

TRAINING MANUAL FOR HYGIENIC AND SANITARY SLAUGHTER OF SMALL RUMINANTS

Prepared by:

Dr. Linnette Murray-Peters, DVM, MVSc, MPH

For: The Inter-American Institute for Cooperation on
Agriculture

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Acknowledgement

This manual entitled “Hygienic and sanitary slaughter of small ruminants” presents an overview of the basic practices and procedures relevant to the production of mutton and goat flesh (chevron) for human consumption. The manual is aimed at small ruminant farmers and butchers and should also prove useful to meat inspectors. Given the target groups in mind, it was not considered necessary to make an interpretation of the many topics covered in terms of technical language, however it provides sufficient information dealing with best hygienic and production practices necessary to guide the relevant target groups, in the production of safe meat and meat products from small ruminants.

I would like to acknowledge the contribution of several individuals who made this manual a reality. They include the IICA Caribbean team, who conceptualized the project and assisted in editing the manual. Finally I would also like to thank VIP Meats, for allowing the use of its facility and the involvement of its staff who professionally captured the photographic exhibits of the slaughter and processing included in this manual.

The preparation of this manual was made possible through a grant from the Inter-American Institute for Cooperation on Agriculture (IICA).

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Objective and Scope of the Manual

Goats and to a lesser extent sheep are of wide spread distribution in most of the countries in the Caribbean Region. The prolificacy, hardiness and ability to easily adopt in various climatic conditions have served to increase their popularity in the environmental conditions provided in the countries of the Region. Again their high levels of cultural acceptability as meat animals have endeared them to local populations and they are a culinary delight- in various countries.

This particular training manual is aimed at achieving two major objectives: firstly that of ensuring that slaughter activities of small ruminants are in full compliance with the relevant international standards governing animals for slaughter; and secondly to ensure that the meat and meat products from these animals are safe and wholesome for human consumption both locally and for the export trade.

The manual is not meant to be a substitute for any national regulation governing the small ruminant sub-sector in any of these countries but rather is designed to provide necessary guidance to small ruminant industry stakeholders – farmers, butchers and other operators in the area of the hygienic and sanitary production of meats from small ruminants.

The procedures outlined are basically recommendations of best practices and quality assurance based on the principles of CODEX Alimentarius and ongoing findings. Materials presented and accompanying illustrations on the various subject matter covered – with respect to procedure, protocols, facility infrastructure and personnel that impact the safety of meat and meat products, as well as the important emerging area of animal welfare especially as it relates to animals for slaughter along the total production/processing chain from farm to consumption and inclusive of ante and post mortem inspections – are aimed at informing and updating various stakeholders.

It should be noted that CODEX general principles serve as the basis for ensuring product safety through the application of stringent hygienic and sanitary measures along the entire food chain, in this case the production of meat and

meat products for human consumption. In this manual the basic tool being applied is that based on the Hazard Analysis Critical Point (HACCP).

The new and accepted approach to product safety is seen as a shared one between the Public and Private Sectors. It is the prerogative of the Private Sector to put in place or implement the various food safety measures that serve to ensure product safety while the onus of the Public Sector is that of providing the regulatory tools of compliance and enforcement.

The current notion is that consumers have a right to safe and wholesome meat supplies hence stakeholders, government and consumers must act in a collaborative approach to achieve the goal of safe meat supplies.

Finally, this manual is specifically aimed at small ruminants farmers, butchers and other operators and has as its main objectives the promotion of safe meat and meat products through the provision of pertinent information provided in a holistic integrated and practical approach. Use is made of a combination of texts, illustrative diagrams and photos to convey the basic principles of safe, quality and wholesome meat supplies from small ruminants production

It is the hope that this particular manual will achieve the intended goals of meat safety assurance.

Definition of terms

Abattoir/slaughter house: Means an establishment where food-producing animals are slaughtered and dressed for human consumption, approved and registered by the appropriate government authorities.

Ante-mortem inspection: Means any procedure or test conducted by a competent person on live animals for the purpose of judgment of safety, suitability and disposition.

Carcass: Means the dead body of an animal, especially one slaughtered and prepared for use as food (Removal of the head, feet, hide and internal organs).

Critical control point (CCP): Means a point, step or procedure in a food process at which control can be applied and, as a result, a food safety hazard can be prevented, eliminated or reduced to acceptable levels.

Dressing: Means the progressive separation of the body of an animal into a carcass and other edible and inedible parts.

Evisceration: Means the removal of the internal organs from the abdominal and thoracic cavities of a carcass.

Fecal: Means anything of or relating to or constituting feces.

Food Chain: means all the critical points through which a food product travels from the point of production or harvesting through to transportation, processing, packaging, storage, shipment and distribution and preparation for human consumption.

Goat Meat or chevron: Means the flesh of goat.

Meat Byproducts: Means any part other than meat desired from goat or sheep which can be used as food for human.

HACCP (Hazard Analysis and Critical Control Point) system: A system that identifies/ evaluates and controls hazards that is significant for food safety.

Hygienic: Means clean and sanitary.

Impervious:

Material that does not allow the absorption of water and other liquids.

Killing floor: Means area of an abattoir where the live animal is slaughtered.

Lairage: Means holding areas for animals waiting to be slaughtered.



Lamb: Means the flesh from a sheep less than 1 year old.

Mutton: Means meat from sheep more than one year old.

Official Mark

The official inspection legend or any other symbol prescribed by regulations to identify the status of any carcass under the Meat Inspection Legislation.

Pathogen

A microorganism (bacteria, parasites, viruses, or fungi) that is infectious and causes disease.

Pelt: Means the skin of a sheep with the wool on.

Potable Water: The term given to water that is safe enough to be consumed by humans or used with low risk of immediate or long-term harm.

Postmortem: Refers to an analysis/ autopsy carried out shortly after conclusion of an event such as, the inspection conducted by the government meat inspector of all animal carcasses immediately after they are killed.

Post-mortem inspection: Means any procedure or test conducted by a competent person on all relevant parts of slaughtered/ killed animals for the purpose of judgment, safety, suitability and disposition.

Preventive Measures: Means all procedures, techniques which are used to minimize or eliminate the food safety risks posed in the production of safe meats and meat products.

Residue: Refers to any substance, including metabolites, remaining in livestock's carcass at the time of slaughter or in the carcass tissues after slaughter, this is the result of treatment or exposure of the livestock to a pesticide, organic or inorganic compound, hormone, hormone like substance, growth promoter, antibiotic, anthelmintic, tranquilizer, or other therapeutic or prophylactic agent.

Sanitation: Means the act of maintaining clean condition in food-handling situation in order to prevent disease and other potentially harmful contaminants.

