

Hygiene, dressing and carcass handling

During initial dressing operations, and with due consideration to minimizing contamination:

- slaughtered animals that are scalded, flamed or similarly treated should be scoured of all bristles, hair, scurf, feathers, cuticles and dirt;
- the trachea and oesophagus should remain intact during bleeding, except in the case of ritual slaughter;
- bleeding should be as complete as possible; if blood is intended for food, it should be collected and handled in a hygienic manner;
- exposure of the tongue should be done in such a way that the tonsils are not cut;
- skinning of the head may not be required for some classes of animals, e.g. goats, calves, sheep, provided that heads are handled in such a way as to avoid undue contamination of meat;
- before the removal from the head of any parts intended for human consumption, the head should be clean and, except in the case of scalded and dehaired carcasses, skinned to an extent sufficient to facilitate inspection and the hygienic removal of specified parts;
- lactating or obviously diseased udders should be removed from carcasses at the earliest opportunity;
- removal of udders should be done in such a way that the contents do not contaminate the carcass;
- gas skinning or dehiding (pumping of air or gas between the skin or hide and the underlying tissue to facilitate skinning) should only be permitted if it can be achieved with minimal contamination and meets required microbiological and organoleptic performance criteria; and
- hides/fleeces should not be washed, de-fleshed or left to accumulate in any part of an abattoir or establishment that is used for slaughter or dressing.

Source: FAO/WHO.

INTRODUCTION

The hide/skin and viscera of animals entering a slaughter facility are potential sources of contamination of carcasses with pathogenic bacteria. The major objectives in hygienic dressing and carcass handling are thus to:

- prevent contamination of the edible portions of the carcass with soiling material from the hides, skins and pelts, and from the contents of the internal organs;
- inhibit microbial growth on the surfaces of carcasses or meat;
- eliminate any carcasses or portions of carcass that are deemed unsuitable for human consumption.

If evisceration is correctly performed, visceral contents are not a significant source of carcass contamination. However, transfer of contamination from the hides to the carcass surface is effectively unavoidable due to the nature of the removal processes. One way of minimizing this source of contamination is by ensuring that all animals that enter the slaughter floor have undergone ante-mortem inspection and have been passed as suitable for slaughter. Thereafter, rigorous measures should be taken to prevent the direct transfer (i.e. contact between the hide and the carcass) and indirect transfer (e.g. from workers' hands, clothes, tools and equipment) of contamination from the hide to the carcass.

The principles of hygienic practice for dressing and carcass handling of red meat animals (cattle/large ruminants, sheep/small ruminants and pigs) are similar for all these species. Therefore, the principles will be outlined for cattle, while for other species only those specific aspects that differ from cattle will be indicated.

GENERAL REQUIREMENTS

Basic equipment required for slaughter and dressing

Slaughtering equipment, particularly for small-scale operations, need not be elaborate and expensive. The amount of equipment will depend on the slaughtering procedures employed. If possible, all equipment should be made of stainless steel or plastic, be rust-resistant and easily cleaned and sanitized.

Equipment that does come into contact with the meat (e.g. overhead rails, working platforms, stunning pens) is usually made of galvanized steel.

The basic equipment that is needed for the slaughtering operation consists of:

- stunning gun, electrical head tongs or simple stunning equipment for direct blow;
- knives:
 - sticking: 16 cm sharpened on both sides;
 - skinning: 16 cm curved;
- a sharpening steel;
- oil or water sharpening stone;
- scabbard and belt for holding knives;
- meat saw (hand or electric) and cleaver;
- block and tackle or chain hoist strong enough to hold the weight of the animal to be slaughtered;
- pritch, chocks or skinning rack (dressing cradle);
- a strong beam, tripod or track 2.4–3.4 m from the floor;
- spreader – gambrel or metal pipe;
- several buckets;
- working platforms.

The following items are additional equipment required when pigs are scalded and scraped rather than skinned:

- scalding barrel or tank;
- pot, barrel or system for boiling water;
- bell scrapers;
- solid scraping table or platform;
- thermometer registering up to 70 °C
- hog or hay hook;
- torch or flame for singeing.

Other useful additional equipment includes:

- stunning pen;
- bleeding hooks (for vertical bleeding);
- blood-catching trough;
- wash trough (for tripe).

The following items are necessary for sanitation of hands and tools:

- hand wash-basin;
- implement sterilizers.

There should be provisions for thoroughly cleaning all equipment coming into contact with carcasses or meat. Implement sterilizers are stainless-steel boxes holding hot (82 °C) water, shaped to suit particular equipment (i.e. knives, cleavers, saws, etc.). Knife sterilizers should be positioned where every operator who uses a knife has immediate access. Handles as well as blades must be sterilized. Each operator should

have at least two knives or other equipment (e.g. flay masters, anchoring chains, kidney enucleators), one to use while the other sterilizes. Failure to sterilize all knives and equipment regularly will result in carcass contamination. Bacteria will be transferred from the hide to the carcass and from carcass to carcass.

Personnel

Workers should wear protective clothing of the type and colour approved by the competent authority. The clothing should be kept clean at all times; otherwise it should be changed on a regular basis. Damaged clothing should be replaced. Aprons, protective sleeves, gloves, boots, knives, steels and scabbards should be clean at the start of breaks and at the beginning of every work period.

Workers should wash their hands and arms whenever they contact contaminated items/surfaces or otherwise on a regular basis, at the start of work and after every break. Workers who handle both external hide/pelt surfaces and exposed products should wash their hands before touching exposed carcass surfaces. Movement of workers between “clean” and “dirty” areas of the abattoirs should be restricted.

Hygienic dressing of cattle

The outer side of the hide must never touch the skinned surface of the carcass. As little blood as possible should come into contact with the hide or skin. Operators must not touch the skinned surface with the hand that was in contact with the skin.

Combined horizontal/vertical methods

Head. After bleeding, while the animal is still hanging from the shackling chain, the horns are removed and the head is skinned. The head is detached by cutting through the neck muscles and the occipital joint, and hung on a hook. The head should be identifiable as part of the carcass from which it was detached for post-mortem inspection. The carcass is then lowered on its back into the dressing cradle.

Legs. Skin and remove the legs at the carpal (foreleg) and tarsal (hind leg) joints. The forelegs should not be skinned or removed before the carcass is lowered on to the dressing

cradle or the cut surfaces will be contaminated. The hooves may be left attached to the hide.

Flaying. Cut the skin along the middle line from the sticking wound to the tail. Using long firm strokes and, keeping the knife up to prevent knife cuts on the carcass, skin the brisket and flanks, working backwards towards the round. Skin udders without puncturing the glandular tissue and remove, leaving the supermammary glands intact and attached to the carcass. At this point raise the carcass to the half-hoist position, the shoulders resting on the cradle and the rump at a good working height.

Clear the skin carefully from around the vent (anus) without puncturing it and cut the abdominal wall carefully around the rectum. Tie off the rectum with twine to seal it. Skin the tail avoiding contamination of the skinned surface with the hide. Raise the carcass free of the floor and finish flaying.

Vertical methods

High-throughput plants have overhead rails that convey the carcass from the sticking point to the chills. Hide removal is carried out on the hanging carcass. The operations are as in the combined horizontal/vertical method, but as it is not possible to reach the hide from ground level, more than one operator is needed. A single operator may work with a hydraulic platform that is raised and lowered as required.

Automatic hide-pullers are used in high-throughput slaughterhouses. Some types pull the hide down from the hind end, others from the shoulders upwards towards the rump.

Automation of hide removal reduces contamination since there is less handling of the carcass and less use of knives. Moving overhead rails also improve hygiene by reducing carcass contact with operators, equipment such as dressing cradles and with each other, since carcasses are evenly spaced.

Hygienic dressing of small ruminants

Sheep fleeces can carry large volumes of dirt and faeces into the slaughterhouse. It is impossible to avoid contamination of sheep and lamb carcasses when the fleece is heavily soiled. Therefore heavily soiled animals should be screened out during ante-mortem inspection and appropriate action taken (e.g. they should be slaughtered at the end of the slaughter line

with more precautions taken to prevent carcass contamination; see Section 6). The fleece or hair must never touch the skinned surface. Neither must the operator touch the skinned surface with the hand that was in contact with the fleece/hair.

Combined horizontal/vertical method

The animal is turned on its back and cuts are made from the knuckles down the forelegs. The neck, cheeks and shoulders are skinned. The throat is opened up and the oesophagus is tied off. The skin on the hind legs is cut from the knuckles down to the tail root. The legs are skinned and the sheep is hoisted by a gambrel inserted into the Achilles tendons. A rip is made down the midline and skinning proceeds over the flanks using special knives or the fists (punching out). The pelt is then pulled down over the backbone to the head. If the head is for human consumption it must be skinned or it will be contaminated with blood, dirt and hairs.

Moving cratch and rail system

The hanging carcass is lowered on to a horizontal conveyor made up of a series of horizontal steel plates, bowed slightly and divided into sets large enough to cradle a single

animal. Two operators usually work together on each lamb performing the legging operations and opening the skin to the stage where it can be pulled off the back. When the gambrel is inserted into the hind legs, it is hoisted onto a dressing rail.

Vertical method

At sticking the animal is shackled by one hind leg and left to bleed. Dressing commences with the free leg, which is skinned, and the foot removed. A gambrel is inserted into this leg and hung on a runner on a dressing rail. The second leg is freed from the shackle, skinned and dressed, then hooked on to the other end of the gambrel. The skin is opened down the midline and cleared from the rump.

A spreader frame (a bar that is U-shaped at each end) spreads the front legs to simplify work on the neck, breast and flanks. The front feet are held in each end of the frame, which is then slung up on to a separate travelling hook. The animal is therefore suspended by all four legs, belly uppermost. Skinning continues as in the combined horizontal/vertical method. To clear the shoulders and flanks, the forelegs are freed from the spreader and the feet removed, the animal returning to a vertical position. The skin

BOX 9.1 Good hygienic practice for skinning of ruminants (traditional, combined horizontal/vertical methods*)

The following good hygienic practice (GHP) principles should apply to all skinning methods and stages:

- Prevent contact (in-rolling) or dirt flicking from freed parts of the hide and the meat surface.
- Do not touch the meat surface or the knife with the hand that held the hide (i.e. do not alternate hide- and knife-holding hands) before effective hand-washing.
- Prevent contamination of the carcass with dirty hooks, rollers and protective clothing.
- After the initial cut through the skin, sterilize the knife in water at 82 °C, and then make all other cuts from the inside out ("spear-cuts").
- Do not create aerosols during mechanical hide-pulling.
- No hair or skin pieces should be left on the skinned carcass.
- No excess blood should appear on the skin of the carcass.

* In some larger abattoirs, more automated methods are used. The skinning principles are the same, but some differences include:

- The carcasses hang from rails (no cradles) and are conveyed through the dressing operation.
- A single operator standing on a hydraulic platform may skin the whole carcass.
- Mechanical hide-pullers remove the hide after initial manual skinning.
- Less manual handling results in improved carcass hygiene.

can now be completely pulled off. The head is also skinned if it is meant for consumption, though this takes some work with the knife. In both methods, after removal of the fleece the vent and oesophagus are cleaned and tied off.

Table 9.1 summarizes the steps in carcass skinning, along with the major points of hygiene that should be focused on.

Specific details related to hygiene of slaughter and dressing of pigs

Scalding of pigs

- Ensure pigs are dead before scalding.
- Ensure the scalding water is around 60 °C and that it is changed as frequently as required to avoid excessively dirty water contributing to carcass contamination.
- The scalding should last around six minutes to loosen the hair sufficiently.
- Scalding can be carried out using a water

tank, or vertically using a hot-water shower (the latter is more hygienic, but more expensive).

Dehairing of pigs

- Dehairing can be done manually using a specially shaped scraper.
- Dehairing can also be done using a special machine with rotating rubber-tipped paddles.
- In some abattoirs, scalding and scraping can be combined and done within the scalding tank.
- Dehairing can also be done by dipping pigs in a melted resin (re-usable), and removing the solidified resin layer together with the hairs.

Singeing of pigs

After scalding, burn the remaining hair on the skin with a hand-held gas torch. In larger abattoirs, this can be done using a furnace. After singeing, the black deposits and ash have to be

TABLE 9.1 Skinning

Main steps	Stages	Pay attention to:
Skimming and removal of head while the animal is hanging	Remove the horns. Skin the head. Detach the head through occipital joint. Tie the oesophagus.	GHP Hook up the head.
Removal of hind legs	Skin and detach the hind legs through tarsal joint.	GHP
Lowering the carcass to horizontal position	Place the carcass on its back, on to cradle.	GHP
Removal of forelegs	Skin and detach forelegs through carpal joint.	GHP
Flaying on cradle	Cut the skin along the middle line from the sticking wound to the tail. Skin the brisket and flanks. Skin/remove the udder.	GHP Do not puncture the udder (mastitis pathogens!). Leave supermammary glands on carcass intact.
Flaying in half-vertical position	Raise the carcass to half-hoist. Clear the skin around anus. Cut abdominal wall around rectum. Tie-off the rectum with twine/cover with plastic bag. Skin the tail.	GHP Do not puncture the anus/rectum (enteric pathogens!).
Flaying in vertical position	Raise the carcass free of cradle/floor. Skin the back and complete flaying.	GHP

scraped off (“polishing”) and the carcass cleaned thoroughly. The scraping equipment (scrapers, brushes) must be regularly cleaned as it may serve as a carcass re-contamination source.

Skinning of pigs

If the pigskin is to be used by the leather industry, pigs can be skinned instead of scalded. In this case the hygienic principles described for cattle are applied.

Evisceration

With all species, care must be taken in all operations not to puncture any organs such as the viscera, urinary bladder, gall bladder or uterus. If this happens, the contaminated portion of the carcass must be cut off. All viscera must be identified with the carcass until the veterinary inspection has been passed. After inspection the viscera should be chilled on racks, etc. for better air circulation.

It is of utmost importance that hands be washed regularly during evisceration. All knives and saws used during this process must be sterilized regularly and must never be put down on the floor.

Facilities should be provided for eviscerators to do their job hygienically. In the case of a mechanical conveyor belt, boot-washing, apron-washing and other washing/sterilizing facilities must be made available. In smaller abattoirs a hand-basin/sterilizer must be provided. In all cases, there should be facilities for sterilizing the evisceration platform and the offal containers.

Cattle

The brisket is sawn down the middle. In the combined horizontal/vertical system this is done with the animal resting on the cradle. The carcass is then raised to the half-hoist position and, when hide removal is complete, the abdominal cavity is cut carefully along the middle line. The carcass is then fully hoisted to hang clear of the floor so that the viscera fall out under their own weight. They are separated into thoracic viscera, paunch and intestines for inspection and cleaning. If any of the stomachs or intestines are to be saved for human consumption, then the oesophagus/stomach and stomach/duodenum boundaries should be tied (the oesophagus and rectum having been tied off during hide removal). This prevents cross-contamination between the paunch and the intestines.

Small ruminants

A small cut is made in the abdominal cavity wall just above the brisket, and the fingers of the other hand are inserted to lift the body wall away from the viscera as the cut is continued to within about 5 cm of the cod fat or udder.

The omentum is withdrawn, the (tied-off) rectum is loosened, and the viscera are freed and taken out. The (tied-off) oesophagus is pulled up through the diaphragm. The breastbone is split down the middle taking care not to puncture the thoracic organs, which are then removed.

BOX 9.2 GHP for evisceration (traditional, combined horizontal/vertical methods*)

The following GHP principles should be applied in all evisceration methods and stages:

- Do not puncture the viscera.
- Prevent leakages from the viscera (alimentary tract), uterus, urinary bladder and gall bladder during separation cuts.
- Prevent contact of viscera with floors/walls.
- Regularly wash hands/aprons and sterilize knives.
- Identify/correlate viscera with the related carcasses.

* In larger abattoirs, where the carcasses hang from rails (no cradles) and are conveyed through the dressing operation, the whole evisceration is conducted in a vertical position.

Pigs

Loosen and tie off the rectum. Cut along the middle line through the skin and body wall from the crotch to the neck. Cut through the pelvis and remove the bladder and sexual organs. In males the foreskin must not be punctured as the contents are a serious source of contamination. All these organs are considered inedible. Remove the abdominal and thoracic viscera intact. Avoid contact with the floor or standing platform. The kidneys are usually removed after the carcass has been split down the backbone. The head is usually left on until after chilling.

Table 9.2 summarizes the steps in evisceration, along with the major points of hygiene to focus on.

SPLITTING, WASHING AND TRIMMING OF CARCASSES

Carcass splitting

Cattle

Work facing the back of the carcass. Split the carcass down the backbone (chine) with a saw or cleaver from the pelvis to the neck. Sawing gives a better result but bone dust must be removed.

If a cleaver is used, it may be necessary to saw through the rump and loin in older animals.

The saw and cleaver should be sterilized in hot (82 °C) water between carcasses. Power saws increase productivity.

Pigs

These are suspended and are split down the backbone as for cattle, but the head is generally left intact.

Sheep

Sheep and lamb carcasses are generally sold whole. If necessary they can be split by saw or cleaver, but a saw will probably be necessary for older animals.

Carcass trimming

The object of carcass trimming is to remove all damaged or contaminated parts and to standardize the presentation of carcasses prior to weighing. Specifications will differ in detail for different authorities. Veterinary inspection of carcasses and offal can only be carried out by qualified personnel. Where signs of disease or damage are found, the entire carcass and offal may be condemned and must not enter the food chain, but more often the veterinarian will require that certain parts, for instance those

TABLE 9.2 Evisceration

Main steps	Stages	Pay attention to:
Open the thorax	Saw the brisket down the middle while the carcass is on the cradle.	GHP No sharp top end of the saw.
Open the abdomen	Raise the carcass to the half-hoist. Cut the abdominal wall along the middle line.	GHP Use a knife with a rounded, blunt tip.
Free the viscera	Raise the carcass clear from the cradle/floor so that viscera fall out. Make double ties at the oesophagus–stomach and stomach–duodenum boundaries. (Note: oesophagus and rectum openings have been sealed during skinning.) Free the viscera from the carcass.	GHP Leave the thoracic and abdominal viscera intact.
Separate the viscera	Catch the edible (e.g. liver, heart, lungs) and inedible viscera in separate trays. (Note: the kidneys are removed later, after carcass splitting.)	GHP Wash the trays between animals.

where abscesses are present, be removed and destroyed (see Section 8). Factory personnel must not remove any diseased parts until they have been seen by the inspector; otherwise they may mask a general condition that should result in the whole carcass being condemned. Any instructions from the inspector to remove and destroy certain parts must be obeyed.

Trimming on a vertical hoist will minimize contamination by floor or cradle contact. Do not let anything drop on the floor, but only into skips. Personal hygiene must be scrupulous. Any spills of gut contents on to the meat should be cut off, but careful work will avoid this. The trimmed carcass should be hung on rails. If beef is quartered to facilitate handling, the cut surface is at risk.

Red meat offal should be hung on hooks. Any offal processing must be in rooms that are separate from meat-handling facilities. Intestines for human consumption must be thoroughly cleaned and washed.

Carcass washing

The primary object of carcass washing is to remove visible soiling and bloodstains and to improve appearance after chilling. Washing is no substitute for GHPs during slaughter and dressing because it is likely to spread bacteria rather than reduce total numbers. Stains of viscera and the contents of other internal organs must be cut off. Wiping cloths must not be used.

Carcass spraying will remove visible dirt and bloodstains. The water used must be clean. Soiled carcasses should be sprayed immediately after dressing before the soiling material dries, thus minimizing the time for bacterial growth. Under factory conditions some bacteria will double in number every 20–30 minutes.

In addition to removing stains from the skinned surface, particular attention should be paid to the internal surface, the sticking wound and the pelvic region. A wet surface favours bacterial growth so only the minimum amount of water should be used and chilling should start as soon as possible. Some time should be allowed for the carcasses to drip dry before they are weighed and then immediately chilled in order to minimize excess moisture in the cooler. If the cooler is well designed and operating efficiently, the carcass surface will quickly dry out, inhibiting bacterial growth.

Bubbling of the subcutaneous fat is caused by

spraying with water at excessively high pressure, which may be due to the pressure in the system or a result of holding the spray nozzle too close to the carcass.

Table 9.3 summarizes the steps in evisceration, along with the major points of hygiene to focus on.

TEMPERATURE-CONTROLLED STORAGE OF CARCASSES AND MEAT

Refrigeration of carcasses

Carcasses should go into the cooler as soon as possible and should be as dry as possible. The object of refrigeration is to retard bacterial growth and extend the shelf-life. Chilling meat post-mortem from 40 °C down to 0 °C and keeping it cold will give a shelf-life of up to three weeks, provided high standards of hygiene were observed during slaughter and dressing.

Carcasses must be placed in the cooler immediately after weighing. They must hang on rails and never touch the floor. After several hours the outside of a carcass will feel cool to the touch, but the important temperature is that deep inside the carcass. This must be measured with a probe thermometer (not glass), and used as a guide to the efficiency of the cooling.

The rate of cooling at the deepest point will vary according to many factors, including the efficiency of the cooler, the load, carcass size and fatness. As a general guide, a deep muscle temperature of 6–7 °C should be achieved in 28–36 hours for beef, 12–16 hours for pigs and 24–30 hours for sheep carcasses. Failure to bring down the internal temperature quickly will result in rapid multiplication of bacteria deep in the meat resulting in off-odours and bone-taint.

High air speeds are needed for rapid cooling but these will lead to increased weight losses due to evaporation unless the relative humidity (RH) is also high. However, if the air is near to saturation point (100 percent RH) then condensation will occur on the carcass surface, favouring mould and bacteria growth. A compromise between the two problems seems to be an RH of about 90 percent with an air speed of about 0.5 m/second. Condensation will also occur if warm carcasses are put in a cooler partially filled with cold carcasses.

The cooler should not be overloaded beyond

BOX 9.3 GHP for carcass splitting/washing methods

The following GHP principles should be applied in all carcass splitting/washing methods and stages:

- Sterilize the splitting equipment between carcasses.
- Use only potable water for carcass washing.
- Wash the carcasses as little as possible to prevent/reduce the spread of contamination from individual spots on to larger areas of the same carcass.
- Prevent/reduce airborne cross-contamination between carcasses by not creating aerosols during washing.
- Remove any surface contamination by trimming rather than by washing.
- Wiping cloths must not be used.

TABLE 9.3 Carcass splitting and washing

Main steps	Stages	Pay attention to:
Split the carcass	Work facing the back of the carcass. Split the carcass down the backbone with saw or cleaver.	GHP Saws are preferred to cleavers.
Wash the carcass	Use water spraying without excessive pressure. Wash the carcasses inside a washing cabinet.	GHP Do not wash carcasses by hosing.

the maximum load specified by the manufacturer and spaces should be left between carcasses for the cold air to circulate. Otherwise, cooling will be inefficient and the carcass surface will remain wet, favouring rapid bacterial growth.

Once filled, a cooler should be closed and not be frequently opened to avoid sudden rises in temperature. When emptied, the cooler should be thoroughly washed before refilling. Personnel handling carcasses during loading and unloading operations should follow the strictest rules regarding their personal hygiene and clothing and should handle carcasses as little as possible.

Marketing of meat under refrigeration

Chilled meat must be kept cold until it is sold or cooked. If the cold chain is broken, condensation forms and microbes grow rapidly. The same rules about not overloading, leaving space for air circulation, opening doors as little as possible and observing the highest hygiene

standards when handling the meat apply. An ideal storage temperature for fresh meat is just above its freezing point, which is about -1 °C (-3 °C for bacon because of the presence of salt). The expected storage life given by the International Institute of Refrigeration of various types of meat held at these temperatures is shown in Table 9.4.

Under commercial conditions, meat temperatures are rarely kept at -1 °C to 0 °C, so actual storage times are less than expected (Table 9.5). The times would also be reduced if RH was greater than 90 percent.

Meat should be placed in the refrigerator immediately following receipt. Any parts that show signs of mould growth or bacterial slime should be trimmed off and destroyed. Hands must be thoroughly washed after handling such trimmings and knives must be sterilized in boiling water. The refrigerator should be thoroughly cleaned after finding such meat and should also be cleaned on a regular basis.

Carcasses, quarters and large primals should

BOX 9.4 GHP for refrigeration

The following GHP principles should be applied in all carcass refrigeration methods and stages:

- Move the carcasses into the cooler as soon as possible to speed up surface drying and hinder bacterial growth.
- Keep the carcasses on rails and without touching floors/walls and other carcasses to prevent cross-contamination.
- Do not overload the cooler.
- Adjust the cooling regime optimally in terms of air temperature, speed and relative humidity, to achieve rapid refrigeration to a deep muscle temperature of 6–7 °C with no condensation or excessive weight losses.
- Do not open the cooler doors either unnecessarily or frequently to avoid temperature fluctuations.

BOX 9.5 Factors to consider in connection with chilling/freezing facilities**Air must circulate efficiently around the heat source.**

- Cold air must be distributed evenly through the room following a circular pattern.
- The fan should not blow air directly onto the carcasses, as the deflection from the carcasses will affect cooling of other parts of the room.
- The more the air is forced to move around the products 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 should be evenly spaced out and the room should not be overloaded. The recommended rail spaces for the different species are 660–750 cm per beef carcass, or two pork carcasses, or two calf carcasses, or six sheep carcasses, with a minimum of 5 cm between carcasses.
- It is not advisable to hang different kinds of carcasses or carcasses of very different sizes in the same room because their rates of cooling will differ.

Ice on the evaporation unit insulates the refrigeration mechanism.

- Ice should be thawed and removed from the evaporation coil at regular intervals.
- Excessive ice formation, which necessitates more frequent defrosting, can be avoided by:
 - not overloading the chiller;
 - closing the door;
 - repairing damaged insulation;
 - mopping up all water during the cleaning process.

Source: adapted from National Department of Agriculture (South Africa), 2000.

TABLE 9.4 Expected storage life of different types of meat under refrigeration temperatures

Type of meat	Expected storage life at -1 °C
Beef	up to 3 weeks (4–5 with strict hygiene)
Veal	1–3 weeks
Lamb	10–15 days
Pork	1–2 weeks
Edible offal	7 days
Rabbit	5 days
Bacon	4 weeks (at -3 °C)

Source: International Institute of Refrigeration, 2000.

not be cut into smaller portions before it is necessary, as this will expose a greater surface area for bacteria to grow. Freshly cut surfaces are moist and provide a better medium for bacterial growth than the desiccated outer surfaces of cuts that have been stored for some time.

An accurate thermometer should be placed in the refrigerator and checked regularly. The temperature should remain within a narrow range (0 to +1 °C).

Freezing

The aim of freezing is to extend shelf-life from weeks to several months. Bacterial growth stops at temperatures below -12 °C. Above that temperature, the shelf-life of meat is limited by the actions of its own enzymes, which cause fat to become rancid. The maximum shelf-life at -18 °C is:

- five months for pork;
- eight months for sheep meat;
- ten months for beef.

TABLE 9.5 Number of days needed for unpleasant smell and slime to appear on the surface of meat at various storage temperatures

Storage temperature (°C)	Time from cutting (days)
0	20
5	10
10	5
15	5
20	3
25	2–3

Source: National Department of Agriculture (South Africa), 2000.

Summary

- The main objectives of hygienic dressing and carcass handling are to:
 - prevent contamination of the edible portions of the carcass with material from the hide/skin and from the contents of the internal organs;
 - inhibit microbial growth on the surfaces of carcasses or meat;
 - eliminate any carcasses or portions of a carcass that are deemed unsuitable for human consumption.
- Basic equipment for dressing should include provisions for cleaning and sterilizing all tools (e.g. knives, saws, cleavers), equipment and working surfaces.
- Workers should be provided with clean protective clothing and basins for washing their hands during and between operations.
- Skinning procedures should be such that direct and indirect hide to carcass contamination is prevented.
- Evisceration should prevent leakage of organ contents on to the carcass, carcass to carcass contamination and dressing surface to carcass contamination.
- Trimming should be done to remove damaged and soiled parts and standardize the appearance of the carcasses. Diseased parts should not be trimmed off until they have been seen by an inspector.
- Washing of carcasses should be done to remove visible soiling and not as a substitute for hygienic dressing. Carcasses should be washed as little as possible to prevent/reduce spread of contamination from individual spots to larger areas of the same carcass.
- Carcasses should be chilled as soon as possible after washing to speed up surface drying and hinder bacterial growth.
- The cooler conditions should be such that a deep carcass temperature of 6–7 °C is achieved in 28–36 hours for beef, 12–16 hours for pigs and 24–30 hours for sheep carcasses.

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