condemnation.

OMPHALOPHLEBITIS

Inflammation of the umbilical vein, and is commonly present in the early stages of navel ill.

OVERSTICKING

In-sticking, back-bleeding. Caused when slashing of the heart or severance of blood vessels of the thorax when sticking pigs. A clot of blood forms in the thorax, staining the tissues, and necessitating the removal of the parietal pleura.

PERICARDITIS

This is an inflammatory process around the pericardium. It can be thickened or be covered with a cream, fibrous membrane indicating an infectious process. In severe cases the pericardium may be adhere to the heart and interfere with the function.

Causes

Infections – bacterial, fungi, viruses.
Mechanical – migration of wire or metal, and other sharp objects from the stomach.

Judgement

Total condemnation, as this may be an indication of a Septicaemia. Condemnation of the organs (heart, liver intestines) if only a localised process.

PERITONITIS

An inflammatory process of the membrane of the abdomen (peritoneum). In early stages it may just be red. Depending on the cause, floccules of pus or adhesions between the organs and the abdominal wall may be evident or an accumulation of oedema may be present.

Causes

Infections – bacterial fungi.
Trauma – penetrating wounds or objects (from the stomach)
Spread from other inflammatory processes – (pericarditis)

Judgement

Total condemnation of the carcass if it is septicaemic.

PETECHIA, ECHIMOSIS, SUGGILATIONS

These are descriptive terms for haemorrhages seen on surfaces of the body or organs. Petechia are the smallest pin point haemorrhages < 1mm. Echinosis are larger. Suggilations are large areas which look as if it has been painted. They can all be seen sometimes in or on one surface.

Causes

Trauma, necrosis of blood-vessel walls, rupture of blood-vessel walls, hipotention, increased permeability of blood-vessel endothelium, interference with the coagulation process.

Judgement

Depending on the cause and other changes of the carcass partial or total condemnation (viraemia).

PLEURITIS

Inflammation of the inner lining of the thoracic cavity (pleura). Acute or chronic as in peritonitis

POORNESS

The animal becomes emaciated due to lack of sufficient food (winter or drought). Body fat will disappear. Muscles and fat around the kidneys is initially firm (not watery). May develop cachexia (in extreme cases—condemn)

PURULENT

It is a process characterised by pus. Pus is a creamy yellow white liquid that may be thin or very thick. It is an accumulation of neutrophilic polymorphonuclear / granulocytes.

Causes

Bacteria – Pseudomonas, Coryne bacterium.
Fungi.

Judgement

Condemnation of the affected part if localised. If the condition is wide spread or associated with wide spread contamination by pus, then total condemnation.

PYAEMIA

The spreading of puss forming bacteria through the blood stream resulting in metastatic abscessation in other parts of the body is known as Pyemia.

Muscles → lungs
Stomach → liver

Causes

All pus forming (purulent) organisms:
Bacteria – Pseudomonas, Coryne bacterium.
Fungi.

Judgement

Total condemnation if carcass is pyemic.

RIGOR MORTIS

This is stiffening of the muscles of the body. It takes place due to a lack of ATP (energy molecule) when the myosin filaments “lock”. It sets in 1-8 hours after death and starts at the most active muscles. Muscle becomes hard, opaque and shrinks. Temperature rises a little at first, then drops to that of surrounding air. It disappears 20–30 hours later due to lysis of proteins.

Rigor mortis is influenced by three factors:

Glycogen reserves in muscles	–	for well-fed animals it takes longer to set in.
pH of the muscle	–	it sets in sooner at a low pH (acid).
Temperature	–	chilling of the carcass retards the development of rigor.

It is important in the industry to evaluate the keeping quality of meat which is related to pH and the proper setting in of rigor.

SEPTICAEMIA (BLOOD POISONING)

A condition where pathogenic organisms are present in the bloodstream

If bacteria penetrate the body, they usually do so through a wound or through the intestine or respiratory canals. In new-born animal it often occurs through the still open umbilical cord.

An animal with septicaemia has fever and numerous small haemorrhages on serous membranes. The liver and kidneys are usually pale and the spleen enlarged, and various organs may be infected.

Cause

There are many kinds of germs that can cause blood poisoning, but those that are of special importance in meat inspection, are those that can cause disease in humans (the so called zoonotic diseases or zoonoses). These include diseases such as Anthrax or Salmonellosis (food poisoning).

TELANGICTASIS

Occurs in the livers of older cattle. Cause unknown. Visible as dark purple red sunken areas of the liver commonly called "plum pudding liver". In serious cases the liver is condemned only for aesthetic reasons

TOXAEMIA

The spreading of toxins produced by bacteria via the blood stream. Lesions or changes depend on the type of toxins and its affinity for organs or systems in the body.

Cause

Bacterial mostly – Clostridium, E. coli, Salmonella.

Judgement

Total condemnation

URAEMIA

The presence of urinary constituents in the blood, and the toxic condition produced thereby.

Typical smell of urine in the meat (test by boiling)

VALVULAR ENDOCARDITIS

Cauliflower-like masses on the heart valves (right atrium and ventricle) caused by bacteria. It is usually dark shiny red and black.

Causes

Bacterial – Via bacteraemia (bacteria in the blood) – bacteria lodge in the heart valves.

Judgement

This condition may indicate a generalised infection in the body therefore the inspector must carefully inspect the rest of the carcass for any signs of infection.

MEAT INSPECTORS MANUAL

GAME

PART II MEAT INSPECTION

MODULE 5

DISEASES & CONDITIONS

Index**DISEASES AND CONDITIONS**

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DISEASES AND CONDITIONS

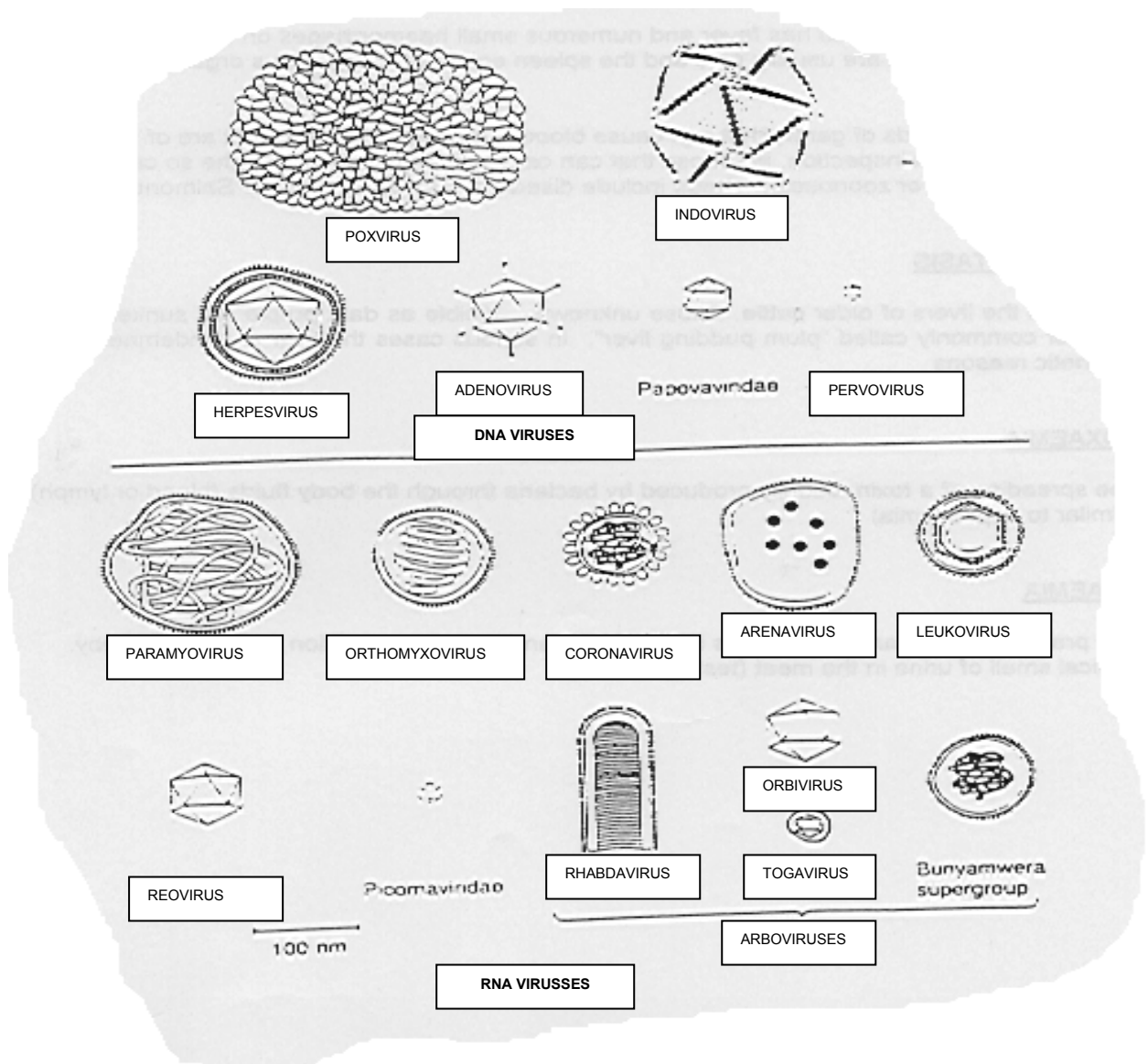
1. DISEASES CAUSED BY VIRUSES AND RICKETTSIAE

VIRUSES

A virus is not a true cell, since it has no autonomous metabolism or life; it needs a living cell to reproduce and is therefore an obligate intracellular parasite

Viruses are much smaller than bacteria and cannot be seen under even the highest magnification of a normal light microscope; a special microscope called an electron microscope that is able to use very high magnifications, is used to obtain images of viruses

The diagram below illustrates the shapes and relative sizes of animal viruses:



The following three diseases affect mainly domesticated animals. Game only acts as a carrier for the disease. Since “The Animal Diseases Act” control these diseases, it is of importance to know of its existence and which animal will act as a carrier for the disease.

AFRICAN SWINE FEVER

A peracute highly fatal, highly contagious disease of domestic pigs (transmitted mainly by the tsetse fly on wild pigs). The disease poses a considerable threat to pig-producing countries. The only effective method of control is by destroying all animals that are possibly infected. Transmission by *Ornithodoros* sp (“Tampans”) on wild pigs or infected carcass / offal.

Cause: Unclassified virus
 Species: Domesticated Pigs
 Ante-mortem: Marked purple blotching of the skin: weakness (especially hind legs); fever
 Post-mortem: Septicaemia
 Decision: Condemn (Controlled disease). Must be reported to nearest State Veterinarian.

CLASSICAL SWINE FEVER (HOG CHOLERA)(EUROPEAN SWINE FEVER)

A peracute, acute or chronic, highly contagious disease of domesticated pigs (transmitted by urine and manure). The disease poses a considerable threat to pig-producing countries. The only effective method of control is by destroying all animals that are possibly infected. Transmission mainly by contact or by infected carcass / offal or swill.

This disease may spread to the wild pig population in S.A. that will result that the wild pig may become a carrier of the disease.

Cause : Pestivirus
 Species : Pigs
 Ante-mortem : Peracute: Sudden death
 Acute: High fever, weakness, conjunctivitis, anorexia, constipation followed by diarrhoea or vomiting. Purple discoloration of abdominal skin. Necrosis of tips of extremities and nervous signs of circling, tremors or convulsions may occur
 Chronic: Occur in vaccinated herds. Weight loss, hair loss, dermatitis and skin discoloration may occur.
 Post-mortem : Haemorrhagic lesions on kidney capsule, lymph nodes, ileo-caecal valve, bladder and larynx
 Decision : Condemn

CONTROLLED DISEASE

BOVINE MALIGNANT CATARRH (Snotsiekte)

An acute, highly fatal infectious disease of cattle. Asymptomatic in blue wildebeest acting as the carrier.

Cause: Alcelaphine Herpes virus - 1
 Species: Cattle
 Ante-mortem: Fever, nasal discharge, inflammation and necrosis of nose and mouth with salivation, inflammation of gastro-intestinal tract
 Post-mortem: Inflammation and necrosis of nasal cavity, mouth and intestines
 Decision: Condemn (notifiable disease). Must be reported to nearest State Veterinarian.

FOOT AND MOUTH DISEASE

An extremely contagious, acute disease of all cloven-hoofed animals, characterised by fever and vesicular eruption in the mouth and on the feet – mild symptoms may be seen in game especially Impala

Cause: Aphtho virus

- Species: All cloven hoofed animals
 Ante-mortem: Fever, lameness, vesicular eruption in the mouth (including tongue) and on the feet (and sometimes on the teats), surface of the cheeks, lips and also the feet just above the clefts. Vesicles erupt and leave raw, red sores. The animal may shed its hooves. After 7–10 days the lesion can only be identified as a greyish-brown patch and after three weeks all that remains is a light coloured patch on the tongue.
 Post-mortem: Vesicles
 Decision: Total condemnation (controlled disease). Must be reported to nearest State Veterinarian.

RABIES

Highly fatal infection of the central nervous system, which occurs in all warm-blooded animals.

- Cause: Lyssa virus
 Species: Man and all mammals can be affected – known in Kudu and cattle.
 Ante-mortem: Nervous symptoms e.g. nature of animal changes, fearless, eyes stormy, salivation, very thirsty but can't drink, aggressive, tenesmus.
 Post-mortem: No lesions
 Decision: Total condemnation based on diagnosis by veterinarian (Controlled disease— fatal disease in humans).

RIFT VALLEY FEVER

Acute disease transmitted by biting insects, chiefly mosquitoes.

- Cause: Phlebo virus
 Species: Man, cattle and sheep. Recorded in captive buffalo causing abortions
 Ante-mortem: Fever, in co-ordination, collapse and sudden death, abortion
 Post-mortem: Necrosis of liver, widespread areas of bleeding
 Decision: Condemn (notifiable disease). Man is susceptible

RICKETTSIAE

EPIRYTHROZOON

Asymptomatic disease in game but may under certain conditions produce anaemia and icterus.

- Cause: Blood parasite – It occurs on and in the r.b.c. It has various shapes and is very small.
 Species: Small game, blesbuck and eland
 Ante-mortem: Weakness, animal lying down and unable to move away.
 Post-mortem: Anaemia, icterus, enlarged spleen, yellow urine. Confirmed with blood smear
 Decision; Condemn carcass

HEART WATER

Regarded as the most important tick borne disease in Southern Africa.

- Cause: Cowdria ruminantium
 Species: Classically in Springbuck and other small antelope spp. if brought to endemic areas
 Ante-mortem: Fever, nervous signs or diarrhoea
 Post-mortem: Fluids in body cavities. Enlarged spleen and lymph nodes. Confirm with brain smear
 Decision: Condemn carcasses, which have signs of fever
 Partially condemn / pass if only signs of diarrhoea

2. DISEASES CAUSED BY BACTERIA

INTRODUCTION

At the end of this Section you should know the condition caused, the bacterial species causing the condition, the animal species involved, the organ involved, the carcass or organ judgement with reasons, and the lesions (Pathology) of the organs. You should also be able to answer the questions at the end of this section.

Bacteria are very small, microscopic, single celled organisms and vary in size and shape. There are three basic shapes of bacteria (They can only be seen under the oil immersion lens of a microscope):

- Cocci (spheres) which include :
 - Streptococci - long chains of cocci
 - Diplococci - pairs of cocci
 - Staphylococci - masses or clumps of cocci
- Bacilli, which are rod-shaped bacteria
- Vibrios, which are curved bacteria.

Bacteria multiply or reproduce by direct splitting of the cells under favourable conditions of temperature, moisture and food supply.

Under adverse conditions, some bacteria (usually bacilli) can form spores that can exist for a long time.

Some bacteria can only grow in the presence of oxygen (aerobic bacteria); others only grow in the absence of oxygen (anaerobic bacteria); while some can grow either in the absence or presence of oxygen (facultatively anaerobic).

Toxins are the poisonous products of bacteria. They are called endotoxins if they are released when the bacterium disintegrates or dies, and are called exotoxins when secreted by a living bacterial cell.

DISEASES

ACTINOMYCOSIS (LUMPY JAW)

This bacteria chiefly causes disease in bovidae, but can also occur in horses and pigs. It causes 'fistulous withers' in horses and is the main cause of chronic mastitis in pigs.

- Cause : *Actinomyces bovis*- a facultative anaerobic rod-shaped or slender, branching filamentous bacterium, found normally in the mouth of cattle or in feed contaminated with saliva.
- Lesions: Infection in cattle is through damaged oral mucosa (abrasions to the tissue lining the mouth cavity). It forms a dense, hard lump on the jawbone, which may break open and discharge pus from time to time. The associated lymph nodes are not involved but may be enlarged. Other organs such as the tongue can be affected, or the organism can spread to the lungs. It affects mainly the bone
- Judgement: Where the carcass is not emaciated or where the disease is not generalised, only the affected parts are removed and condemned.

ANTHRAX (NOTIFIABLE DISEASE)

Anthrax is a highly contagious disease of domestic and wild animals as well as humans. In most species of animal the disease is characterised by a terminal septicaemia with rapid death, and the presence of bacteria in the blood and body fluids at death.

- Cause: *Bacillus anthracis.*, an aerobic, spore forming, brick shaped bacteria. These bacteria occur in extremely large numbers in the blood (septicaemia) and excrete a powerful toxin, which disappears soon after death.
If the organisms come into contact with air they will form extremely resistant spores which can survive for up to one hundred years. For this reason, and to protect abattoir workers from infection, it is imperative that all animals that die in an abattoir have a blood smear examination performed on the carcass, and that infected carcasses are not opened for post mortem examinations as this will cause the bacteria to sporulate and spread the infection.
- Signs: The disease causes septicaemia - ruminants die very quickly (cattle die so quickly that they may not be seen to be sick), while horses and pigs are more resistant. Birds and wild animals can be very resistant. Infected animals have a high temperature and usually have bloody diarrhoea. (Blood from all body openings, which is watery and black in colour)
- Lesions: On Post mortem examination the blood is very dark, there is bloody fluid in the chest and abdominal cavities, lymph nodes are swollen and have small haemorrhages and the spleen is very large and tarry.

Zoonosis: Anthrax can manifest as one of three forms of disease in humans: (1) Skin form, where infection occurs through wounds in the skin (called malignant pustular disease) (2) Lung form, where infection occurs through the lungs (called "woolsorters' disease) (3) Intestinal form caused by eating infected meat. (4) All of these forms can cause septicaemia, meningitis, encephalitis and death.

Judgement: The carcass and all manure, hay etc. in the pens must be burnt. The floor must also be disinfected with flame or steam (heat).

If the animal has been slaughtered, all carcasses that have been in contact must also be destroyed. Infected clothing must be burnt and knives and instruments must be boiled for 30 minutes.

BLACK QUARTER (QUARTER ILL, SPONSSIEKTE)

This disease is called Black Quarter in cattle, and Malignant Oedema or Gas Gangrene in other animals. Disease been experienced in Impala in farming set up.

Cause: *Clostridium chavoei*, anaerobic rod-shaped bacteria. Young animals often in prime condition up to 3 years of age become infected through wounds or through ingesting (entry per mouth) spores.

Lesions: The large muscle groups of the front or hind legs are usually affected. Mortality is high and decomposition is rapid. The affected leg usually sticks out, and the affected area usually feels spongy (due to gas). If the area is cut open it is red and jelly-like with the smell of rancid butter. Small haemorrhages may be seen on the heart, kidneys or liver.

Judgement: Total condemnation.

BOTULISM (LAMSIEKTE)

Currently not yet seen in game

This disease is a highly fatal intoxication affecting mainly sheep and cattle especially with a phosphate or protein deficiency and rarely pigs. Is characterised by paralysis. Humans are susceptible.

Cause: *Clostridium botulinum* multiplies in rotten meat and forms toxins. The organism can be classified into 6 groups namely A, B, C, D, E, and F. Animals (rabbits, tortoises, birds, dogs, cats, etc.) can die in the field and the bacteria can multiply in the carcasses and form toxins. If parts of these animals are eaten by susceptible animals, they will develop botulism.

Young-growing animals, cows in calf and lactating cows can use up phosphorus reserves in their bones due to growth or production, and if they are in a phosphorous deficient area this phosphorus will not be replaced by their diet. Such animals may show signs of swollen sore joints, and they may also exhibit pica (an abnormal appetite for bones, stones and pieces of metal) to try and supplement their phosphorous intake. Due to pica pieces of bone or meat containing botulism toxin may be eaten resulting in clinical botulism.

Signs: The toxin paralyses the muscles, so there is lameness, difficulty in swallowing, the tongue may hang out, the neck may be limp. Pneumonia may also develop.

Judgement: Total condemnation irrespective of carcass condition.

Compare to 3-Day Sickness (a viral disease with fever) (Ephemeral fever).

BRUCELLOSIS (CONTAGIOUS ABORTION, MALTA FEVER)

This is a **notifiable** disease and an important **zoonosis**. It causes Contagious Abortion (C. A.) in cows, and Malta or undulating fever in humans.

Species: This disease is currently rife in Buffalo in the Kruger National Park. Although it is extensively tested for during the process of certifying the animals as "clean" it is still a Zoonosis and therefore of importance.

Cause: *Brucella abortus* causes contagious abortion in cattle and Undulating Fever in humans. (*Brucella melitensis* rarely occurs in South Africa and affects goats and humans - it

causes Malta fever in humans which is a more severe disease than Undulating Fever). Cattle contract the disease through the mouth e.g. They eat pasture, grass, fodder or water, which has been contaminated by a cow which has aborted or sometimes from licking these cows, their aborted fetuses or afterbirths. Cattle abort only once or twice and are then immune but they can remain carriers for life. They sometimes give birth to live calves, which die soon afterwards. The only way these cows can be identified is by means of serological tests.

Signs: It causes abortion "storms" in a newly infected herd. The abortions are characteristically mid- to late-term.

Lesions: Lesions may be seen in the placenta following abortion. The bacteria develop in the placenta and cause inflammation of the cotyledons. This interferes with the blood supply and the calf dies, resulting in the abortion. Bacteria can also develop in the udder thereby infecting the milk. Brucellosis can cause infertility in bulls due to inflammation of the testes.

The disease is not seen at slaughter, even in C branded animals.

Zoonosis: People become infected by drinking the milk of infected animals or by coming into contact with body fluids (e.g. placenta, uterine fluid of cow during calving) of infected animals, therefore slaughtermen are at great risk of contracting the disease when an infected animal is slaughtered if no protective measures are taken. Touching aborted calves or placentas also exposes people to infection. Malta fever is a lingering disease whose symptoms resemble influenza, but the fever present fluctuates. The disease may recur time and again for many years.

Prevention: There is a national scheme to eradicate brucellosis being conducted by the Directorate of Veterinary Services. This involves testing the blood of herds and slaughtering all positive animals. These positive animals are branded with a 'C' on the right hand side of the neck. They then travel to certain abattoirs by prior arrangement with a red-cross permit. These permits must be collected and returned to the State Veterinarian of the district from which the animal came. Slaughter personnel can recognise positive animals from the 'C' brand mark and take the necessary steps to avoid exposure to the disease - wearing gloves, face masks, protective glasses and protective clothing during slaughter. Such animals are usually slaughtered last on the line and kept in quarantine pens prior to slaughter.

Judgement: The meat is safe for consumption after bleeding out and is therefore unconditionally passed. It is advisable to remove all the major lymph nodes, as well as the uterus and udder unopened. Care must be taken not to cut into the udder tissue. Compare with metritis.

NECROBACILLOSIS

A disease of ruminants causing sores and abscesses between the claws, in the throat and other internal organs.

Cause; *Fusobacterium necrofrum*. The organism is excreted through the faeces and affects animals especially during dry periods when animals concentrate around muddy water points. The organism enters through open sores or through the mouth. Extremely wet conditions are favourable for the spreading of the disease.

Species: Eland, gemsbok

Ante-mortem: Cripple animals favouring one leg or more. Putrefying wound between hooves that may even result in "Slipper" formation and sloughing of the horny part of the hoof. Animals with a mouth lesion may salivate and have difficulty in swallowing. These animals may even become emaciated or septicaemic when internal organs are affected.

Post-mortem: Putrefying lesion between hooves. Septicaemic carcass in the case of internal organ infection.

Judgement: Condemn hoof if localised. Condemn the entire carcass if generalised.

1. Haemorrhages on many of the serous and mucous membranes.
2. Pethicea on the pericardium, endocardium, and the surface of the kidneys (under capsules)
3. Look at adrenals and lymph nodes
4. Pethicea and hyperemia present in most of these glands
5. Sometimes pethicea and ecchimoses in the muscular tissue
6. If severe also in the liver and sometimes the lungs
7. Pethicea seen in m.m. of eye

8. Carcass may be feverish (reddish)

PARATYPHOID

This is a disease that generally affects calves younger than three months of age or stressed animals. If animals recover they may become "carriers" and infect other animals. Kom veral voor in buffel, renoster en olifant kalwers.

Cause: Various *Salmonella* species and types may cause the disease.

Lesions: On post mortem severe enteritis (inflammation of the intestines) is usually seen. The mesenteric lymph nodes are swollen. In less acute cases there are small white spots (the size of a pinhead) seen on the liver. These are areas of necrosis.

Judgement: Condemn entire carcass because *Salmonella sp.* cause food poisoning in humans. Compare with several other bacterial or viral diarrhoeas and/or pneumonia's in young animals. In these cases the entire carcass is also condemned unless the illness is mild and not generalised.

PASTEURELLOSIS

It is an acute or sub-acute disease of cattle and a few game species causing "Shipping fever" or haemorrhagic septicaemia in its acute form or chronic pneumonia, meningitis, mastitis or arthritis in the more sub-acute form. stress and other diseases as well as lungworm may be a predisposing cause of this disease. It is a common cause of pneumonia in sheep especially feedlot lambs.

Cause; *Pasteurella multocida* or *haemolytica*. Method of transmission unsure but probably droplet ingestion of infected food. Animals are usually very susceptible to various diseases and parasites shortly after transportation. This is then usually the time when they contract the acute forms.

Species: Kudu, sable and duiker.

Ante-mortem: Lethargic animals, may be emaciated. Coughing may be seen in pneumonic cases. In sheep there is fever, nasal discharge, dyspnoea and depression.

SWINE ERYSIPELAS (NOTIFIABLE)

This disease is often referred to as 'Diamond Skin Disease'. It affects mainly pigs, but can also affect humans and have been documented in Springbuck.

Cause: *Erysipelothrix rhusiopathiae*, a facultatively anaerobic rod shaped bacterium. The organism can live in the soil and can also occur in the digestive system of healthy animals. Pigs become infected when they eat contaminated food, faeces or soil, or through wounds in the skin.

Lesions: There are several forms of the disease. In the acute form a septicaemia develops leading to rapid death. It is thought that the bacteria produce an enzyme, which affects the blood vessels leading to small haemorrhages in the kidneys, lungs and mucous membranes. The lymph nodes and spleen are enlarged and red, and there are usually red patches on the skin.

In the sub-acute form typical 'Diamond skin disease' develops. Large, red, slightly raised diamond shaped lesions is seen in the skin. Scabs form at a later stage.

Pigs that are chronically affected are usually unthrifty and suffer from infections of the heart valves and/or chronic arthritis.

Zoonosis The disease in humans is usually an infection of the skin with painful sores. It occurs due to contact with infected pigs or chickens.

Judgement: All suspected cases of Erysipelas should be condemned.

TUBERCULOSIS (NOTIFIABLE)

This disease is an important **zoonosis**. It is a controlled animal disease and therefore the nearest State Veterinarian must be notified of any suspicious case.

Cause: *Mycobacterium bovis*, *Mycobacterium tuberculosis* or *Mycobacterium avium*. *M. bovis* is the main cause of tuberculosis in cattle, *M. tuberculosis* is the main causes of the disease in people (but can also affect cattle), and *M. avium* affects birds.

Lesions: The organism is either inhaled or ingested by susceptible animals that have contact with infected animals or people. Infection therefore develops mainly in the lungs or intestines, with spread to the lymph nodes draining these regions.

The lesions that develop at first appear as little nodules, which are greyish, and these later become yellow-white and cheesy (resemble chunky cottage cheese). The body tries to isolate the infection by surrounding it with a capsule. Later the nodules calcify. In cattle these nodules calcify quickly and when the blade of the knife is pulled over the cut surfaces it resembles gritty sand granules.

If the animal has enough resistance, the disease will remain localised, but when resistance is lowered the disease spreads in a number of ways. A septicaemia may develop with the organism being present in the blood and lymph system. This may occur so quickly that multiple small lesions are seen in the organs e.g. liver, kidneys, spleen etc. This form is known as acute miliary tuberculosis.

Re-infection can lead to a spread of the infection in the organs—so-called chronic organ tuberculosis. These lesions are cheesy masses with small haemorrhages and indistinct borders. This form usually spreads to the lymph nodes.

Zoonosis: Humans can become infected if they drink raw (unpasteurised) milk from infected animals, or if they eat meat infected with the organisms. Infection through wounds in the skin may also occur if the wounds are directly contaminated with the bacteria e.g. during slaughter.

Prevention: There is a national scheme being performed by the Directorate of Veterinary Services to eradicate tuberculosis from South Africa. It involves testing herds by injecting tuberculin into the skins of the animals and measuring the skin reaction before and after intra-dermal injection.

Positive reactors to the skin test are branded with a "T" on the left side of the neck. These animals may then only travel with a red-cross permit to an abattoir by prior arrangement. These permits are also collected and returned to the State Veterinarian in the district of origin. (Compare with Brucellosis).

Judgement:

a. Beef/ Buffalo and Kudu.

1. i) TB with emaciation - total condemnation.
- ii) Generalised TB - total condemnation. This refers to:
 - Miliary TB of both lungs.
 - TB lesions on both pleura and peritoneum.
 - TB lesions in muscle and in lymph nodes.
 - TB lesions in the muscles of the pharynx, trachea, diaphragm, intestines and hilus of the liver.
2. When the carcass is otherwise healthy only the affected parts need to be condemned if :
 - i) Lesions are localised and confined to the lungs and lymph nodes in the chest.
 - ii) If lesions are confined to the liver.
 - iii) Lesions are confined to the head and throat.
 - iv) Lesions confined to any combination of these, but limited.

b. Pigs

1. Lesions in the lymph nodes in the jaw and in any other part of the body - total condemnation.
2. If TB is only found in the head, and nowhere else, then condemn only the head.

The additional examination to be carried out in the case where evidence of tuberculosis is found, or a pyaemic condition is suspected is set out in Schedule 2, Section II of Standing Regulations GN No R3505 of 9 October 1969.

3. PROTOZOAL DISEASES

Protozoa mostly of microscopical size and the most primitive organisms. Single celled and multiply by division.

Of most importance in meat inspection are:

COCCIDIA

Affect certain food animals and being specific cross-infection do not occur. It affects the digestive tract and cause red dysentery. Condemn intestines if localised. Condemn carcass if generalised effect has been caused which is very rare. Have been documented in captive buffalo.

SARCOSPORIDIA (Zoönosis)

1. Sarcocystis

Cause; Sarcocystus miescheriana & tenella

Species. Various domesticated spp. E.g. cattle, pigs and sheep but also extensively in Buffalo. Found chiefly on the oesophagus of the sheep and goat. Also on tongue, pharynx, diaphragm and skeletal muscles. Cigar shaped and the size of a grain of cooked rice or bigger. Can be mistaken for a mass of fat or small abscess

Lesions: It appears as light grey oblong dots. Can be confused with calcified cysticercus (measles).

Judgement: Inspection of the carcass should be done as in Cistecercus and treated the same. Having made the four additional incisions in the shoulder muscles for secondary inspection and on the majority of cuts surfaces (i.e. 19+) one or more cysts are found, the level of infestation is excessive and the carcass must be condemned.

The most common way of treatment of a measly carcass is to freeze it for 72 hours in a freezer at -18°C or for 10 days at a temperature of -10°C . The deepest muscle must reach -6°C for effective treatment.

EAST COAST FEVER (Theileriosis)

Game are mainly acting as a carrier of the disease for domesticated animals

Caused by Theileria parva carried by the Brown tick. Lives in red blood cells and in white cells (Kochs bodies - bluish balls with darker dots. Practically eradicated. (Notifiable). Lymph glands very enlarged, like tennis balls.

Condemn carcass.

4. FUNGAL INFECTION OF MEAT

Fungi do not play a major role in food poisoning or spoilage under modern conditions. The one essential requirement for their development is moisture, and fungi thus become important when meat is stored or transported under moist conditions. Although most fungi are retarded by cold some species may thrive under refrigeration, which once again emphasises the importance of free air circulation during chilling as these organisms cannot survive dehydration (drying out).

Fungi develop essentially on the surface of meat, especially that with no fat covering, They are mostly non-poisonous but they often impart an undesirable colour and odour to meat. Most fungi form spores which frequently contaminate the walls and equipment of slaughterhouses and chillers and thus the carcasses. The more important types of fungi which are encountered by the meat inspector are fairly easy to identify by their colour, growing habit, etc. and include:

CLADOSPORIUM spp:

Usually occurs in carcasses held near freezing point and is seen as black spots about 1 cm in diameter and penetrating only some 5 mm into the meat. The spots cannot be wiped off and affected areas have to be cut away.

SPOROTRICHON spp:

This is probably the most common fungus infection encountered and takes the form of small, white, woolly and superficial spots which can usually be scraped off.

MUCOR AND THAMODIUM spp:

Usually occurs in carcasses held near freezing point and cause a heavy outgrowth of whitish whiskers up to 2,5 cm long.

PENICILLIUM spp:

Cause blue- green areas of various sizes and frequently seen on "mouldy" bread, etc.

Many mouldy areas may be simultaneously contaminated by bacteria which give the areas a slimy look.

When such contamination is of recent origin and not too advanced, trim the meat to a variable depth, or strip any serous membranes. In old cases with deep penetration it may be necessary to condemn on aesthetic grounds.

5. PARASITES

A parasite is an organism that lives on another organism known as the host, deprives the host of its nutrients, resulting in the loss of the host's condition and retarding growth.

CLASSIFICATION

ECTO PARASITES

Ticks
Sarcoptic Mange

INTERNAL PARASITES

Cestodes: Tapeworms
Nematodes: Roundworms
Trematodes: Flukes

TAPEWORMS

These are segmented, flat worms, which live mainly in the intestines to which they attach by means of hooks or suckers on their heads.

Life cycle

When the posterior segments are ripe and full of eggs, they break off and pass out with the faeces. These eggs are eaten by the intermediate host, where they hatch in the intestines and the larvae, which develop, migrate to a suitable part of the body for further development, forming a cyst or bladder worm, which is the immature form of the tapeworm. When the final host eats the cyst, the infective head reverts and once in the intestine attaches itself to the intestinal wall where it lives on the semi-digested food and grows into the adult form.

The following tapeworms are of importance in meat inspection:

a. Taenia saginata

Final host: man
Intermediate host: cattle, buffalo, Eland, Blue wildebeest (may also infect other game spp. but this has not yet been confirmed.)
Cyst name: Cysticercus bovis

This worm can become 9 meter long. The life cycle is very similar to that of *Taenia solium*. The lower ripe segments are mobile and can leave the host spontaneously and can therefore be transmitted from infected humans to pasture and infest cattle despite the provision of adequate toilet facilities.

The following incisions during meat inspection for cysticercosis should be made in the following muscles and organs:

(a) *Masticatory muscles*

1. Two incisions parallel to each other in the masseter muscles on the outside of each jaw.
2. One incision in the pterygoideus muscle on the inside of the jaw.

(b) *Heart*

1. One incision in the left ventricle from the basis to the apex of the heart.
2. Two incisions obliquely cut through the septum, parallel to each other and ± 1 cm apart.

(c) *Shoulder muscles*

One deep incision in the triceps brachii muscles about 10cm proximal of the bone process (olecranon) or the "elbow" of each front leg.

- (d) Two parallel incisions cut in the *diaphragm* and the strip pleura or peritoneum between the two cuts, must be stripped off for inspection of the exposed muscle.

When during the routine inspection one or more cysts are found, two additional incisions should be made in the shoulder muscle, parallel to each other, ± 2 cm apart proximal of the primary cut.

Judgement: Having made the four additional incisions in the shoulder muscles for secondary inspection and on the majority of cuts surfaces (i.e. 19+) one or more cysts are found, the level of infestation is excessive and the carcass must be condemned.

The most common way of treatment of a measly carcass is to freeze it for 72 hours in a freezer at -18°C or for 10 days at a temperature of -10°C . The deepest muscle must reach -6°C for effective treatment.

b. *Taenia hydatigena*

Final host: dog, jackal, wild dog

Intermediate host: sheep beef and pig

Cyst name: *Cysticercus tenuicollis*

A tapeworm of dogs. The cysts are found in the abdominal cavity, they are about 5 cm in diameter and have a long neck.

Judgement: removal and condemnation of the cysts.

c. *Taenia solium*

The importance of this disease is unknown in currently in game but may follow the same pattern as the others

Final host: man

Intermediate host: wild pig spp.

Cyst name: *Cysticercus cellulosae*

This is a 5m worm. The lower ripe segments are not mobile. They are passed out with human faeces and when ingested by pigs, they migrate through the intestinal wall into the blood stream, which carries them to different muscles. They have a predilection for the most active muscles of the body: skeletal muscles, heart, tongue, diaphragm and shoulder. In the muscles they grow into cysts and at about 10 weeks they are seen as 2,5-cm fluid filled cysts with a clearly visible head (white spot).

Judgement: If only a few cysts are present, the carcasses may be treated by freezing at -10°C for 10 days or -18°C for 72h. When there is one or more cysts on the majority of cut surfaces, the carcass must be condemned.

d. *Taenia multiceps*

Final host: dog

Intermediate host: sheep

Cyst name: *Coenurus cerebralis*

A tapeworm of dogs and the cyst is found in the brain of sheep, causing pressure.

Judgement: condemn the head.

e. *Echinococcus granulosus*

Final host: dog & possibly wild dogs, Hyena & Jackal big buck species

Intermediate host: ruminants, pig and man, wild carnivores, Large buck species & Zebra

Cyst name: Hydatid cyst

This is a small tapeworm of dogs. Most animals, including man act as intermediate host. The cysts develop mainly in the lungs and liver and can grow to a large size. Can cause pressure necrosis and be fatal in cases of brain involvement

Judgement: the affected organs must be condemned.

f. *Stilesia hepatica*

Final host: Impala (Category C game)

Intermediate host: unknown

A very thin tapeworm found in Impala livers, sometimes in large numbers blocking the bile duct and causing icterus.

Judgement: affected livers are condemned. *Stilesia* can be removed from the bile ducts with a suction pump or trimming and in this case, livers can be passed after secondary inspection.

ROUND WORMS

These worms are round, long, with pointed ends, the females lay eggs and their life cycle is direct, without an intermediate host.

1. *Ascaris suum*

Host: pigs

Life cycle: adults live in the pig small intestines. When eggs are ingested by the pig, the larvae hatch in the intestine and migrate to the liver and then via the blood to the lungs. Once in the lungs they get coughed up and swallowed to grow to maturity. During this migration through the liver they cause damage with in the formation of spots (milk spot liver) and in the lungs they may cause pneumonia.

Judgement: If the liver is badly affected, it must be condemned on aesthetic grounds, otherwise the spots must be cut out. Affected lungs must be condemned.

2. *Cooperoides hepatica*

Host: Impala

Life cycle: Adults live in the bile ducts of the liver. Eggs are secreted through the bile into the intestines and on to the grazing. The life cycle compares to a great extent to that of the hair worm of other species.

Lesions: May produce inflammation and resultant bacterial infection of the bile ducts of the liver. (cholangitis)

Judgement; Depending on the amount of infection produced in the bile ducts the liver may be condemned entirely or be trimmed and partially approved.

3. *Parafilaria*

Host: cattle

The life cycle of the parasite requires a final host (cattle and have also been documented in buffalo) and an intermediate host (fly). The female parasite is 6 mm in length, burrows her way to the subcutaneous tissue through the hide to deposit her eggs in superficial blood. The fly (*Musca* species) ingests the eggs, which hatch into larvae. Larvae are transmitted via the saliva of the fly to other cattle. These larvae grow into the adult worm and after fertilisation the female continues the cycle.

The subcutaneous lesions are jelly-like, greenish in colour with a typical copper smell. The condition is known as false bruising.

Judgement: Affected areas can be trimmed off. When the condition is generalised the carcasses must be condemned.

FLUKES

1. *Liver fluke*

Fasciola hepatica

Host: Cattle, hippo

These are flat, leaf shaped parasites about 3 cm long, brownish in colour and live in the bile-ducts of the liver of cattle and hippos.

Life cycle: The eggs pass out with the faeces and after hatching the larvae penetrate the water snail, which acts as intermediate host. After leaving the water snail they swim to the nearest grass blade where they are ingested by the final host (cattle). Once in the final host they burrow through the intestine wall and migrate to the liver where they penetrate through to the bile ducts and grow to maturity. The parasites cause marked irritation and hardening of the bile ducts.

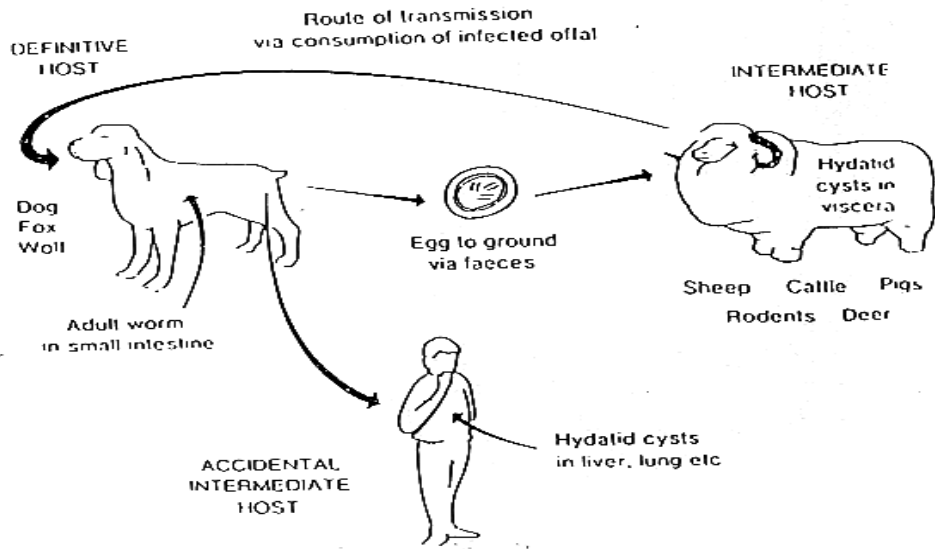
Judgement: Severely affected livers must be condemned. Slight affection confined to the bile ducts may be excised and the remainder passed.

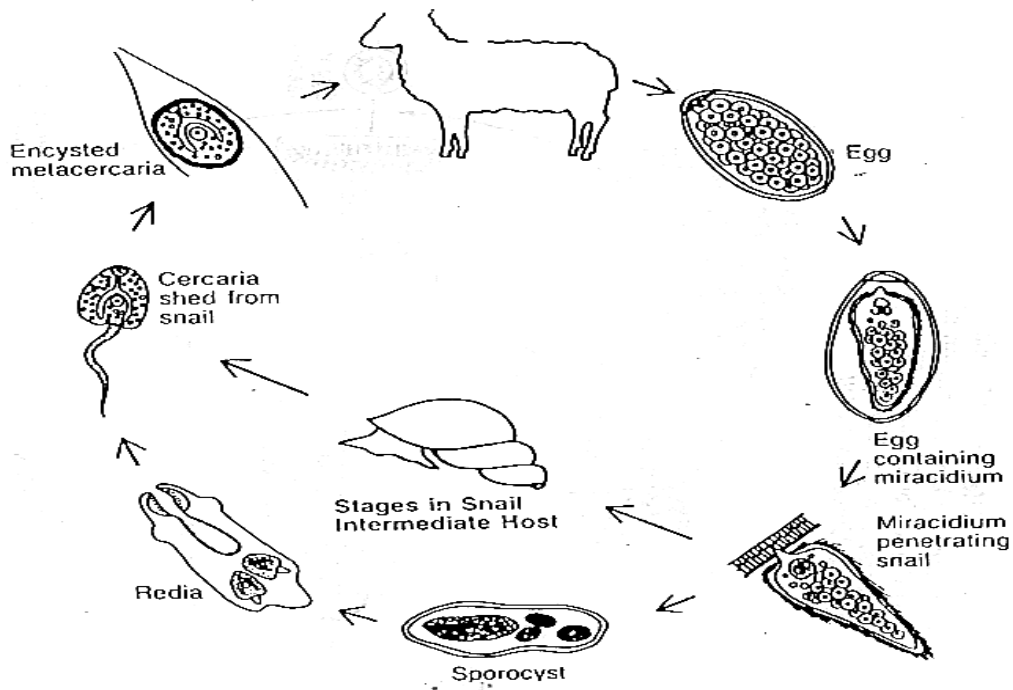
IMPORTANT TAPEWORMS FOR MEAT INSPECTIONS

WORM	FINAL HOST	LARVA	INTERMEDIATE HOST	ORGAN
Taenia saginata	Man	Cysticercus bovis	Beef, blue wildebeest	Muscles
Echinococcus granulosus	Dog	Hydatid cyst	Ruminants, man, pig, Large buck species	Liver, lungs, eye and brain of man

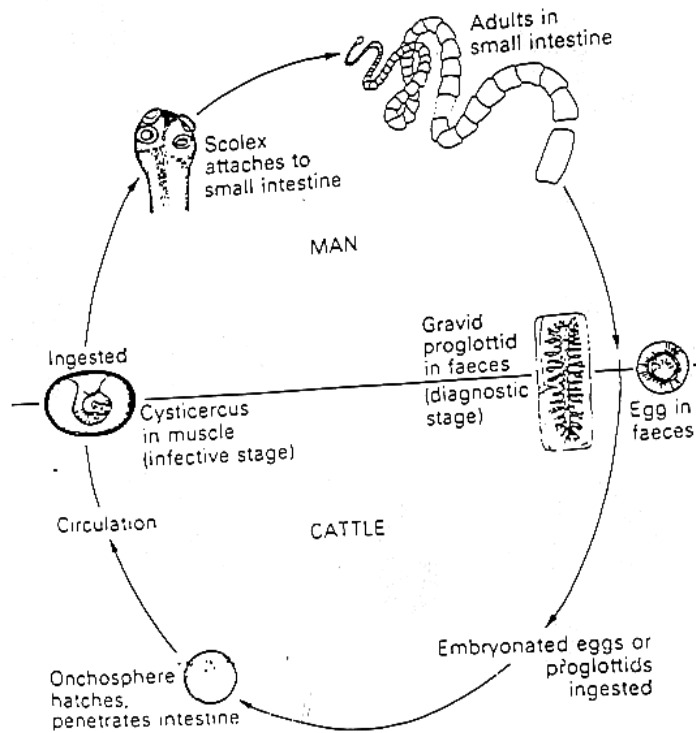
Meat Hygiene

Life cycle of *E. granulosus*. (Courtesy of Center for Disease Control, Atlanta, Georgia, USA, and Oxford University Press)





Life cycle of *Taenia saginata*. (By kind permission of the Center for Disease Control, Atlanta, Georgia, USA and Oxford University Press)



6. METABOLIC DISEASES

Most of the diseases in this category leave very little, if any post mortem lesion's.

Therefore information obtained from the ante-mortem inspection as well as Veterinary certificates, if available, is of utmost importance in the final evaluation and judgement of these cases.

pH measurements after overnight chilling will in most cases be the deciding factor, whether meat from these animals suffering from metabolic diseases is fit for human consumption or not.

pH values higher than 6,3 in case of cattle or sheep, 6,4 in pigs and 6,1 in horse meat warrants total condemnation due to poor shelf-life and reduced nutritional value of the meat

White muscle disease

Cause : Vitamin E/Selenium deficiency/ See also Capture Myopathy (D.D)
 Ante mortem: A disease more often seen in sheep. Muscle weakness.
 Post mortem: Pale striped appearance of muscles in especially the hind quarters.
 Judgement : Condemn on aesthetic grounds.

Wounds/bruising/fractures/haematomas

Cause: Often seen at abattoir are injuries during transportation.
 Ante mortem: Lesions with/without bleeding, lameness, swelling, often no superficial signs.
 Chronic: Wounds that are secondarily infected can become necrotic. Scar tissue formation. Septicaemia, fever, abscess formation.
 Post mortem: Lesions with/without systemic involvement.
 Judgement: Total condemnation with septicaemia and fever. If localised trim affected areas. In all cases detain for 24 hours and determine pH.

7. POST MORTEM LESIONS/CONDITIONS

Contamination

Faeces/Gut content/Bile

Cause: Bad slaughter techniques. In pigs the gut may burst during mechanical de-hairing.

Pus

Cause: Abscess accidentally cut open.

Grease and oil

Cause: Poor maintenance of overhead rails and equipment.
 Judgement: If localized affected areas may be trimmed. If generalised - total condemnation

“Bone Taint”

Cause: Post mortem growth of especially *Fusobacterium necrofrum* organisms in deep laying joints e.g. hip and shoulder. More common in very large carcasses in cold rooms with inadequate chilling.
 Post mortem: Green foul smelling bone joint and meat near the bone. (Deep seated meat)
 Judgement: Remove affected bone, joint and meat. If infection penetrated the meat extensively – total condemnation.

Erythema (reddening)

Cause: Often seen in pigs that were transported for long periods and lay in urine and faeces.
 Anti mortem: Animals very dirty.
 Post mortem: Red blotches appear on the skin (ventral surfaces and sides) after scalding.
 Judgement: Trim affected areas

Mechanical damage

Cause	:	Often seen in sheep after unnecessary delays between stunning and bleeding.
Post mortem	:	Widespread bleeding of different sizes.
Judgement	:	No health risk but is esthetically unacceptable.

8. ZONNOSES**Viruses**

- (a) Rabies (Hondsdotheid)
Rift Valley Fever (Slenkdalkoors)

Bacterioses

Actinomycosis
Animal Erysipelas and Human Erysipeloid (Wondroos)
Anthrax
Botulism
Brucellosis
Campylobacteriosis (Campylobacteriose)
Salmonellosis (Voedselvergiftiging)
Staphylococcal Food Poisoning (Voedselvergiftiging)
Zoonotic Tuberculosis

Parasitic Diseases

Sarcocystosis

Mycoses

Aspergillosis (Sistemiese mikose)

Helminthiasis

Hydatidosis
Taeniasis and Cysticercosis (Lintwurmbesmetting en sistiserkose)

Acanthocephaliasis and Nematodiasis

Cutaneous Larva Migrants (Velmol or Sandwurm)
Trichinosis (Triginose)
Visceral Larva Migrants and Toxocariasis (Viserale or ingewandslarwemigrasie)

MEAT INSPECTORS MANUAL GAME

PART II MEAT INSPECTION

MODULE 6 MEAT INSPECTION

Index**MEAT INSPECTION**

1. ANTE MORTEM INSPECTION
2. PRIMARY MEAT INSPECTION - GAME
3. SECONDARY MEAT INSPECTION
4. LABORATORY TECHNIQUES

MEAT INSPECTION

1. ANTE MORTEM INSPECTION

Introduction

The ante-mortem inspection is the first opportunity the hunter has to identify and remove animals, which for some or other reason cannot be transformed into a wholesome product. This is the basic purpose of ante-mortem inspection; to accept for slaughter only those animals, which can be turned into products suitable for human (and animal) consumption.

The aims of the ante-mortem inspection are:

1. The identification of animals suffering from diseases which are transmissible to humans; either to abattoir personnel, who handle the live animals or carcasses (such as rabies) or to the consumer, who eats or handles the meat or offal (such as anthrax).
2. The identification of diseases, which exhibit definite symptoms in the living animal but have no clear or specific signs during a post-mortem inspection. Examples are Rabies, Tetanus, Botulism and metabolic ailments.
3. The identification of animals with symptoms indicating the affection of a particular organ system or part of the animal to which the inspector responsible for the post-mortem inspection must be alerted; examples are diarrhoea, lameness, nervous symptoms and especially mastitis.
4. The identification of diseases, which can infect other animals and humans (zoonoses) such as foot and mouth disease and rabies. It is especially important to trace back notifiable diseases.
5. The identification of septic or suppurating conditions, which could infect the slaughter floor and equipment, such as, retained foetal membranes, septic wounds and abscesses.
6. The prevention of cruelty by removing injured or dying animals. Such animals qualify for emergency slaughter, and dying animals can be shot and destroyed.
7. "Where the hunter suspects the presence of any of the diseases mentioned in Schedule 1, he shall forthwith isolate the animal or detain the carcass, meat or viscera as the case may be, and report the fact to the Veterinary Meat Inspector and the Superintendent. The Veterinary Meat Inspector shall immediately investigate and report his findings to the Superintendent. If the Veterinary Meat Inspector confirms the presence of such disease, he shall immediately notify the nearest State Veterinarian."

1.1. Purpose of Ante-Mortem Inspections

It would be ideal if all ante-mortem inspections could be carried out by veterinarians, as they are best qualified to recognise and evaluate abnormal symptoms. It is obvious that many conditions such as leg injuries, listlessness and so on can only be observed while the animals are moving.

The following should be considered during ante-mortem inspection:

1. History

Animals are usually presented for slaughter without any background information. Individual cases may be accompanied by a veterinary certificate indicating a disease and its treatment (antibiotics etc.). Consignments may have been involved in road or rail delays or accidents, or may have come from certain enzootic disease areas (Foot And Mouth, East Coast Fever), types of veld (Gousiektebossie) or feeding trials (methyl thioracil).

2. The general behaviour of animals in the herd

Look out for animals that are excited or showing nervous symptoms.

3. Movement and posture

In game that is recumbent and is reluctant to get up, it may be an indication of injury or disease.

4. Skin or hide conditions

Ticks and mange on animals, suppurating wounds, superficial abscesses, and so on are all conditions, that should be observed.

5. Nutrition

Emaciation is attributable to specific conditions like tuberculosis, internal parasites or malnutrition as a result of drought.

6. External features

Swellings on certain parts of the animal may indicate specific conditions, or may be of a general nature - arthritis, abscesses, haematomas or emphysema.

7. Chemical residues

Animals that might have been treated recently with antibiotics or other chemo-therapeutical agents. Such animals must be marked in such a way that the carcass can be identified and tested for any antibiotic or other residues during the secondary meat inspection.

2. MEAT INSPECTIONS

2.1 Ante mortem inspection

The Hunter

The responsibilities of the hunter are that –

- (a) no game animal may be hunted or harvested unless the hunter or professional harvester has assured him or herself that the animal has a normal healthy appearance;
- (b) no animals may be hunted if any sign of injury or disease is evident;
- (c) moribund animals if killed must be condemned;
- (d) all suspect animals, including those that have been wounded, must be identified and clearly marked and relevant information be provided to the registered inspector;
- (e) any additional information including observations made during hunting must be communicated to the registered inspector;
- (f) A hunter must acquaint him/her-self of all further guidelines issued by the national executive officer regarding ante-mortem inspections.

The owner

The responsibilities of the owner of the game animals to be harvested for commercial purposes, are that –

- (a) the owner of the game animals must provide the registered inspector with any information regarding –
 - (i) controlled disease outbreaks within a radius of 10km of the place of origin of the animals to be killed;
 - (ii) any other relevant information that may render the harvested or hunted game unsafe for human consumption;
- (b) no animal for which there is reasonable suspicion to have been administered with antibiotics, immobilising drugs, tranquilisers or any other substance may be harvested or hunted;

- (c) no carcass or part thereof that has been condemned may be brought into any part of a depot or an abattoir containing edible products;
- (d) the registered inspector may authorize the salvage of the hide or skin, or any part of the animal contemplated in paragraph (c) for the sole purpose of producing trophies or curios, providing that such a condemned animal may only be handled in the abattoir after the normal processing for the day has been completed; and
- (e) An owner must acquaint him/her-self of all further guidelines issued by the national executive officer regarding ante-mortem inspections.

2. PRIMARY MEAT INSPECTION

2.2. Provisions for meat inspection personnel

The provincial executive officer may determine the number of meat inspectors or meat examiners required at a depot or in an abattoir after having considered the abattoir design, number of inspection stations, line speed, different species, structural and managerial aspects.

2.2. General

- (1) No carcass, part thereof, rough or red offal may be sold or dispatched from an abattoir unless inspected and approved by a registered inspector and marked with the "PASSED" mark, as contemplated in Part VII.
- (2) All relevant information, including ante mortem and health records must be taken into consideration when doing meat inspection.
- (3) No person may remove, cut or debone or otherwise handle any carcass or meat prior to inspection.
- (4) No person may remove any sign or evidence of any disease, condition, contamination or soiling by washing, trimming or any other manner prior to meat inspection.
- (5) No lymph nodes may be removed prior to meat inspection.
- (6) Heads, feet, rough and red offal must be identifiable with the carcass of origin until inspection is done.
- (7) A registered inspector must acquaint him/her-self of all further guidelines issued by the national executive officer regarding primary meat inspections.

2.3. Examination of the category C game carcass and organs

- (1) The Registered inspector must examine a carcass by means of observation, palpation, smell and, where necessary incision and take the following into consideration –
 - (a) its state of nutrition;
 - (b) colour;
 - (c) odour;
 - (d) symmetry;
 - (e) efficiency of bleeding;
 - (f) contamination;
 - (g) pathological conditions;
 - (h) parasitic infestation;
 - (i) injection marks;
 - (j) bruising and injuries;
 - (k) any abnormalities of muscles, bones, tendons, joints, or other tissues; and
 - (l) the species, age, and sex of the animal from which it was derived.
- (2) When examining the hindquarter, the Registered inspector must examine bilaterally –
 - (a) the parietal peritoneum by observation;
 - (b) the Lnn iliaci mediales et laterales by observation;
 - (c) the Lnn inguinalis superficialis, Ln subiliacus, Ln popliteus and Ln analis by palpation;
 - (d) kidneys by exposure, observation and palpation and the Lnn. renalis by palpation; and
 - (e) the muscular part of the diaphragm by visual inspection.

- (3) When examining the forequarter, the registered inspector must examine bilaterally –
 - (a) the parietal pleura and thoracic cavity; and
 - (b) Lnn cervicalis superficialis by palpation.
- (4) When examining the head, the registered inspector must –
 - (a) visually examine the head; and
 - (b) if required, examine the throat, mouth, tongue and retro-pharyngeal and parotid lymph nodes.
- (5) The feet must be examined by observation.
- (6) When examining the red offal, the registered inspector must examine –
 - (a) the surface of the visceral pleura by observation;
 - (b) the liver by palpation and incisions into the gastric surface and the base of the caudate lobe to open the bile ducts;
 - (c) the hepatic lymphnodes by multiple incisions into the Ln. hepaticus;
 - (d) the lungs, oesophagus and trachea by observation and palpation;
 - (e) the bronchial and mediastinal lymphnodes by observation;
 - (f) the pericardium and the heart by an incision made lengthwise to open the ventricles;
 - (g) the spleen by observation and if necessary palpation;
 - (h) both sides of the diaphragm by observation; and
 - (i) the testes and ovaries by observation.
- (7) When examining the rough offal, the registered inspector must examine –
 - (a) the visceral peritoneum by observation;
 - (b) the outer surface of the stomach and intestines as well as the omentum, and if necessary, the inner surfaces of the stomach and intestines but this examination will only take place in the rough offal room or detention area with separate equipment; and
 - (c) the gastric and mesenteric lymphnodes (Lnn. gastrici, mesenterici, cranialis and caudalis) by observation.

2.4. Examination of the warthog and bush pig carcass and organs

- (1) The registered inspector must examine a carcass by means of observation, palpation, smell and, where necessary incision and take the following into consideration –
 - (a) its state of nutrition;
 - (b) colour;
 - (c) odour;
 - (d) symmetry;
 - (e) efficiency of bleeding;
 - (f) contamination;
 - (g) pathological conditions;
 - (h) parasitic infestation;
 - (i) injection marks;
 - (j) bruising and injuries;
 - (k) any abnormalities of muscles, bones, tendons, joints, or other tissues; and
 - (l) the species, age, and sex of the animal from which it was derived.
- (2) When examining the hindquarter, the registered inspector must examine bilaterally –
 - (a) the parietal peritoneum by observation;
 - (b) the Lnn iliaci mediales et laterals by multiple incisions;
 - (c) the Lnn inguinalis superficialis by multiple incisions;
 - (d) the muscular part of the diaphragm by making two incisions approximately 25 mm apart and removing the peritoneal layer to expose the muscle; and
 - (e) kidneys by exposure or incisions if necessary and the Lnn. renalis by incisions if necessary.
- (3) When examining the forequarter, the registered inspector must examine bilaterally –
 - (a) the parietal pleura; and
 - (b) M triceps brachii by making one deep transverse incision through the distal part of the muscle.
- (4) Where the carcass has been split, the sternum, ribs, vertebrae and spinal cord must be examined.

- (5) When examining the head the registered inspector must examine bilaterally –
- (a) the Lnn mandibulares and Lnn parotidei by multiple incisions;
 - (b) the external masseters (M. masseter) by making two deep linear incisions parallel to the mandible and the internal masseters (M. pterygoideus medialis) by making a single deep linear incision; and
 - (c) observe the tongue, skin, lips, gums, hard and soft palate, eyes and nostrils.
- (6) When examining the red offal, the registered inspector must examine –
- (a) the surface of the visceral pleura by observation;
 - (b) the liver by palpation and incisions into the gastric surface and the base of the caudate lobe to open the bile ducts;
 - (c) the hepatic lymphnodes by multiple incisions into the Ln. hepaticus;
 - (d) the trachea by a lengthwise incision and the oesophagus by observation;
 - (e) the lungs by palpation and an incision in their posterior thirds perpendicular to their main axes to open the main branches of the bronchi;
 - (f) Lnn mediastinales by multiple incisions;
 - (g) Lnn bronchiales bilaterally by multiple incisions;
 - (h) the pericardium and the heart by an incision made lengthwise to cut through the interventricular septum and open the ventricles and two additional vertical cuts into the split septum;
 - (i) the spleen by visual examination and if necessary incision;
 - (j) both sides of the diaphragm by observation; and
 - (k) the testes and ovaries by observation.
- (7) When examining the rough offal, the registered inspector must examine –
- (a) the visceral peritoneum by observation;
 - (b) the outer surface of the stomach and intestines as well as the omentum, and if necessary, the inner surfaces of the stomach and intestines but this examination will only take place in the rough offal room or detention area with separate equipment; and
 - (c) the gastric and mesenteric lymphnodes (Lnn. gastrici, mesenterici, cranialis and caudalis) by multiple incisions.

2.5. Additional tests

Additional tests must be carried out to determine the presence of *Trichinella* where required by the provincial executive officer.

2.6. Examination of the category B game carcass and organs

- (1) The registered inspector must examine a carcass by means of observation, palpation, smell and, where necessary incision and take the following into consideration –
- (a) its state of nutrition;
 - (b) colour;
 - (c) odour;
 - (d) symmetry;
 - (e) efficiency of bleeding;
 - (f) contamination;
 - (g) pathological conditions;
 - (h) parasitic infestation;
 - (i) injection marks;
 - (j) bruising and injuries;
 - (k) any abnormalities of muscles, bones, tendons, joints, or other tissues; and
 - (l) the species, age, and sex of the animal from which it was derived.
- (2) When examining the hindquarter, the registered inspector must examine bilaterally –
- (a) the parietal peritoneum by observation;
 - (b) the Lnn iliaci mediales et laterales and the Lnn subiliacus by multiple incisions;
 - (c) the Lnn inguinalis superficialis by multiple incisions;
 - (d) the muscular part of the diaphragm by making two incisions approximately 25 mm apart and removing the peritoneal layer to expose the muscle; and

- (e) the kidneys by exposure or incisions if necessary and the Lnn. renalis by incisions if necessary.
- (3) When examining the forequarter, the registered inspector must examine bilaterally –
- the parietal pleura;
 - Lnn cervicalis superficialis by palpation; and
 - M triceps brachii by making one deep transverse incision through the distal part of the muscle.
- (4) Carcasses must be split and the sternum, ribs, vertebrae and spinal cord must be inspected.
- (5) When examining the head the registered inspector must examine bilaterally –
- the Lnn mandibulares, Lnn parotidei, and the Lnn retropharyngiales by multiple incisions;
 - the external masseters (M. masseter) by making two deep linear incisions parallel to the mandible and the internal masseters (M. pterigoideus medialis) by making a single deep linear incision.
 - the tongue must be palpated;
 - the registered inspector must observe the skin (or external surface of de-masked heads), lips, gums, hard and soft palate, eyes and nostrils; and
 - the tonsils must be removed under supervision after inspection as part of the slaughtering process and condemned.
- (6) The feet must be examined by observation.
- (7) When examining the red offal, the registered inspector must examine –
- the surface of the visceral pleura by observation;
 - the liver by palpation and incisions into the gastric surface and the base of the caudate lobe to open the bile ducts;
 - the hepatic lymphnodes by multiple incisions into the Ln. hepaticus;
 - the trachea by a lengthwise incision and the oesophagus by observation;
 - the lungs by palpation and an incision in their posterior thirds perpendicular to their main axes to open the main branches of the bronchi;
 - Lnn mediastinales by multiple incisions;
 - Lnn bronchiales bilaterally by multiple incisions;
 - the pericardium and the heart by an incision made lengthwise to cut through the interventricular septum and open the ventricles and two additional vertical cuts into the split septum;
 - the spleen by visual examination and if necessary incision;
 - the tail by observation;
 - the thyroid gland by observation;
 - both sides of the diaphragm by observation; and
 - the testes and ovaries by observation.
- (8) When examining the rough offal, the registered inspector must examine –
- the visceral peritoneum by observation;
 - the outer surface of the stomach and intestines as well as the omentum, and if necessary, the inner surfaces of the stomach and intestines but this examination will only take place in the rough offal room or detention area with separate equipment; and
 - the gastric and mesenteric lymphnodes (Lnn gastrici, mesenterici, cranialis and caudalis) by observation and, if necessary by multiple incisions.

2..7. Inspection of zebra carcass and organs

- (1) The registered inspector must inspect a carcass by means of observation, palpation, smell and, where necessary incision, and must take into consideration –
- its state of nutrition;
 - colour;
 - odour;

- (d) symmetry;
 - (e) efficiency of bleeding;
 - (f) contamination;
 - (g) pathological conditions;
 - (h) parasitic infestation;
 - (i) injection marks;
 - (j) bruising and injuries;
 - (k) any abnormalities of muscles, bones, tendons, joints, or other tissues; and the species, age, and sex of the animal from which it was derived.
- (2) When inspecting the hindquarter, the registered inspector must inspect bilaterally –
- (a) the parietal peritoneum, by observation;
 - (b) the Lnn iliaci mediales et laterales, and the Lnn subiliacus by multiple incisions; and
 - (c) the kidneys, by exposure or incisions if necessary and the Lnn. renalis by incisions if necessary.
- (3) When inspecting the forequarter, the registered inspector must inspect bilaterally –
- (a) the parietal pleura, by observation; and
 - (b) the Lnn cervicalis superficialis, by palpation;
- (4) Carcasses must be split after which the sternum, ribs, vertebrae and spinal cord must be inspected.
- (5) To inspect the head the registered inspector must –
- (a) examine the head by observation;
 - (b) palpate the tongue; and
 - (c) observe the skin, lips, gums, hard and soft palate, eyes and nostrils.
- (6) The feet must be inspected by observation.
- (7) When inspecting the red offal, the registered inspector must inspect –
- (a) the surface of the visceral pleura, by observation;
 - (b) the liver, by palpation and incisions to open the bile ducts;
 - (c) the hepatic lymphnodes, by multiple incisions into the Ln. hepaticus;
 - (d) the lungs, oesophagus and trachea by observation and palpation and an incision into the trachea;
 - (e) the pericardium and the heart, by an incision made lengthwise to cut through the interventricular septum;
 - (f) the spleen, by visual inspection and if necessary by palpation;
 - (g) the tail, by observation;
 - (h) both sides of the diaphragm, by observation; and
 - (i) the testes, by observation.
- (8) When inspecting the rough offal, the registered inspector must inspect –
- (a) the visceral peritoneum, by observation; and
 - (b) the outer surface of the stomach and intestines and the omentum, by observation.

2.8. General

The inspection of category A game will be in accordance with a protocol approved by the provincial executive officer.

2.9. Parasitic intermediate stages and treatment

- (1) A carcass, head and red offal found to be infested with one or more parasitic intermediate stages, which may be alive or calcified, must be detained and in category B animals and wild pigs, two additional incisions must be made into each M. triceps brachii, parallel and proximal to the original incisions.
- (2) If one or more parasitic intermediate stages are found on the majority of incision surfaces the carcass must be condemned.
- (3) Where the infestation is not excessive the carcass and organs may be passed on condition that it undergoes treatment as described below.
- (4) A conditionally passed carcass must be identified by roller marking in red ink along its entire side with the letter "M", being a minimum of 2 cm in height.

- (5) All parts belonging to the carcass to be treated, must be identified by "M" tags.
- (6) Carcasses and organs must be treated by freezing –
 - (a) as sides in a freezer with air temperature at minus 18 °C for 72 hours;
 - (b) as sides in a freezer with air temperature at minus 10 °C for 10 days;
 - (c) to reach a deep bone or core temperature of less than minus 6 °C, confirmed by the registered inspector and in accordance with the protocol approved for the specific abattoir by the provincial executive officer;
 - (d) after deboning, in accordance with a protocol approved by the provincial executive officer and –
 - (i) the container or carton in which deboned meat is packed must be marked with the letter "M" and the date of introduction into the freezer must be indicated;
 - (ii) the core temperature of meat inside the container must be below minus 6 °C before it can be released by the registered inspector.
 - (e) in portions in a chest type freezer according to a protocol approved the provincial executive officer.
- (7) Visible parasitic intermediate stages must be removed from the meat of a carcass that is conditionally passed and treated as described above.
- (8) Records of core temperatures, freezer temperatures and batches of containers, carcasses and organs introduced for freezing must be kept by the abattoir owner for at least six months, and must be available for inspection purposes.

4. SECONDARY MEAT INSPECTIONS

4.1 General

- (1) Suspect carcasses found during primary meat inspections in terms of sub part B, must be marked "detained" and must be subjected to secondary meat inspection by a registered inspector who is a veterinarian.
- (2) During secondary inspection, information regarding carcasses must be ascertained on the –
 - (a) species, age and sex;
 - (b) organ or part of the carcass affected;
 - (c) condition or disease;
 - (d) probable cause of the condition or disease; and
 - (e) finding and the motivation therefore where applicable.
- (3) Depending on the said finding, the carcass, organ or meat may be –
 - (a) approved;
 - (b) conditionally approved, subject to treatment;
 - (c) partially approved by removing the condemned part; or
 - (d) totally condemned.
- (4) (a) In case of totally condemned, partially condemned, or conditionally passed carcasses, the owner may request a written condemnation certificate.

4.2. Additional examination for suspect game carcasses

- (1) The meat of animals which were referred to a registered inspector, who is a veterinarian, during ante mortem inspection, as contemplated in regulation 73, must be examined by the veterinarian who must pay particular attention to –
 - (a) the carcass colour, blood content of intercostal veins and the small vessels beneath the serosa of the abdominal wall and in the retroperitoneal fat in the walls of the pelvis;
 - (b) all visible lymph nodes after the carcass has been split and examine and loosen a shoulder and open an acetabulum from the medial aspect to observe the exposed connective tissue, fat, lymphnodes and articular surface; and
 - (c) the condition of the musculature and abnormal odours;

- (2) If regarded as necessary by the registered veterinarian, the carcass or meat must be submitted for laboratory examination in order to make a final decision.

4.3. Records

86. The results of the ante mortem examination, primary meat inspection and secondary meat inspection must be recorded, and where zoonotic and controlled diseases, contemplated in the Animal Diseases Act 1984 (Act No. 35 of 1984), are diagnosed, the local state veterinarian must be notified on the day such diagnosis are made.

5. GENERAL REQUIREMENTS FOR PERSONS DOING MEAT INSPECTIONS

5.1. Required qualifications for other persons doing meat inspection at game meat abattoirs

The other duly qualified persons to perform meat inspection services as contemplated in section 11(l)(d) of the Act are-

- (a) persons having an appropriate bio-scientific qualification as approved by the national executive officer;
- (b) if required by the national executive officer, a certificate for game Meat Examiners which is approved by the national executive officer and accredited by South African Qualifications Authority (SAQA); and
- (c) Commercial hunters who have acquired the qualification of game meat examiner as contemplated in (b), to perform inspections at a harvesting depot.

5.2. Registration as registered inspector and commercial hunter with provincial executive officer

- (1) Persons contemplated in section 11(l)(d) of the Act wishing to do game meat inspection must register with the provincial executive officer in order to do meat inspection at a specified game abattoir or be associated with a specific harvesting team.
- (2) Commercial hunters must register with the provincial executive officer and provide information on proposed harvesting operations as may be required by the provincial executive officer.

6. MARKS AND MARKING

6.1. Specifications for stamps, marks and ink used

- (1) All stamps or roller marks used to mark any carcass or meat must be constructed of a non-toxic, non corrosive material and must be so constructed as to be readily cleanable.
- (2) The following stamps are required:



(Rural)



(High throughput)



(Low throughput)

- (3) The stamps must contain –
 - (a) the abattoir registration number; and
 - (b) the wording shown in sub-regulation (2) which must be in at least two official languages, one of which must be English.

- (4) The minimum sizes of stamps are 60 mm in diameter for the round mark shown in sub-regulation (2)(a).
- (5) The letters on the stamps must be readable and may not be less than 8 mm high.
- (6) Marks printed on wrapping material may be smaller than the sizes stated in sub regulations (4) and (5) to suit particular circumstances provided they are approved by the provincial executive officer.
- (7) A purple coloured ink is required where stamps are applied to carcasses or meat and must be manufactured of harmless, edible ingredients approved for use on foodstuffs as described in the Foodstuffs, Cosmetics and Disinfectants Act, 1972 (Act No. 54 of 1972).
- (8) The marks must be placed, in case of –
 - (a) all game, on each quarter of the carcass; and
 - (b) on heads of game if skins are removed.

6.2. *Wrapping, packing and labelling at export approved cutting plants*

- (1) All labels used on meat must –
 - (a) be printed on food grade paper or plastic printing material and treated in the same hygienic way as in contact wrapping material; and
 - (b) include the information required by regulation 89(3) as well as any other information required by the provincial executive officer.
- (2) Where products are individually wrapped, food grade wrapping material on which the mark of approval is printed or a label, printed with such mark, must be used and wrapping bearing the mark of approval may not be re-used after opening.
- (3) In the case of bulk packing, containers or cartons must be clearly marked with a facsimile of the mark of approval clearly visible and of readable size.
- (4) A container must be clearly marked on both ends with information required by the Agricultural Products Standards Act, 1990 (Act No.119 of 1990), as well as –
 - (a) the name, address and registration number of the establishments in which the meat was packed;
 - (b) the net weight of the contents;
 - (c) an accurate description of the contents;
 - (d) the date packaged or a code which enables the date of packaging to be determined; and
 - (e) directions regarding the temperature at which the product must be stored.

6.3. *Security of stamps*

- (1) The stamp of approval must be kept and used under control of a registered inspector;
- (2) When not in use the stamp must be secured by a registered inspector and kept in safe custody;
- (3) A stamp of approval must never be used at an abattoir where the abattoir number differs from the number on the stamp.

6.4. *Use of marking equipment*

- (1) Stamps and roller marking equipment must be cleaned and sterilized regularly during use;
- (2) All marking equipment must be kept hygienically, away from the floor and other dirty surfaces;
- (3) Marks must be applied in such a manner that it is clearly legible on the carcass or meat.

6.4.1. General

- (1) No person may place a stamp of approval on, or remove such mark from, any carcass, part thereof, meat or a wrapping, packing or container, except under the supervision of a registered inspector.
- (2) The registered inspector may at any time re-inspect a carcass or meat, in an abattoir, notwithstanding that it may already have been passed for consumption and, if upon re-inspection he or she is of the opinion that it is no longer fit for human or animal consumption, he or she must remove the stamp of approval by trimming, and such meat must be condemned.

7. Additional Examination for Tuberculosis or a Pyaemic Condition

The meat inspector finding evidence of tuberculosis or suspecting a pyaemic condition in a carcass during examination, must detain such animal for secondary inspection by the Veterinarian who will—

- (1) it will be required that the carcass must be split to examine the vertebrae, ribs, sternum, spinal cord and the brain and if a lesion of a kidney is visible or suspected, incise the kidney; then
- (2) first inspect the lymphnodes, which are least likely to be infected according to visual evidence e.g. if the head shows lesions, the hind quarter must be inspected before the forequarter;
- (3) in the case of the carcass of a Category B game or zebra, examine and incise by means of multiple incisions the following lymph nodes, if not previously incised –

Lnn. cervicales profundi caudales;
Lnn. sternalis craniales et caudales;
Ln. axillaris proprius;
Lnn. intercostales;
Ln. cervicales superficiales;
Lnn. inguinales superficiales;
Lnn. iliaci mediales et laterales;
Lnn. lumbales aortici and;
 if considered necessary, the *Ln. subiliacus* and *Ln. popliteus*.

- (4) in the case of the carcass of a warthog, examine and incise by means of multiple incisions the following lymph nodes bilaterally, if not previously incised –

Lnn. cervicales superficiales;
Lnn. inguinales superficiales;
Lnn. intercostales;
Lnn. lumbales aortici;
Lnn. iliaci mediales et laterales;
Ln. subiliacus and;

if he considers it necessary, the *Ln. popliteus*;

- (5) in the case of the carcass of a category C game, examine by palpation as well as by observation such lymph nodes as are readily accessible, and unless obviously diseased, examine and incise by means of multiple incisions the following lymph nodes –

Ln. cervicalis superficiales;
Ln. subiliacus;
Lnn. inguinales superficiales;
Lnn. iliaci mediales et laterales and;
 if considered necessary, the *Ln. popliteus*.

The veterinarian must pass, conditionally pass or condemn the carcass as well as organs where evidence of tuberculosis was found in accordance with the following –

- (1) the method of spread of the disease, the character and age of the tuberculosis lesion, the extent of the disease and the condition of the animal. The existence of tuberculosis in the lymph node of an organ will act as evidence of the disease in that organ;
- (2) the entire carcass and all the organs must be condemned where there is –
 - (a) tuberculosis associated with fever or emaciation;
 - (b) evidence of active generalisation, e.g. acute miliary tubercles in the lungs or widespread active lesions;
 - (c) any congenital tuberculosis of suckling animals;
 - (d) tuberculosis in intermuscular lymph nodes, bone, joints, central nervous system or muscular tissue;
- (3) the entire carcass and organs must be condemned if-
 - (a) active caseous change and inflammatory hyperaemia in any organ or lymph node;
 - (b) any acute extensive exudative tuberculosis of pleura, peritoneum, pericardium or meninges;
 - (c) any massive caseous or extensive organ tuberculosis;
 - (d) multiple tuberculosis of the liver.
- (4) subject to the provisions of (3), all tuberculous organs and their lymph nodes must be removed and condemned, and the rest of the carcass passed, when –
 - (a) the disease is localised and no longer active; or
 - (b) generalisation appears only in the form of a few old calcified lesions of limited size in the organs; or
- (5) the serosa, the cavity wall and the associated lymph nodes must be condemned where the disease is localised and provided the total area of affected serosa does not exceed the size of a hand;
- (6) for purposes of condemnation of portions of the carcass, meat or viscera, the following must be considered –
 - (a) care must be taken not to contaminate surrounding healthy tissue, or any adjoining sound carcass or edible offal;
 - (b) where an organ or its lymph node is tuberculous, both must be condemned;
 - (c) where the *Lnn. mesenterici* are affected, the mesentery, stomach and intestines must be condemned;
 - (d) in tuberculosis of the lungs or pulmonary lymph nodes, the lungs, heart, diaphragm, oesophagus and associated lymph nodes must be condemned;
 - (e) where there are chronic non-extensive pleural lesions of tuberculosis in game, the affected part of the thoracic wall and underlying ribs together with the *Lnn. sternales*, *Lnn. intercostales* and *Ln. axillaris proprius* must be removed and condemned;
 - (f) in cases of chronic non-extensive peritoneal tuberculosis, the peritoneum and underlying fatty tissue as well as the thin flanks and the diaphragm, together with the *Lnn. iliaci laterales*, must be removed and condemned.

8. Additional examination for cysticercosis and Treatment

1. A carcass, head and red offal found to be infested with *Cysticercus bovis* or *Cysticercus cellulosae* must be detained by the veterinarian/ meat inspector, and during secondary inspection he must—

- (1) make two additional incisions into each *M. triceps brachii*, parallel and proximal to the original incisions.
- (2) base his decision on the following table:

Area bilaterally	No. of surfaces
M triceps brachii	12
Masseters muscles	8
Pterygoid muscles	4
Diaphragm	8
Heart muscles	6
Total	38 surfaces

- (3) If one or more cysticerci are found on the majority of surfaces (at least 20 of the surfaces) the carcass must be condemned;
 - (4) where the infestation is not excessive (less than 20 surfaces affected) conditionally pass the carcass and organs.
8. A conditionally passed carcass must be identified by roller marking in red ink along its entire side with the letter “M” being a minimum of 2 cm in height.
9. All parts belonging to the carcass must be identified by “M” tags, and must thereafter be treated in the following way-
- (1) Freezing:
 - (a) At minus 18 °C for 72 hours at an airspeed of 1,8 m/s consecutively;
 - (b) At minus 10 °C for 10 days at an airspeed of 0.5 m/s consecutively;
 - (c) At minus 12 °C in a chest type freezer for 12 days;
 - (d) After reaching a deepbone or core temperature of less than minus 6 °C, confirmed by an authorised person and in co-ordinance with the approved protocol for the specific abattoir, the meat may be released.
 - (2) Untreated Cysticercosis meat may only be deboned in accordance to an approved protocol.
 - (3) The container in which mealy meat is placed must be marked with the letter “M” and the date of introduction into the freezing chamber must be indicated.
 - (4) The core temperature of the meat inside the containers must be below minus 6 °C before it can be released by the authorised person.
 - (5) Records of thermometer readings, freezer temperatures and batches of containers, meat and organs introduced for freezing must be kept by the abattoir owner for at least six months and it must be available for inspection purposes.

8.2. Additional examination for warthogs

1. The veterinarian/ meat inspector must additionally examine the directly visible muscular surfaces, in particular the thigh muscles, the pillars of the diaphragm, the intercostal muscles, the heart, the tongue and the larynx and if necessary the abdominal wall and the psoas muscles freed from fatty tissue to investigate cysticercosis.

8.3. Records

10. The results of the ante-mortem, primary meat inspection and secondary meat inspection must be recorded and where zoonotic and notifiable diseases are diagnosed, the local state veterinarian must be notified on the day of slaughter.

9. LABORATORY TECHNIQUES

1. PREPARATION OF BLOOD-SMEARS
2. PHASE TEST FOR ICTERUS
3. ALCOHOL-FLOATATION TEST FOR OEDEMA
4. DETERMINING THE CHLORINE CONTENTS OF WATER
5. pH DETERMINATION OF MEAT:
6. SAMPLING FOR DISPATCH TO OTHER LABORATORIES

Although a meat examiner is not trained as a laboratory technician, there are a few tests that could be performed with just the basic skills and equipment.

These tests are mostly diagnostic procedures that can assist the veterinarian in making his judgement of a detained carcass and are sometimes referred to as tertiary inspection.

All tests and procedures must be carried out according to the STANDARD PROCEDURES FOR MEAT HYGIENE LABORATORIES and include the following tests:

1. Preparation of blood-smears

- a. Bloodsmears are made to examine a blood sample for the presence of protozoa, e.g. **Babesia**, **Anaplasma**, etc., for the presence of bacteria, especially Anthrax bacilli and also for conditions such as anaemia.
- b. Bloodsmears should be made as soon as possible after the death of the animal, especially if the smear is to be used for cytological studies. The longer the period after death the more putrefactive organisms develop, which sometimes makes a diagnosis of Anthrax difficult.
- c. Blood for blood-smears is usually collected by cutting a small vein on the ear or under the tail of the animal.
- d. A small drop of the blood is then picked up with the edge of a glass slide (slide A).
- e. Pick up a second slide (slide B) and hold it between the thumb and index finger and place slide A on the flat surface of slide B at an angle of approximately 45° so that the drop of blood spreads along the entire edge at the back of slide A.
- f. Smear the blood over the surface of slide B with a single quick stroke. Always make at least 2 smears and make sure that no water gets onto the slide.
- g. Air-dry the film of blood by waving it through the air until completely dry.
- h. Fix in methyl alcohol (methanol) for 3 minutes.
- i. Stain one smear for 30 minutes in 10% Giemsa stain and the other smear for 5 minutes in 50% Giemsa.
- j. Air-dry and examine under the oil immersion lens of the microscope.

2. Phase test for icterus

- a. Place 2 g of kidney fat (free from connective tissue and blood) in a test tube.
- b. Add 5 ml of a 5% aqueous solution of sodium hydroxide (Na⁺OH⁻).
- c. Clamp the test tube in tongs and heat slowly and carefully over the flame of a Bunsen burner.

NB: *Always keep the mouth of the test tube away from yourself and from bystanders because sodium hydroxide reaches its boiling point very suddenly and with a stormy reaction!!!*

- d. Boil for 1 minute until all the fat has dissolved.

- e. Cool down the contents of the tube by holding the tube under running tap water until the tube can just be comfortably held in the hand without burning.
- f. Slowly add 5 ml of di-ethyl ether and shake carefully.
- g. Allow the suspension to stand for a few minutes until the phases have separated, i.e. a water-soluble phase at the bottom of the test tube and an ether soluble phase on top.
- h. If bile salts were present in the fat, it will form a water-soluble salt in the bottom phase, which will then be greenish-yellow in colour.
- i. If the fat was yellow due to plant pigments (mainly carotin) the ether phase on top will show a yellowish discoloration because plant pigments are insoluble in water.
- j. Plant pigments in the fat do not justify condemnation of the carcass.
- k. If both the ether and water-soluble phases show a yellow discoloration, both plant pigments and bile salts were present in the fat; condemnation of the carcass would then be justified because of the presence of bile salts.

3. Alcohol-flotation test for oedema

- a. This test is used to determine the water content of bone marrow, e.g. when judging an oedematous carcass. The water content of normal bone marrow of bovines is below 25%.
- b. Three reagents are needed, namely 32%, 47% and 52% ethanol.
- c. Pour 30 ml of each of the 3 reagents into separate glass beakers.
- d. Collect bone-marrow from the suspected carcass and float a pea-sized piece in each of the 3 beakers.
- e. If the marrow sinks to the bottom in all 3 beakers, the water content is more than 50% and the carcass is condemned for oedema.
- f. If the marrow floats in 32%, but sinks in 47% and 52%, the water contents are between 40 - 50% and the judgement will depend on the physical appearance of the suspected carcass after overnight chilling.
- g. If the marrow floats in 32% and 47%, but sinks in 52%, the water contents is between 25 - 40% and the judgement will also depends on the physical appearance of the carcass after overnight chilling.
- h. If the marrow floats in all three beakers, the water contents is below 25% and the carcass can be passed.

4. Determining the chlorine content of water

The most convenient method for determining the chlorine content of water is by using the Lovibond Comparator Method. Three chlorine values are of importance in meat hygiene, namely **Total Residual Chlorine** (the amount of chlorine originally put into the water), **Free Chlorine** (the amount of usable chlorine left in the water) and **Combined Chlorine** (the amount of chlorine that was used up to kill micro-organisms in the water). Of these 3 values, the free chlorine content is the one most frequently used.

To determine the chlorine content of water, you will need the following equipment and reagents:

- Lovibond Comparator 2000
- Comparator Chlorine discs
- DPD Tablets No 1 and No 3

- a. Aseptically collect a water sample from an appropriate source on the slaughter floor.
- b. Fill the left-hand tube of the Comparator with 10 ml of the sample.

- c. Rinse out the other tube with the sample but leave about 2ml in the tube.
- d. Add to the 2 ml sample, one DPD No 1 Tablet and allow to dissolve or crush with a stirring rod.
- e. Make the volume up to 10 ml with the sample, mix and place in the right hand compartment of the Comparator.
- f. Immediately hold the Comparator against a bright white light and rotate the disc until a colour match is obtained.
- g. Record the reading as p.p.m. of **free chlorine**.
- h. To obtain a **total residual chlorine** reading, proceed as described above but use one DPD No 1 and one DPD No 3 tablet together.
- i. Record the reading as p.p.m. of **total residual chlorine**.
- j. To obtain a **combined chlorine** reading, deduct the free chlorine reading from the total residual chlorine reading.
- k. Potable water should preferably have a free chlorine reading of at least 2 p.p.m. chlorine, whereas the water in a poultry spin chiller should have a free chlorine reading of at least 50 p.p.m. chlorine.

5. pH Determination of Meat:

The pH-value of a live muscle is about 7,0 - 7,1. After slaughtering, physiological processes commence which cause a gradual lowering of the pH-value from the initial 7,0 to values between 5,0 and 6,0 after 24 hrs.

pH-1 values (1 hour after death) are used as an early detection of PSE and DFD meat and pH-24 values (24 hours after death) of normal carcasses are used to determine the requirements set out in the Standing Regulations:

• Horses	-	6,1	
• Pigs	-	6,4	
• Category B game	-	6,3	} Ruminants all 6.3
• Category C game	-	6,3	

When the pH-24 value of a carcass is higher than the above mentioned requirements, the approval of the carcass should be re-evaluated by the Veterinarian. Provided the bacteriological test results are negative, such meat may be passed or conditionally passed by him.

- a. Apparatus and materials needed are as follows:
 - Portable pH meter
 - Suitable meat piercing electrode
 - Piercing tool
 - Standard Buffer Solutions pH 7 and pH 4
 - Wash bottle containing distilled water
- b. The best measuring site is on the **M. Longissimus dorsi** directly across the last pair of ribs. Alternatively triceps brachi or gracillis.
- c. Prior to every series of readings, calibrate the pH meter in the buffer solutions according to the manufacturers instructions.
- d. Pierce a hole in the muscle with the piercing tool.
- e. Wipe the electrode with a soft tissue and insert the electrode into the prepared hole.
- f. Take and record the pH reading.

- g. Remove the electrode from the muscle, rinse the tip of the electrode with distilled water and wipe dry with a tissue. This must be done between every reading.
- h. Repeat the procedure on other carcasses.

6. Sampling for dispatch to other laboratories

Where pathological or other samples have to be dispatched to a laboratory for analyses, the sampling procedures, use of suitable containers, etc. should be according to those prescribed by the Veterinary Institute in their ONDERSTEPSPOORT DIAGNOSTIC SERVICE MANUAL available from the Institute.

The samples could be dispatched by courier to the laboratory, or you could make use of the arrangement between the Veterinary Institute and Drs du Buisson and Partners.