Sanitation Standard Operating Procedures (SSOPs):

Pre-operational and operational SSOPs should minimize direct and indirect contamination of meat to the greatest extent possible and practicable. A properly implemented SSOP system should ensure that facilities and equipment are clean and sanitized prior to the start of operations and appropriate hygiene is maintained during operations.

Sanitize: Means the adequate treatment of all food contact surfaces in a food processing or slaughter facility by use of an approved chemical or other compound which is effective in destroying potential contaminating micro-organisms which are of public health importance as well as substantially reducing other undesirable micro-organisms.

Sanitizers: Are chemicals or physical agents that reduce microorganism contamination levels presented on inanimate environmental surfaces.

Stun: This a process of making an animal unconscious for a short period of time before cutting the blood vessels of the throat during the slaughter process.

Withdrawal period: The period of time between the last administration of a veterinary drug and the collection of edible tissue or products from a treated animal that ensures the concentration of residues in food comply with the maximum residue limit for the drug.

Withdrawal Time: A “withdrawal” period is required from the time antibiotics are administered until it is legal to slaughter the animal. This is so residues can exit the animal’s system.

Module 1: HACCP, on farm food safety practices, animal Welfare and traceability

Module Objectives

- 1. To provide a brief overview of HACCP**
- 2. To Identify 3 main on-farm food safety practices that enhance the quality of meat.**
- 3. To provide examples of veterinary drugs used on the farm and their potential impact on the meat.**
- 4. To highlight the importance of animal welfare and traceability to the production of safe meat.**

At the end of this module readers are expected to know:

- 1. What is HACCP**
- 2. Three farm practices that impact the quality and safety of meat**
- 3. Some of the veterinary drugs used on the farm that can result in residues in the meat**
- 4. Important storage conditions for concentrate feeds and the implications for the health of the animals**
- 5. Names of at least two (2) diseases that may be transmitted by rats**
- 6. What happens to concentrate feed when it is exposed to moisture**
- 7. What is animal welfare**
- 8. What is traceability**

M1-1: Introduction to HACCP

The meat inspection programme that was first developed was based on sight, touch, and smell and referred to as organo-leptic inspection. The major public health concerns were the potential for transmission of diseases from sick animals to humans and the lack of sanitary conditions for animal slaughter and production of processed products. Meat inspection is aimed at keeping meat from diseased animals out of the food supply.

The Public Health legislations mandate that every carcass intended for sale to the public for human consumption must be inspected. The major objective is to prevent entry into the market of: meat from carcasses showing signs of disease (e.g. tumors and lesions), meat from animals with diseases such as Tuberculosis and fascioliasis that could pose human health risks, fecal contaminated meat and meat from carcasses bearing visible physical damage (such as bruises), which can also pose health threats.

Hazard Analysis and Critical Control Points (HACCP) is a food safety quality assurance system which is:

- Science based
- Aimed at the prevention of food safety hazards
- Take steps to prevent, minimize and or eliminate those food safety hazards at the critical steps in the production of meat from the farm to the fork.

There are seven principles of HACCP:

Principle 1: *Conduct a hazard analysis.*

- Determine potential food safety hazards at each step in the conversion of the live animal into a carcass. Identify the preventive measures that can be applied to control these hazards.

Principle 2: *Identify critical control points.*

- A critical control point (CCP) is a point, step, or procedure in the process at which control can be applied and, as a result, a food safety hazard (biological, chemical, physical agents) can be prevented, eliminated, or reduced to an acceptable level.

Principle 3: *Establish critical limits for each critical control point.*

- A critical limit is the maximum or minimum value to which a physical, biological, or chemical hazard must be controlled at a critical control point to prevent, eliminate, or reduce it to an acceptable level.

Principle 4: *Establish critical control point monitoring requirements.*

- Monitoring activities are necessary to ensure that the process is under control at each critical control point. The monitoring procedure and its frequency should be recorded in the HACCP plan.

Principle 5: *Establish corrective actions.*

- These are actions to be taken when monitoring indicates a deviation from an established critical limit.
- Corrective actions are intended to ensure that no product injurious to health or otherwise adulterated as a result of the deviation enters commerce.

Principle 6: *Establish record keeping procedures.*

- The HACCP system requires the documentation and the maintenance of certain records, including the hazard analysis and written HACCP plan, and records documenting the monitoring of critical control points, critical limits, verification activities and the handling of processing deviations.

Principle 7: *Establish procedures for verifying that the HACCP system is working as intended.*

- *Validation* ensures that the plans do what they were designed to do; that is, they are successful in ensuring the production of safe product.

Figure1 shows the processing steps for the conversion of the live animal to meat and table 1 provides a guide to hazard analysis of the processing steps.

Figure 1: The Steps in the Slaughter Process

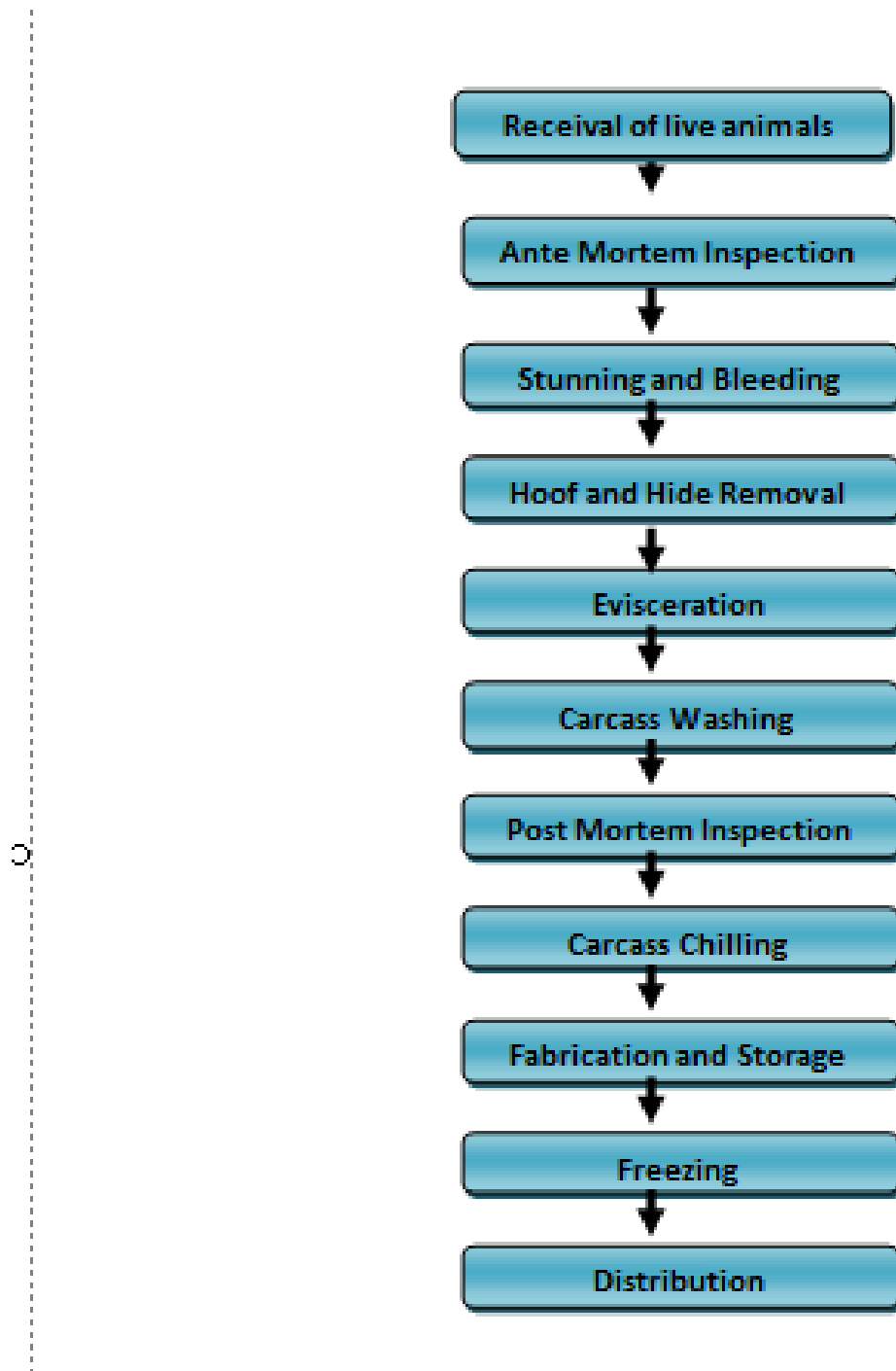


Table 1: Example of Hazard Analysis for the slaughter and processing of Sheep and Goat

Process Step	Potential Hazards	Control Measures
Receival Of live animals	<p>1. Microbiological -feaces, ingesta, hair coat/pelt. <i>Salmonella Spp.</i>, <i>Camphylobacter jejuni</i>, <i>Clostridium Spp.</i></p> <p>2. Chemical residue e.g. veterinary drugs, heavy metals</p>	<p>GMP,(Good Manufacturing Practices)</p> <p>Health certificate declaration from veterinary officer.</p>
Ante mortem Inspection	None	None
Stunning	None	None
Bleeding	Microbiological – associated with bacteria from the skin/pelt.	GMP- adhere to proper sticking technique to minimize contamination
Hoof and hide removal	Microbiological - associated with bacteria from the skin/pelt.	GMP- adhere to proper technique to prevent/minimize contamination
Evisceration	Microbiological – Germs from gastrointestinal track contaminate carcass during evisceration	GMP- Hygienic technique during evisceration and tying of the esophagus and the rectum

Carcass Washing	Microbiological – Use of non-potable water.	GMP – Use potable water for washing carcass
Post Mortem Inspection	None	None
Process Step	Potential Hazards	Control Measures
Carcass Chilling	Microbiological – growth and multiplication of microbes from the intestines can occur if there is cooling failure.	GMP – Cool to -2°C and 2°C (or 28°F to 35°F).
Fabrication	Microbiological - microbes from the intestines Physical Hazards – Metal, bones	GMP – Maintain cool temperature during fabrication. Use of metal detector,
Freezing	Microbiological – growth and multiplication of microbes can occur if there is refrigeration failure.	Freeze to minus -12°C
Distribution/transportation storage	Microbiological – growth and multiplication of microbes can occur if there is refrigeration failure.	GMP – Transport meat in refrigerated vehicle

Benefits of implementing HACCP System

The major benefits of implementing the HACCP system are as follows:

- It takes a preventative approach to the control of hazards in food
- It is systematic in how hazards are treated
- It helps to demonstrate to farmers and butchers the commitment needed in the production of safe meat

- It is an internationally accepted quality assurance system.

The key to the HACCP system is the analysis of potential production and meat processing hazards and identification of places or critical points along the production/process chain where measures can be taken to prevent or minimize these hazards. There are three main hazards that occur in the production of meat:

1. Biological (germ contamination)
2. Chemical (cleaning agents or veterinary drug residues)
3. Physical (foreign material in meat e.g., glass or pieces of bone, stomach contents).

During the slaughter of the animal you may identify several hazards, for example germs from the stomach, such as *E. Coli*. A critical control point to prevent this hazard is at the evisceration step.

During evisceration, extreme care must be taken not to puncture the intestines because there is the potential for spreading the germs to the carcass by the hands of the butcher or the knife. In the event that a spill occurs the corrective actions might include GMP (good manufacturing practices) i.e. immediate trimming of defects from carcasses, the sanitation of evisceration tools in 180°F water, etc.

It is absolutely prohibited to use cloth to wipe the carcass.

Butchers must be aware that this quality system called HACCP can only be implemented if the facility meets the recommended construction requirements and the operator of the slaughterhouse adheres to **GMP** such as cleaning and sanitation and personal hygiene etc.

M1-2: On Farm Safety Practices, Animal Welfare and Traceability

At the farm production level, good agriculture practices should be implemented in a way that reduces the likelihood of the introduction of disease causing micro-organisms and contamination by chemical residues in water, environment etc. while at the same time contribute to the production of safe meat that is fit for human consumption.

On the farm Good Hygiene Practices involves activities that directly impact the quality and safety of meat. Three main areas of focus at the farm level that directly affect the quality of meat are:

- Health status of animals
- Drinking water quality
- Feed quality and safety

M1-2.1: Health status of animals:

Records of the health status of each animal must be kept, these include:

- **The name of any drugs used to treat the animal**
- **Date/s when animal was treated**

All animals intended for slaughter must comply with the withdrawal periods as specified on the label of the veterinary drugs used prior to their transfer to the abattoir. The use of all veterinary drugs should be done under the control of a veterinarian.

This is done to prevent unacceptable levels of veterinary drugs residues in the meat intended for human consumption. Some common examples of veterinary drugs with withdrawal periods are:

- a) **Antibiotics** (injectable, tablets, powders, intra-mammary infusions for mastitis and dry off treatments)
- b) **Anthelmintics** (i.e. de-wormers) e.g. ivermectin, panacur, levox, valbazen)
- c) **Pesticides/ tick wash** (e.g. triatix, asunthol powder etc.)

M1-2.2 Drinking water quality:

1. Provide animals with clean water to drink. See figure 2
2. Protect water source from contamination with effluent, manure and herbicides

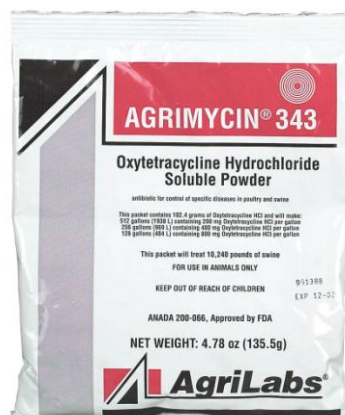
Fig 2: Animals drinking clean water



M1-2.3 Feed quality and safety:

1. Feed given to animals prior to slaughter should not contain substances that could result in residues in the meat at levels that make it unsafe for human consumption e.g. medicated feeds.
2. Neither antibiotics, hormones nor growth promoters should be added to the feed of animals at least 2 weeks prior to slaughter. See figure 3.
3. Proper storage of all chemicals/drugs is essential.
4. Do not use expired drugs.

Figure 3: Example of an antibiotic used in animal feed



5. Feedstuff and supplements should be protected from moisture and contamination by rodents and other pests.

6. Records should be kept of all feed stuff and feed ingredients and supplements. See table 2 for sample feed record sheet.

Table 2: Sample Feed Record Sheet

Farmer’s name and address..... Year

Name of feed	Composition of feed	Number/Flock of Animals Fed	Period (from/to)	Quantity of Feed

Other important points to consider when feed is stored:

Feed must not be stored in a wet area because it might absorb moisture which encourages the growth of molds, (fungi) that can produce aflatoxins (a special type of toxin which is very harmful to animals and human health). These toxins can be deadly to animals.

Pest control programme is very important at the farm level because rats and other pests can contaminate the feed and spread diseases such as Leptospirosis and salmonellosis. Remember, the quality of the feed impacts the quality and acceptability of the meat for human consumption.

M1-2.4: Animal Welfare

What is animal welfare?

This is an issue of serious concern which in times past was not given the attention it deserved. At the farm level it is very important to consider animal welfare not only for ethical reasons but also because it affects the productivity of the animal. Animals that are stressed, experiencing pain and discomfort or are

inadequately fed, watered or housed will not produce to their full potential and the quality of their meat produced is compromised.

Basic Animal Welfare involves:

- The **provision of potable water** ad lib as well as food and air to maintain health and productivity.
- **Protection from disease** and injury and access to veterinary care if necessary.
- **Sufficient space to lie**, stand, stretch and enjoy natural behaviour patterns
- **Adequate housing** (figure 4 shows an undesirable situation of overcrowding).
- **Protection** from extreme climatic conditions e.g., excessive sun, rain.

Figure 4: Shows overcrowding



M1-2.5: Traceability

To the extent possible, small ruminants should bear some form of identification so that the origin of meat can be traced back from the abattoir to individual farm and if possible the herd of origin. Ear tagging or tattooing can be used. See figure 5.

Figure 5: Ear tags



Module 2: Animal Selection, transportation and ante-mortem inspection

Module Objectives

- 1. To provide guidance in the selection of animals on the farm for slaughter**
- 2. To describe how animals should be transported**
- 3. To describe the ante-mortem inspection procedures**

At the end of this module readers are expected to know:

- 1. Ways of transporting sheep and goats for slaughter.**
- 2. The impact of improper mode of transportation of animals for slaughter**
- 3. What is ante-mortem inspection**
- 4. The importance of ante-mortem inspection**
- 5. Three objectives of ante-mortem inspection**
- 6. Abnormalities to look for during ante-mortem inspection**

M2-1: Selection of animals for slaughter

General assessment of animals for slaughter prior to leaving the farm/Feeding lot

Ordinary signs of ill-health should not escape the attention of the farmer making selection of animals for slaughter. Some abnormal conditions that may be considered signs of a state of ill-health are:

- i. Rapid breathing
- ii. High temperature and fever
- iii. A foamy or frothy mouth
- iv. Diarrhea
- v. Discharge from the body openings

Rectal or other protrusions

Figure 6: Abnormal signs

a) Diarrhea



b) Prolapse



Animals seen with any of the aforementioned signs must be separated from the rest of the herd and be fully examined and treated before being sent for slaughter or be culled.

Animals for slaughter should be assessed while in motion and at rest (see figure 7). Observation is made of the:

- Gait of the animal (signs of lameness, posture) and

- Ease with which the animal walks and runs in reaction to the farmer's command;
- State of nutrition (Muscle to bone ratio)

Figure 7: Animals in motion and at rest



The practice of slaughtering sick, diseased and dying animals in an attempt to salvage their meat is not permitted, since such meat can be a source of infection or food poisoning. An extremely weak, old and meager animal often have poor reflexes due to weak muscle condition and does not produce desirable meat upon slaughter. Also, animals in an advanced state of pregnancy must be spared from slaughter, because their blood has large accumulations of harmful waste materials associated with the developing fetus as such the meat should not form part of food intended for human consumption.

M2-2: Transportation of animals from farm to abattoir

Animals intended for slaughter must be clean and healthy. Animals should not be transported in a manner that will negatively impact their safety and welfare and as a consequence the quality of the meat. Traceability of the animals starts at the farm of origin and must be maintained throughout their movement. An appropriate method which can be used in transporting small stock in developing countries is shown in figure 8.

Figure 8: Example of an appropriate method of transporting small stock



M2-2.1 Some Guidelines for Animal Transportation

The following guidelines should inform the transport of animals from the farm to the abattoir:

- Animals must be loaded and un-loaded easily with **minimum risk** of injury.
- **Undue stress should be avoided** – larger and horned animals should be loaded first and be physically separated from the rest of the animals.
- Sheep and goats may be transported together, but **should not be mixed** with cattle because they may inflict injury to each other. However, if they must be transported together, they must be physically separated.
- **Overloading and overcrowding** should not take place so as to prevent animals from bruises and suffocation.
- **Ventilation must be adequate**, especially for sheep which are usually more prone to heat stress as compared to goats.
- On arrival at the slaughterhouse, the animals must be **unloaded with patience, avoiding all cruelty**.
- Should it be necessary to lift and carry the sheep or goat, **one hand must be placed under the jaw with the other at the hock** as illustrated in **figure 9**.

N.B. Sheep and goats should not be lifted by grasping the skin or hair as this may be painful and may cause surface bruising. To catch the animals, be sure to grab a leg first.

- The vehicle in which the animals are to be conveyed should first be washed and be disinfected with an approved disinfectant repeat after each unloading.

Figure 9: A recommended method of lifting sheep for easy loading/off-loading



M2-3: Ante mortem inspection

Ante mortem inspection refers to the inspection of the live animal by a government regulatory inspector prior to slaughter.

By law all animals intended for slaughter for human consumption must be subjected to ante mortem inspection. Ante mortem examination should be done within 24 hours of slaughter and repeated if slaughter has been delayed beyond a day.

There needs to be sufficient natural or artificial lighting to undertake antemortem inspection of the animals. Animals should be observed both collectively and individually and at rest and in motion (See figure 10). Live animal inspection provides invaluable information about the health status of animals to be slaughtered that will be useful at post mortem inspection.

M2-3.1: Objectives of Ante mortem Inspection

The major objectives of ante mortem inspection are as follows:

- To assist in preventing the production of an wholesome meat entering trade
- To identify in advance animal with diseases which if slaughtered would contaminate the slaughter-house
- To ensure animals are properly rested allow for a review of farm animal health report and the treatment history of animals intended for slaughter.
- To protect the health of the slaughter house worker through the prevention of unnecessary exposure to animal diseases particularly diseases that can be passed from animals to humans.

Figure 10: Ante mortem inspection of animals collectively and at rest



M2-3.2: The general procedures for ante-mortem inspection

The general procedures for ante-mortem inspection are as follows:

- I. Both sides of an animal should be examined and the animal should also be inspected whilst at rest and when in motion. (See Figure 10).
 - II. The general behaviour of animals should be observed, as well as their nutritional status, cleanliness, signs of diseases and physical or other abnormalities.
 - III. Some of the abnormalities which are checked for during ante-mortem examination include:
 1. Breathing
 2. Behaviour
 3. Posture (while standing or lying down)
 4. Structure and conformation
 5. Discharges or protrusions (swelling) from body openings (See figure 6)
 6. Colour of skin
 7. Odour of breath/faeces
- i. Abnormal breathing is observed in animals by looking at the movement of the rib cage. In some cases the tongue of the animal will protrude from the mouth in its effort to get air. If the breathing pattern is different from normal the animal should be segregated and be tagged as a suspect to be further examined.
 - ii. Abnormalities in behaviour are manifested by one or more of the following signs. The animal may be:
 - a. Walking in circles or show an abnormal gait or posture
 - b. Pressing its head against a wall
 - c. Charging at various objects and acting aggressively
 - d. Showing a dull or anxious expression in the eyes
 - iii. An abnormal gait in an animal is associated with pain in the legs, chest or abdomen or may be an indication of a neurological disease.
 - iv. Abnormalities in structure (conformation) are manifested as:
 - a. Enlarged joints
 - b. Umbilical swelling (hernia or omphalophlebitis)
 - c. Enlarged sensitive udder indicative of mastitis

- d. Bloated abdomen
 - e. Swellings (abscesses) - particular importance for Caseous lymphadenitis (CLA) diagnosis.
- iv. Some examples of abnormal discharges or protrusions from the body are:
- a. Discharges from the nose, excessive saliva from the mouth, afterbirth
 - b. Protrusions from the rectum (e.g. rectal prolapse)
 - c. Protrusions from the vulva and vagina (e.g. uterine prolapse, limb or head of unborn kid)
 - d. Tumors or growths on the eye
 - e. Bloody diarrhea
- v. An abnormal colour is not necessarily as important as the other abnormalities, however the inspector should be on the lookout for signs of inflammation (red areas on light coloured skin), gangrene (dark blue areas on skin or udder) and jaundice (yellow discoloration of the skin or white of the eye).
- vi. An abnormal odour is difficult to detect on routine ante-mortem inspection. The odour of an abscess, a medicinal odour, or an acetone odour of ketosis may be observed.

NOTE: The government Inspector will make a determination about the animal based on the aforementioned findings with normal animals proceeding to slaughter and abnormal animals segregated for further inspection.

Module 3: Abattoir Site selection construction, layout, slaughter tools and equipment

Module 3 Objectives:

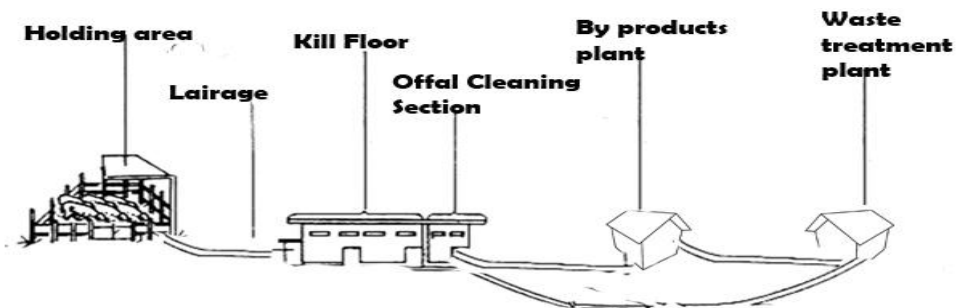
- 1. To provide some guiding principles for the construction of a slaughterhouse**
- 2. To outline some critical features of the layout of a slaughterhouse**
- 3. To describe the materials suitable for use in the construction of a slaughterhouse**
- 4. To have knowledge of the tools and equipment used in the slaughter process**

At the end of this module readers are expected to know:

- 1. Some factors to be taken into consideration when determining the site for the construction of an abattoir**
- 2. The basic layout of a slaughterhouse and some hygiene provisions**
- 3. The materials to be used in the construction of a slaughterhouse**
- 4. The equipment and tools required for slaughter**

M3-1: Siting of Abattoir/ Slaughterhouse

Slaughterhouses are best sited on the outskirts of a town or village, at a distance from built-up areas. This is to prevent possible inconvenience to dwelling-places either by way of pollution from slaughter wastes or by way of nuisance from noise, stench or the presence of scavenging animals such as vultures, stray dogs, etc. that may be associated with the operation.



The area selected should be open, treeless and with air currents to provide for natural lighting and ventilation. Dark environments can cause lapses in hygiene while stagnant air can induce growth of spoilage organisms on meat and meat handling equipment. Trees also attract birds which are potential vectors of disease agents.

The site selected should afford for easy drainage. The siting of slaughter premises near waterlogged areas must be avoided. Such sites can give rise to sanitation problems such as the breeding of mosquitoes and stagnation of slaughter and animal waste material. Where possible, the location of the slaughterhouse should be made at a higher elevation relative to the surroundings.

If siting is close to rivers and streams the liquid waste must be treated before it is discharged into rivers and streams thereby causing environmental pollution. The quality of the treated liquid waste must meet national environmental standards for liquid waste and be rendered safe for aquatic life or for humans using the water source.

The abattoir must be sited where it is easily accessed and in an area that has electricity and water supply.

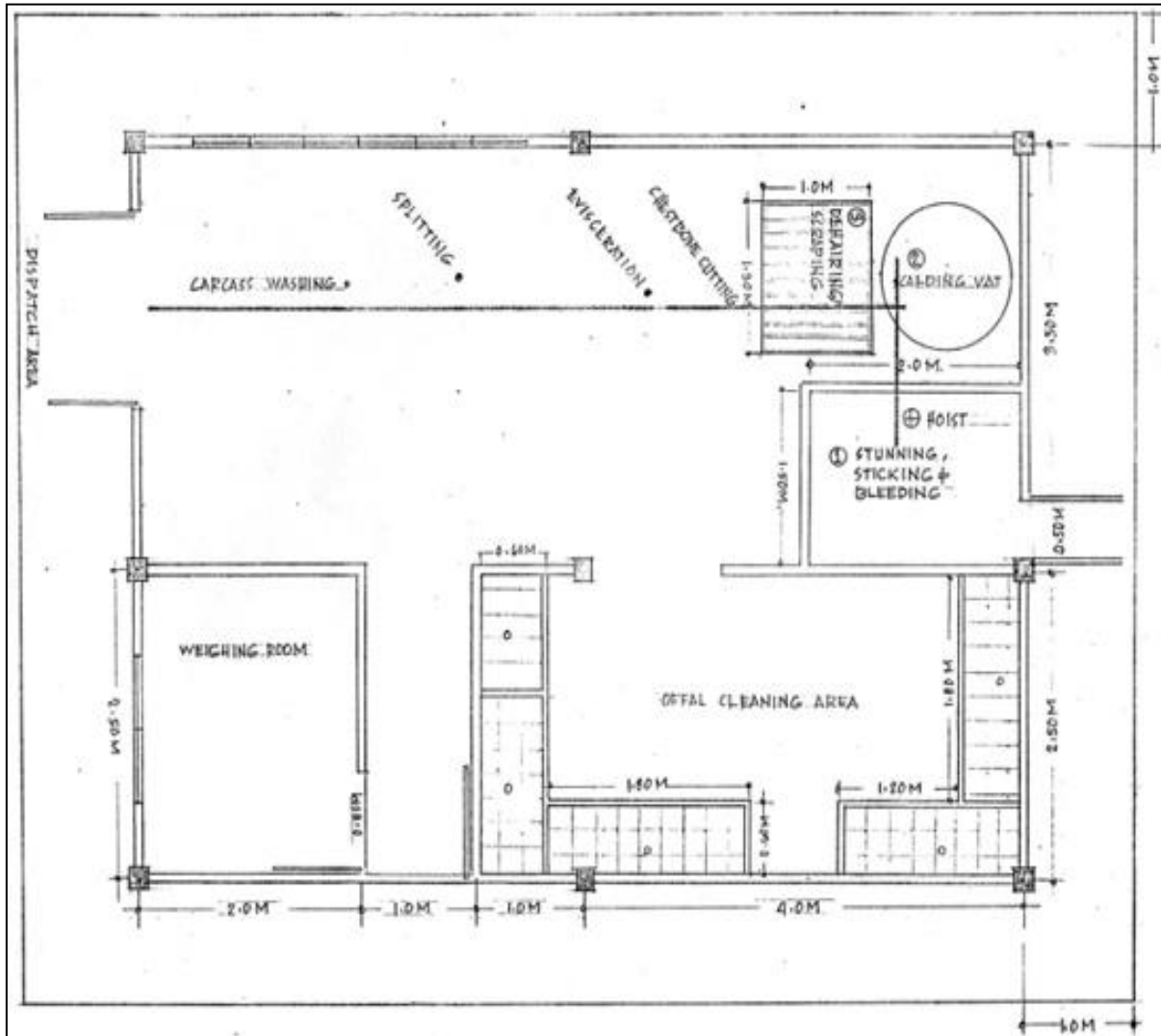
M3-1.1: The Slaughter Premises

The premises must be fenced to restrict access and prohibit entry of unauthorized personnel and stray animals onto the compound. Lairage should be enclosed and must have safe potable water for drinking and ample feeding troughs. Animals should have ready access to grazing in the event they are not slaughtered within 24-48 hours of arrival to the abattoir. The minimum space that should be provided Sheep/Goat 35m²/head.

M3-1.2: The Kill Floor

Each area on the kill floor must be physically identifiable and there must be separation of operational zones as far as possible such as killing, dressing, inspection and cleaning areas. Additionally, each zone or area should have its own set of equipment. See layout of slaughterhouse above.

Figure 11: Layout of slaughter house



M3-1.3: Materials for Construction and Installation in the abattoir/slaughterhouse

Materials for constructing and equipping the slaughterhouse must be durable and able to resist deterioration or destruction from external influences such as the

weather, wind, steam, water and pests and be non-absorbable. This means that materials such as wood and corrugated iron are undesirable. It is recommended to use concrete, stone, tile and metal panels.

On the kill floor materials used must be impervious to water and blood or stained by fat. Glazed tile or a hard smooth material should be used for the walls to facilitate cleaning and prevent absorption of moisture and fat. Equipment should be made of stainless steel, galvanized metal or aluminum. However, hard plastics may be suitable for some containers and some working surfaces e.g. inedible offal and condemned meats.

M3-2: Facilities, Equipment and Tools

M3-2.1: Water and Drainage

All slaughter premises must have a dependable source of potable water, preferably pipe-borne, to maintain hygiene and sanitation in the abattoir. Approximately 100 liters of water is required to process one small ruminant. The water must be well distributed in terms of point and location on the kill floor. So called rhino tanks are commonly used as a water storage facility and can be used where pipe-borne water is not available.

Hot water at a temperature of 70C must be available for sanitizing knives, and other tools used in the slaughter process.

In the absence of pipe-borne water, surface or underground water from rivers and wells maybe used but must be pre-treated. Such water may be treated using 1 table spoon of bleach to a gallon of water. It would be useful, however, to install a reservoir or tank on the premises as a back-up against shortages and breakdown of pumps.

M3-2.2: Floor

The floor of the abattoir should be designed to slope toward the main collecting drain; the latter in turn should slope toward exterior connecting pipes. The floor must also be rough or grooved to prevent slipping.

All washings or wet cleaning must easily run over and off the slaughter floor into a collecting drainage and empty eventually outside the building.

M3-2.3: Lighting and Ventilation

Transparent roofing can be placed in the roofing at vantage points to provide natural lighting. It is recommended that the light intensity for the kill floor be 220 lux. Ventilation can be provided by wide windows covered with mesh which also serve to exclude insects.

Where any light bulb or light fixture is suspended over an area where slaughter occurs or meat is handled the bulb or fixture must be shielded to prevent contamination of the meat by falling dust particles insects etc. The shielding is necessary to prevent contamination in the event of breakage of the bulb. The lighting must be suitable and adequate and in compliance with the occupational health regulations.

M3-2.4: Sanitation

Hygienic measures deal with the operational aspects or the creation of conditions under which animals, activities and personnel can be secured from contaminating the products, (cross-contamination) whereas, sanitation is focused on the establishment and maintenance of a healthy environment and appropriate physical conditions suitable to achieve the production of a wholesome un-contaminated product. In essence, the two concepts are identical with the same end-result, but different target areas.

The scope of sanitation may be identified broadly with structures and facilities:

- The premises
- Installation
- Equipment

Additionally, sanitation covers specific slaughter operations that are likely to cause contamination, e.g. offal cleaning, waste disposal and pest infestation.

M3-2.4: Construction and layout of Facility

Materials used in constructing and equipping the plant must be durable; specifically they must be impervious to water, easy to clean and to sanitize, non-corrosive and not attractive to insects or termites.

The slaughter/dressing area should be clearly demarcated from the offal/waste handling areas, as well as, from areas designated for staff welfare such as lunch room, bathrooms and toilets. In other words, the layout should provide for appropriate product process. The interior of all rooms and chamber should have ample lighting and ventilation: lighting to facilitate the work and ventilation to flush out stagnant air and enhance the keeping quality of the product.

The availability of adequate water is most important. Standards should be in keeping with local Public Health Legislations and should stipulate the use of ample supply of potable water from the public or municipal supply system. The availability of hot as well as cold water is necessary.

Provisions must be made for emergency water and the necessary mechanisms must be in place to ensure that it meets the required standards for the operation of the slaughterhouse. Size of facility will depend on through-put in terms of animals to slaughtered on daily basis.

M3-3: Vermin and their Control

Vermin include rats, mice, flies and cockroaches, which can multiply in great numbers within a short period of time.

These creatures live in hidden places (i.e. splits, holes and crevices in floors and walls) and gather dirt on their skin, appendages and mouth/mouthparts, with which they can contaminate meat. The danger lies in both the physical contamination of meat by dirt as well as their ability to transmit disease as mechanical vectors. For example, rats can transmit the agents of food poisoning, leptospirosis, typhus fever and bubonic plague among others.

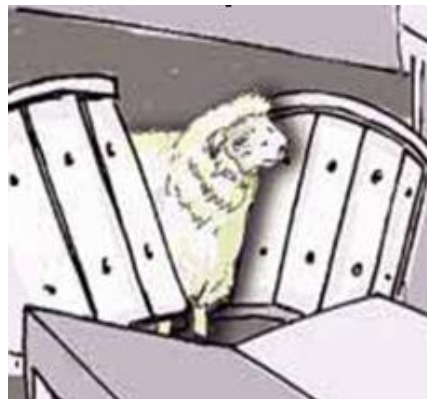
They are usually attracted by the accumulation of waste material (manure, offal etc). Therefore cleanliness and general environmental sanitation will in the control of these vermins. Doors and windows should also be secured by rat and insect proofing. All openings must be adequately screened to keep out vermin and other pests. Pest control programmes are an essential part of maintenance and sanitation and should follow Good Hygiene Practices (GHP).

M3-4: Basic Equipment for Abattoir/ Slaughterhouse

The standard equipment used in modern slaughter premises are those necessary to effect the rapid and hygienic conversion of food animals into meat, which includes the processes of carcass dressing and cleaning of offal.

- a. The facilities and equipment used for dressing of the carcass include:
 - ii. **Stunning Pen:** A small or narrow enclosure into which the animal is led from the Lairage to be rendered unconscious after which it is bled (see Figure 12).

Figure 12: Stunning Pen



- iii. **The Hoist:** A device for lifting up the stunned animal for bleeding. It can be operated manually (block and tackle), mechanically or electrically. The hoisting system can be built into an overhead rail-system to facilitate the movement of the animal for dressing and the carcass for inspection.

In small slaughter facilities and where animals are not marketed at weights in excess of 100 pounds after stunning, the animal can be manually lifted and the hind legs placed in a pre-tied loops. See Figure 13 below.

Figure 13: The manual lifting of animals after stunning



- iv. **Skinning Cradle:** A V-shaped metal structure (see figure 14) onto which the bled animal is placed for skinning and evisceration. This is used where a hoist system is unavailable.

Figure 14: Skinning cradle



- b. The offal gear comprises the following major equipment:
- i. **Drums/ Large plastic buckets:** These are containers for receiving blood or collecting gut material and are also utilized for disposal of non-carcass components such as shanks and hoofs.
 - ii. **Offal Cleaning Table:** This may be of concrete, galvanized metal or stainless steel and be provided with high pressure water points for cleaning offal.

M3-5: Orientation of Slaughter Floor Activities

As far as possible, the carcass dressing and offal cleaning operations should be kept separate.

A small slaughterhouse may operate on a single “all-purpose” floor, but the separation of dressing and cleaning operations should be done by organizing the activities in such a way that they flow in one direction only from dirty to clean. Care must be exercised to minimize or prevent cross-contamination during the dressing operations as skinning and evisceration are dirty operations and can cause contamination of the meat.

Blood collection and the initial handling of condemned meat must also be done carefully and away from the edible carcass.

M3-6: Slaughter Tools

Relatively fewer tools are required for the slaughter of small ruminants, and some can be made by local machine shops. They include the following:

- a. **Sticking Knife:** A knife with a six-inch blade (12.2cm) sharpened on both sides and a pointed v-shaped end used for severing the blood vessels of the neck to allow animal to bleed.

Figure 15: Sticking Knife



b. Skinning Knife:

As the name implies, this knife is used for the removal of the animal's skin. Also with a six-inch blade and characteristically curved backwards to allow for ease of operation, it can be used to scrape off burned hair from carcasses being dressed with the skin-on.

Figure 16: Skinning Knife



- c. **Meat Saw:** A replaceable blade

handsaw which is used in sawing through bones.



Fig 17: Meat Saw

d. **Meat Chopper:** Also called the cleaver, the meat chopper is a heavy axe used for separating heavy structures, e.g. the head from the neck and the shanks from the leg.



Figure 18: Meat Chopper

e. **Spreader:** A metal device for suspending the animal's body and spreading out the legs for dressing and inspection purposes.



Figure 19: Spreader

f. **Grinding and Honing Stones:** Grinding stones are coarse grained and used for the initial sharpening of knives into thin edges, which are then finished with the honer of fine-grain to provide extra thinness. Either oil or water may be used in sharpening knives to prevent the stone from heating the knives.



Fig 20: Grinding Stone

g. **Steel:** A long tapering, rounded and smooth metal rod on which knives are smoothed from time to time to improve sharpness.

Figure 21: Steel



h. Meat Hooks: These are metal devices with bent curved ends for holding or displaying parts of the carcass and offal for washing and inspection.

Figure 22: Meat hook



i. Butchers Gloves: Made of stainless steel to protect fingers from

ii. getting cuts during the dressing and fabrication processes.

Butchers



Figure 23:
Gloves

Module 4: The slaughter process

Module Objectives:

1. To provide guidelines for the slaughter of sheep and goat from the animal arrives at the slaughterhouse
2. To illustrate how humane slaughter should be done
3. To describe the steps in the slaughter of sheep and goats
4. To provide the requirements for the proper storage of meat
5. To outline the cleaning process after slaughter
6. To provide a brief description of the edible offals

At the end of this module readers are expected to know:

1. How animals should be treated in the holding-pen or lair age
2. What is humane slaughter
3. The stunning methods recommended for sheep and goats
4. The steps in the slaughter of sheep and goats
5. How meat should be stored and at what temperature
6. How to clean up after slaughter
7. What are offals and how they are categorized

M4-1: Animal Holding and Care

Physically fit animals that are to be slaughtered within 24 – 48 hours are placed in the lairage for rest. During the resting period any excitement of the animals must be avoided.

Feed must be kept away from the animals at least during the last eight hours before slaughter. This reduces the volume of gut contents which contain bacteria and therefore reduces the risk of carcass contamination during dressing process. However, fresh clean water may be provided throughout the resting time as this will enhance the skinning process. (see Figure 22).

Rest is important for the animals because overworked or fatigued animals produce lower quality meat due to the absence of rigor mortis it also affects the efficiency of the bleeding process. The meat quality is believed to be negatively affected if the animal is fed during the resting period prior to slaughter.

Time must therefore be allowed for the gut to empty itself of the feed which would cause fewer nutrients to be present in both the blood stream and cells of the body. With this, spoilage bacteria act less in the carcass, thus reducing the incidence of off-taste and souring.

Additionally, when a lot of food is present in the gut, it makes evisceration difficult. Conversely an empty gut reduces viscera size and makes its removal easier: It also lessens the possibility of spilling the contents of the gut on to the carcass. Therefore, the reduction in the volume of gut contents which contain bacteria will serve to reduce the risk of carcass contamination during dressing.



Figure 22: Animals drinking water prior to slaughter

M4-2: Humane Slaughter

Humane slaughter is the slaughter of animals that are in a complete state of unconsciousness prior to bleeding. Stunning is the process whereby the animal is rendered unconscious by mechanical, electrical or chemical means and is unable to feel pain. Stunning also renders the animals motionless thus eliminating or minimizing the risk of the animal injuring the butcher or the assistants.

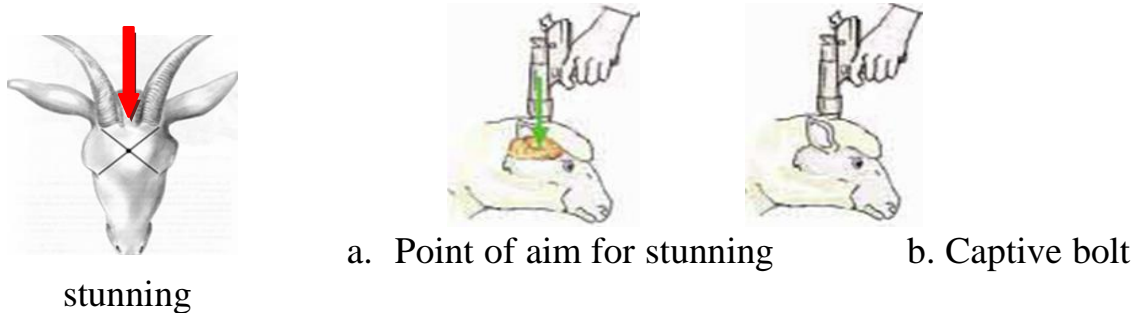
M4-3: Methods of Slaughter

Unless not permitted by rituals and/other established traditions, the humane method of slaughter is recommended for use as they allow for safer, more economic and hygienic operations and a desirable quality product. The following steps are crucial in the application of the method:

M4-3.1: Stunning

- a. **Mechanical Stunning:** The modern mechanical method of stunning is by shooting, consisting of two forms:
 - i. Use of a captive bolt pistol which delivers a force (concussion) into the head of the animal to make it unconscious (see figure 23).

Figure 23: Captive bolt pistol stunning



- ii. A penetrating .22 caliber 1.2 grain can be used with sheep, calves, young lambs and goats

The following are signs of an ineffective mechanical stun:

- The animal does not collapse immediately and may attempt to raise its head and stand up
- The eyes are rolled down

An older method in which a knocking or striking hammer is wielded on the head of the animal is now disallowed in humane practices in some countries, but in extreme and needy cases the hammer can be used to stun small ruminants by a quick blow at the back of the neck or in the center of the forehead (see figure 24). The reason for banning the use of the hammer is because butchers often do not know the precise point on the skull to inflict the blow that will cause the animal to become unconscious and often resort to battering the animal with several blows.

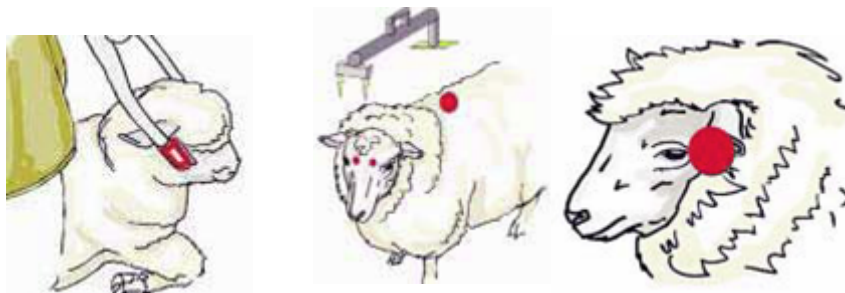
Figure 24: Old method of mechanical stunning



b. Electrical Stunning

The simplest mechanism consists of electrodes or probes built in the form of tongs, with insulated handles, which is applied between the ears and eyes of the animal on either sides of the head, or head to shoulder, for 1-4 seconds (See figure 25). About 5-7 seconds must elapse before the animal is bled. The level of voltage used for sheep and goats is between 60 and 70 volts/AC 50-60 cycles.

Figure 25: Electrical Stunning methods



It is important to re-emphasize that stunning only lessens consciousness. It is necessary that the animal still be alive, as the pumping action of the heart is needed to improve the efficiency of the bleed-out after the throat is cut.

M4-3.2: Throat Cutting and Bleeding

Figure 26: **Bleeding process**



Bleeding: Stunned animals must be positioned for bleeding. