MIZ 321: MEAT INSPECTION AND ZOONOSIS II:

2.0 ABNORMALITIES OF FOOD ANIMALS:

The abnormalities of food animals can be classified as either physiological or pathological. Some of the physiological conditions may be detected both ante- mortem and post –mortem.

2.1 Physiological condition:

This is a term that is used in medicine, biology or biochemistry in reference to conditions that may be as a result of internal or external consequence that may occur naturally in the animal (in the state of normal animal bodily function) in contrast to those affecting an animal as a result of either disease condition or artificial laboratory manipulations.

Physiological abnormalities affecting food animals include;

Abnormal odor and taste;

Pigmentations and abnormal color;

Fatigue/ and its effects on the carcass;

Imperfect bleeding and hypostasis;

Immaturity, poorness and emaciation;

Physiologic fatty infiltration;

Fetuses and still born carcasses;

Setting of carcasses and its significance and;

Cadavers

2.1.1 Abnormal odors and taste:

This refers to the smell that one may detect upon inspection of the carcass at postmortem:

> (1) Carcasses with a pronounced abnormal dietary odour, such as fish, garbage, garlic, stinkweed, shall be condemned; mildly affected carcasses may enter the chill room for subsequent examination by the heating test.
>
> (2) Carcasses affected with a pronounced medicinal odour shall be condemned.
>
> (3) Carcasses that give off a urine or abnormal sexual odour shall be condemned, except when the odour is slight and dissipates on cooling; the disposal of carcasses permitted to go to the chill room shall be determined by the heating test.

(4) Carcasses that give off abnormal metabolic odours associated with febrile conditions shall be condemned; mildly affected carcasses may enter the chill room for subsequent examination by the heating test.

(5) A carcass may present an acetone odour which may be indicative of ketosis.

It is of great importance as the smell tends to affect the flavour as well as the palatability of the meat that the consumer will be purchasing. The inspector should bear in mind that abnormal odours are not some easily detected on ante-mortem inspection.

2.1.2 Pigmentations and abnormal discolorations:

Pigmentation is the presence of coloring substance within the animal tissues. It normally occurs as a result of a disturbance in the metabolism of pigment. Pigmentation can be classified into two groups as either; endogenous pigments or exogenous pigments.

Endogenous pigments are those discolorations found within the animal tissues whilst;

Exogenous pigments are those that are obtained from the external environment.

Endogenous pigmentation:

These can be further sub-divided into those;

Those related to melanin:

Melanin is the normal black pigment produced by melanoblasts or melanocytes (derived from the neural crest tissue). It is normally found in the skin, retina, choroids and iris as minute brown granules. After it production in the melanoblasts melanin is transferred to the epithelial cells by way of dendritic processes of the melanoblasts. The function of melanin is to serve as a protection from the ultraviolet rays of the sun. Complete lack of melanin is a congenital defect which is known as albinism.

Conditions associated with melanin include:

Melanosis;

This refers to the presence of melanin in an abnormal location. Melanosis is an accumulation of melanin in various organs including the kidneys, heart, lungs and liver, and other locations such as brain membranes, spinal cord, connective tissue, periosteum etc.

Melanin is an endogenous brown-black pigment randomly distributed in tissue. In grey and white horses, this pigment is found under the shoulder, axillary area and ligamentum nuchae. Melanin is also found in lymph nodes, pig skin and belly fat or mammary tissue in female pigs. This condition is called “seedy belly” or “seedy cut” since the black color in the mammary tissue resembles round, black seeds.

The melanotic tissue in pigs shows a tendency towards neoplasia. Melanin deposits in the esophagus and adrenal glands in older sheep are a common finding on postmortem examination.

Multifocal deposits of melanin in the liver of a calf are known as “Melanosis maculosa”. It is common in calves and it usually disappears after the first year of age.

Ancanthasis nigrans;

This refers to an increased amount of melanin in the skin. It is associated with hyperkeratosis (excessive thickening of the stratum corneum of the skin, due to an increase in the number of keratinized cells), hormonal imbalances associated with diseases and tumors of the testicles and pituitary glands. The parts of skin that are normally involved are those of the abdomen and medial surface of the legs.

Melanomas;

These are tumors of melanoblasts and melanocytes and they be either beignin or malignant.

Leukoderm;

Also known as achromotricia, this refers to a focal are of skin that lacks pigmentation. This is normally observed with conditions such as copper deficiency, scars and radiation burns.

Those derived from lipid –ceroids (lipid pigments):

Most of these pigments are as a result of oxidation and polymerization of unsaturated lipids. Two lipid pigments are of significance;

Lipofuscin;

This is a yellowish-brown (golden-yellow) granule in the cytoplasm of affected parenchymal cells. It occurs in matured and aged animals also known as wear and tear pigments, commonly in the myocardial cells in cattle as well as the adrenal and thyroid glands. The presence in the myocardial cells of cattle is referred to a s brown atrophy. The Ayshire breed of cattle is commonly affected.

Ceroids;

These are lipids found in macrophages as golden brown pigments following tissue damage or hemorrhage or both during which lipids become free in the tissues affected.

Those derived from Hemoglobin:

Hemoglobin is the pigment contained within the erythrocytes and composed from heme (5%) and globulin (95%). The pigments derived from hemoglobin include;

Hemoglobin:

This may occur as a result of excessive release from the erythrocytes. Microscopically, it has a distinctive reddish orange color. The presence of hemoglobin in urine is called hemoglobinuria and this is a clinical sign of underlying disease e.g. copper poisoning, Babesiosis etc.

Hemosiderin (Iron stores):

This is in reference to the brown, iron containing pigment found in macrophages of the reticuloendothelial system. In instances that results in it being present in appreciable to massive amounts the condition is known as Hemosiderosis. Microscopically it is identified with Prussian blue stain. The amount present is an indication of iron stores or blood breakdown. Hemosiderin is naturally found in clumps of macrophages, renal epithelial cells or hepatocytes.

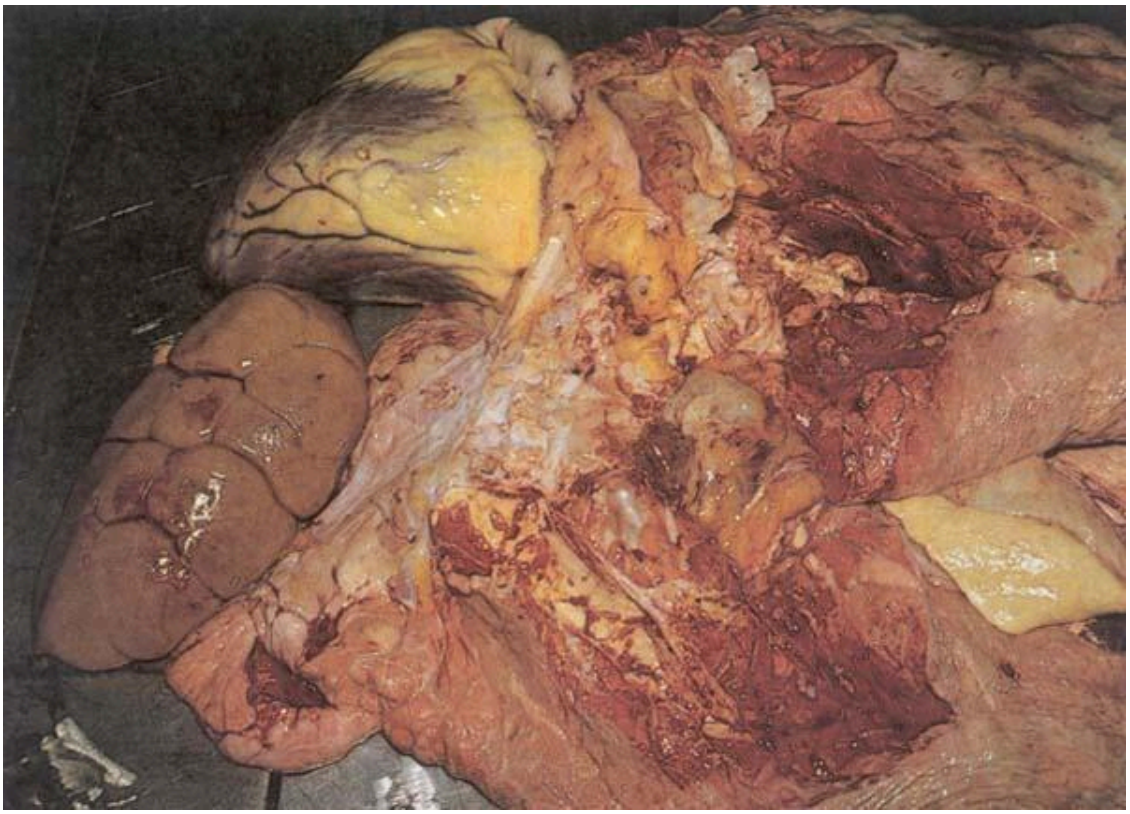
In chronic left heart failure, the RBCs cross into the alveoli because of passive congestion and become phagocytosed by alveolar macrophages which gradually take on the brown coloration and known as heart failure cells.

Billirubin:

This is a hemoglobin derived pigment formed from prophyrin (tetrepyrole ring) after iron has been removed. It is a normal product of hemoglobin breakdown, transported to the liver by hepatoglobin where it is conjugated (in hepatocytes) with glucuronic acids to form chole Billirubin (pigment of bile).

Jaundice or icterus:

It occurs due to excessive Billirubin in plasma and leads to affected tissues being stained yellowish brown; Conditions such as Babesiosis, Iso-immune erthrolysis and Rift valley.



Porphyrins:

They accumulate in the blood causing pigmentation of tissues with jaundice and also photosensitization. The disease is called porphyria which could be;

Congenital;

There is a metabolic defect in the steps of breakdown of Porphyrins. Some will accumulate and react with the sunlight, resulting in edema and inflammation of non-pigmented area of the body exposed to the sun. Porphyrins are also found in urine (cause dark urine) and may collect in teeth and bone.

Hepatotoxic;

Phylloerythrins (a metabolite of chlorophyll that has photosensitizing properties) accumulates when toxic damage to the liver impairs its normal degradation. The liver lesions are usually chronic and may involve the bile duct system. Seen in facial eczema in sheep caused by ingestion of a fungal toxin; sporidesmin.

Primary;

Caused by plants that contain compounds that directly photosensitize if ingested without causing any hepatic injury e.g. Fagopyrism and hypercism.

Exogenous pigmentation:

These are pigmentations of animal tissues that result from the outside and usually occur by inhalation. They include;

Pneumocosis:

Normally caused by inhalation of compound like minerals and organic dusts which become visible in the respiratory tract and draining lymph nodes. It causes and occupational pigmentation of the lungs called Pneumonocosis that is dependent on the concentration of inhaled substance, the size and shape of the particles, chemical nature of the compound and duration of exposure. This of more concern in humans associated with mining; Silicosis, Anthracosis, Calcinosis and Asbestosis.

Anthracosis:

It is as a result of inhalation of carbon compounds that lead to a gray and mottles discoloration of the lungs with the bronchial lymph nodes being colored black, particularly in the medullary region where particles are heal in sinusoidal macrophages. The lesion in the lungs centered around the bronchioles as collection of black granules in the walls of these structures.

Thus on postmortem;

> (1) Livers extensively affected with carotenosis (yellow carotenoid pigmentation of fat and liver, and not the natural yellow colour of the fat of certain breeds of cattle) shall be condemned.

(2) Carcasses affected with endogenous pigmentation (natural to the body but present in abnormally high amounts of concentration) shall be dealt with as follows:

(a) When complete removal of melanosis (black pigmentation) cannot be accomplished, the affected carcass, organ or part shall be condemned;

(b) When complete removal of osteohaemochromatosis (reddish to chocolate brown discoloration of bone, liver and spleen of cattle and swine) cannot be accomplished, the affected carcass, organ or part shall be condemned;

(c) When complete removal of ochronosis (dark brown or black discoloration of cartilage ligaments, tendons and joint capsules) cannot be accomplished, the affected carcass, organs or part shall be condemned;

(d) when xanthosis (brown atrophy of musculature) is confined to organs or parts, the affected parts shall be removed and condemned; when the condition results in the extensive discoloration of the musculature of the body, the carcass shall be condemned;

(e) When icterus (yellow discoloration of all body tissues by bile pigment) is associated with parenchymatous degeneration of organs, the result of infection or intoxication or intense yellow discoloration, the carcass shall be condemned; Where discoloration is slight and disappears on chilling, the carcass may be passed for food if it is otherwise healthy and fit for food; the final inspection for this discoloration shall be completed under natural light.

2.1.3 Immaturity, poorness and Emaciation compared:

Immaturity

Immaturity occurs mainly in calves. In many countries, the slaughter of calves younger than two weeks of age is prohibited. The muscle of immature animals is moist, pale, flabby and poorly developed. It is low in protein, high in water content and contains a high proportion of bone. Immature animals should not be slaughtered for human consumption.

Ante mortem and postmortem findings:

Presence of the umbilical cord
Bluish and not completely retracted gums
Greyish muscles are flabby, tear easily and are not well developed
Dark red kidney and oedematous kidney capsule

A carcass shall be condemned for immaturity if;

(a) the meat has the appearance of being water soaked, or is loose, flabby, tears easily and can be perforated with the fingers,

(b) Its colour is greyish-red,

(c) good muscular development as a whole is lacking, especially on the upper shank of the leg, where small amounts of serous infiltrate or small oedematous patches are present between the muscles, or

(d) the tissue that later develops as the fat capsules of the kidney is oedematous, dirty yellow or greyish red, tough and intermixed with islands of fat.

Emaciation

This condition, in comparison with poorness with which it should not be confused, is due to some pathological condition, generally chronic, e.g. Jöhne's disease in cattle and parasitic infestation in sheep. It is characterised by wasting of muscular tissue and by a reduction in the amount of fat, which is soft, wet and, in advanced cases, gelatinous. The flesh is wet, soft and flabby. This is best detected on a freshly cut surface when the muscles pit on pressure and are soft and sticky to the touch. The carcass does not set and the outside is wet, as are the pleura and peritoneum. The region of the brisket is generally a particularly wet area in cattle. In ewes the kidney fat gives a good indication. Where doubt exists, the carcass should be hung for 12–24 hours to see if it will set and dry out. Emaciated carcasses in fact tend to get wetter.

Ante mortem findings:

Wrinkled, dry leathery skin
Rough hair coat
Prominent bones and sunken eyes

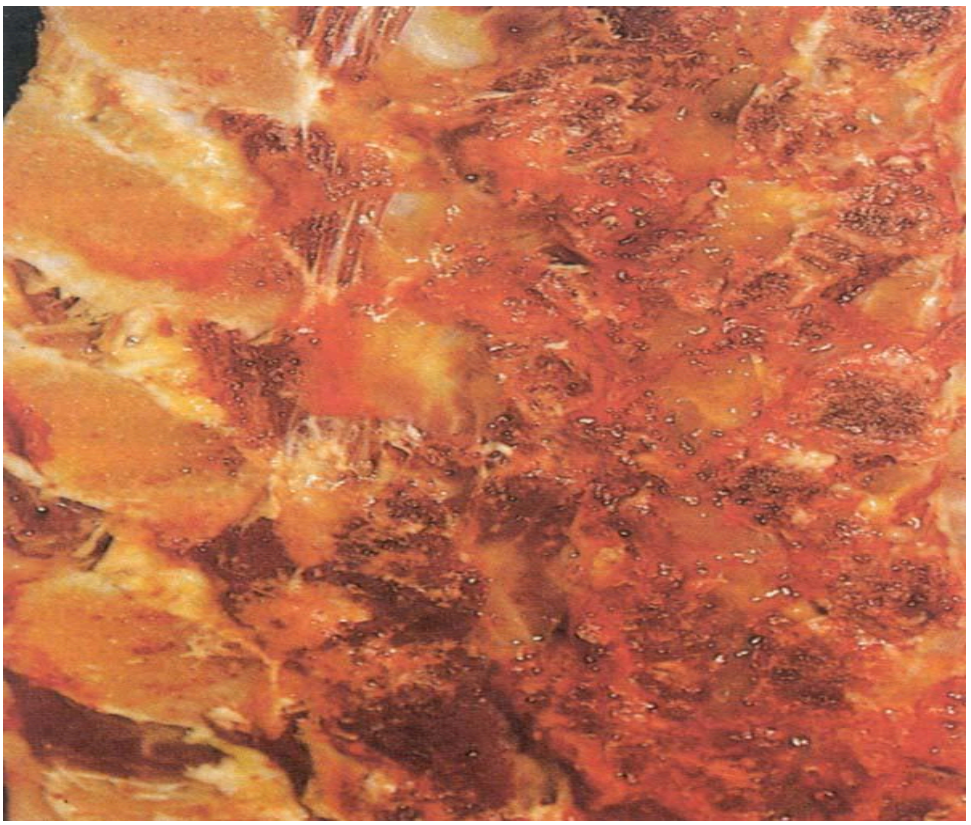
Postmortem findings:

Serious atrophy of fat in the carcass and organs especially the pericardial and renal fat
The fat is watery. Translucent or jelly-like and hangs from the intervertebral spaces
Edema and anaemia may develop due to starvation and malnutrition due to parasite infestations.

(1) An emaciated carcass shall be condemned.

(2) For the purposes of this section, emaciation is a condition, usually secondary, caused by lowered food intake or increased metabolic rate, characterized by atrophy and flabby condition of the musculature and general retrogression in body condition and diminution of the size of the organs; the outstanding characteristic is the loss of inter-muscular tissue and internal fats that are replaced by a sickly yellow and jelly-like substance.

(3) A carcass shall not be regarded as emaciated by reason only that it is lean.



Poorness

Leanness (Poorness) is often observed in range bulls on poor quality pasture, high milking cows and young growing animals which have had protein deficient diet.

The animals are physiologically normal and the reduced fat deposits of the animal carcass are normal in color and consistency. The reduced muscle tissue is firm and of a normal consistency. The muscle color is darker than normal, and fat tissue may still be present in the orbit of the eye.

Cachexia

This is the advanced state of constitutional disorders, wasting, anemia, hydraemia or weakness.

2.1.4 Fetuses and still born carcasses:

The carcass of an animal that gave birth to young within the 10 days immediately preceding slaughter shall be condemned. An animal that give birth at the abattoir should be condemned together with their young whether live or still born.

This is the flesh of unborn or still-born animals and is regarded as unfit for human consumption. The lungs are solid and sink in water. There is an open urachus (the canal that joins the bladder with the allantoic cavity, which sometimes persists after birth, the urine escaping via the umbilicus). The umbilical veins and arteries gape widely. The eyes may be closed and the hooves are soft and unwalked upon (‘golden slippers’).

Further signs are the flabby, sodden conditions of the muscles, the gelatinous condition of the connective tissue around the kidneys and the presence of red marrow in the long bones. The stomach is empty.

The carcass of an animal that gave birth to young within the 10 days immediately preceding slaughter shall be condemned.

An animal that give birth at the abattoir should be condemned together with their young whether live or still born.

2.1.5 Fatigue and its effect on the carcass:

The energy required for muscle activity in the live animal is obtained from sugars (glycogen) in the muscle. In the healthy and well-rested animal, the glycogen content of the muscle is high. After the animal has been slaughtered, the glycogen in the muscle is converted into lactic acid, and the muscle and carcass becomes firm (rigor mortis). This lactic acid is necessary to produce meat, which is tasteful and tender, of good keeping quality and good

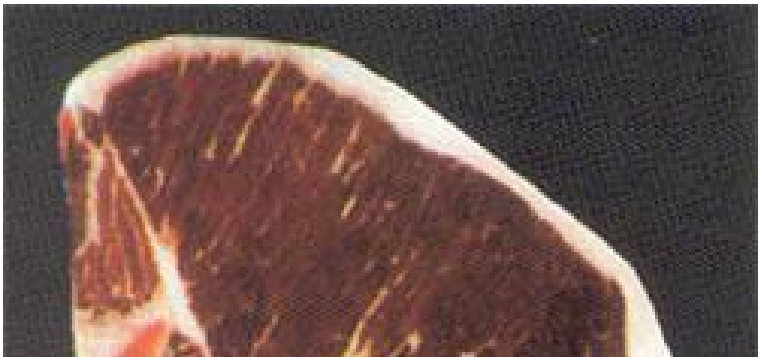
colour. If the animal is stressed before and during slaughter, the glycogen is used up, and the lactic acid level that develops in the meat after slaughter is reduced. This will have serious adverse effects on meat quality.

Pale Soft Exudative (PSE) meat:

PSE (Pale soft exudative meat) in pigs is caused by severe, short-term stress just prior to slaughter, for example during off-loading, handling, holding in pens and stunning. Here the animal is subjected to severe anxiety and fright caused by manhandling, fighting in the pens and bad stunning techniques. All this may result in biochemical processes in the muscle in particular in rapid breakdown of muscle glycogen and the meat becoming very pale with pronounced acidity (pH values of 5.4-5.6 immediately after slaughter) and poor flavour. This type of meat is difficult to use or cannot be used at all by butchers or meat processors and is wasted in extreme cases. Allowing pigs to rest for one hour prior to slaughter and quiet handling will considerably reduce the risk of PSE.

Dark Firm and Dry (DFD) meat:

This condition can be found in carcasses of cattle or sheep and sometimes pigs and turkeys soon after slaughter. The carcass meat is darker and drier than normal and has a much firmer texture. The muscle glycogen has been used up during the period of handling, transport and pre-slaughter and as a result, after slaughter, there is little lactic acid production, which results in DFD meat. This meat is of inferior quality as the less pronounced taste and the dark colour is less acceptable to the consumer and has a shorter shelf life due to the abnormally high pH-value of the meat (6.4-6.8). DFD meat means that the carcass was from an animal that was stressed, injured or diseased before being slaughtered.



It is necessary for animals to be stress and injury free during operations prior to slaughter, so as not to unnecessarily deplete muscle glycogen reserves. It is also important for animals to be well rested during the 24-hour period before slaughter. This is in order to allow for muscle glycogen to be replaced by the body as much as possible (the exception being pigs, which should travel and be slaughtered as stress free as possible but not rested for a prolonged period prior to slaughter). It is important that the glycogen levels in the muscles of the slaughtered carcass are as high as possible, to develop the maximum level of lactic acid in the meat. This acid gives meat an ideal pH level, measured after 24 hours after slaughter, of 6.2 or lower. The 24h (or ultimate) pH higher than 6.2 indicates that the animal was stressed, injured or diseased prior to slaughter.

Lactic acid in the muscle has the effect of retarding the growth of bacteria that have contaminated the carcass during slaughter and dressing. These bacteria cause spoilage of the meat during storage, particularly in warmer environments, and the meat develops off-smells, color changes, rancidity and slime. This is spoilage, and these processes decrease the shelf life of meat, thus causing wastage of valuable food. If the contaminating bacteria are those of the food poisoning type, the consumers of the meat become sick, resulting in costly treatment and loss of manpower hours to the national economies. Thus, meat from animals, which have suffered from stress or injuries during handling, transport and slaughter, is likely to have a shorter shelf life due to spoilage. This is perhaps the biggest cause for meat wastage during the production processes.

2.1.6 Imperfect bleeding and hypostasis:

Imperfect bleeding

This occurs when the animal is moribund (dying) or very distressed and is said to have been killed to ‘save its life’. The flesh is dark, there is capillary bleeding, the organs, particularly liver, lungs and kidneys, are dark and congested and when cut, blood runs out.

The intercostal veins are full of blood and are clearly visible. The forelegs often tend to be ‘tucked up’. The carcass sets badly and decomposes rapidly.

The blood vessels under skin appear and congested and the internal viscera congested and rich with fluid. The lymph nodes in large with blood but not swelling and it's show clear in the Prescapular lymph nodes. When make cut in the masseter muscle we can see oozing of blood from site of cutting. The left ventricle of heart show flood with blood, the color of carcass more dark (deep red) and when make cut in the elbow site we can see congested of the veins with blood and this called (May's test).

Must know the different between the imperfect bleeding and hyperemia, which occur with fever; the carcasses in case hyperemia congested and have pathological changes. While the imperfect bleeding occur in case non fever and the mechanical cause.

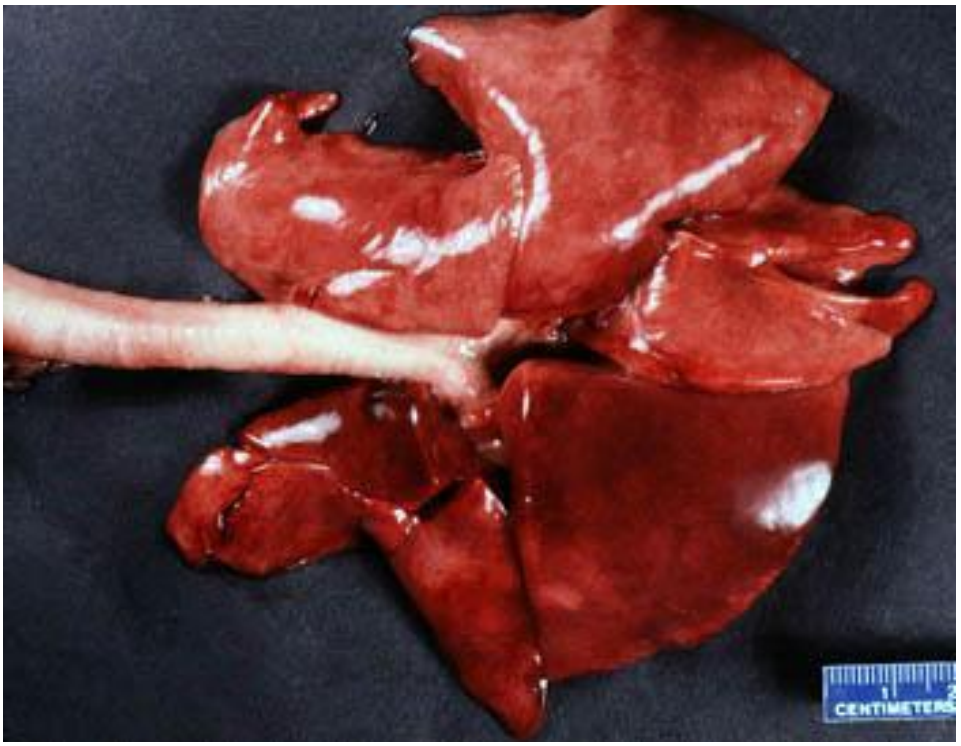
Hypostasis

This refers to the accumulation of fluid or blood in the lower parts of the body or organs under the influence of gravity, as occurs in cases of poor circulation or after death.

It is also known as Livor mortis or post mortem lividity. Cessation of circulation, stagnation and settling of blood due to gravity leads to discoloration appearing on dependant parts of the body.

Porcine Carcass

An aborted ovine fetus



Lung; note the darker areas

Not after death gravity pulls blood into the lower parts of the carcass (to dependent portions of the vascular bed) resulting in pooling of blood in the most ventral areas. Note this would not occur if clotting was present or the animal was exsanguinated (bled out).

This can cause distinct surface patterns on organs. The condition is known as Livor mortis or hypostasis. The skin on the ventral part of the carcass becomes colored red to purple. The lower lung and kidney are darker, wetter and heavier than an upper lung and kidney. The lower portions of liver are affected similarly. There will be paleness where organs have pressed against each other.

2.1.6 Suffocation:

This is a condition that leads to death by preventing the access of air to the blood through the lungs or analogous organs, (as gills; strangle). Respiration is impeded leading to discomfort due to the lack of access to fresh, cool, clean air.

Some of the causes of suffocation include; choking, drowning or trampling and crushing during transit. It is probably the most common cause of animals arriving dead at the abattoir, particularly in sheep and pigs.

In cold weather, pigs huddle together, with the result that the one at the bottom of the heap gets suffocated. Blood or bloody froth often emanates from the nostrils. The organs of a suffocated animal are generally congested, especially the lungs, which also contain frothy mucus. The right side of the heart is full of clotted blood and the left side is empty.

The flesh is dark and sets badly. The blood vessels, particularly the subcutaneous vessels of the side on which the animal was lying, are markedly congested. The carcass decomposes quickly.

2.1.7 Physiological Fatty Infiltration:

This refers to the deposition and accumulation of fat in tissues or cells where it is not normally found and in excessive amounts.

There is an accumulation of fat in the *heart, liver, kidneys, pancreas*, etc.

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

THROUGHOUT the world sheep breeders suffer losses among their breeding ewes from a disease variously known as "pregnancy disease", "pregnancy toxaemia", and "twin lamb disease". The two most characteristic clinical features of this disease are a marked ketosis and extreme fatty infiltration of the liver.
It was shown that ketosis can be produced in pregnant ewes by under nutrition, and the possible relation between the experimental condition and pregnancy disease was discussed. The ketosis was associated with marked fatty infiltration of the liver and opportunities were taken to make quantitative and qualitative studies on the fat present in the livers of normal and abnormal experimental animals, and also in livers from field cases of pregnancy disease.
It is sometimes stated that a certain degree of fattiness of the liver is a normal physiological associate of pregnancy.

Skeletal muscle and bone share common embryological origins from mesodermal cell populations and also display common growth trajectories early in life. Moreover, muscle and bone are both mechanoresponsive tissues, and the mass and strength of both tissues decline

with age. The decline in muscle and bone strength that occurs with aging is accompanied in both cases by an accumulation of adipose tissue.

In bone, adipocyte (AC) accumulation occurs in the marrow cavities of long bones and is known to increase with estrogen deficiency, mechanical unloading, and exposure to glucocorticoids. The factors leading to accumulation of intra- and intermuscular fat (myosteatosis) are less well understood, but recent evidence indicates that increases in intramuscular fat are associated with disuse, altered leptin signaling, sex steroid deficiency, and glucocorticoid treatment, factors that are also implicated in bone marrow adipogenesis.

Importantly, accumulation of ACs in skeletal muscle and accumulation of intramyocellular lipid are linked to loss of muscle strength, reduced insulin sensitivity, and increased mortality among the elderly. Resistance exercise and whole body vibration can prevent fatty infiltration in skeletal muscle and also improve muscle strength.

Therapeutic strategies to prevent myosteatosis may improve muscle function and reduce fall risk in the elderly, potentially impacting the incidence of bone fracture.

2.1.8 Setting of the Carcass and its significance:

Carcass is simply the body of a dead animal; in reference to animals used for human food; the body after the hide, head, tail, extremities, and viscera have been removed.

Rigor mortis; the muscles are hard, the joints fixed, muscle tissue loses its translucence. Proper setting is an indication of satisfactory preparation for storage of the meat without deterioration.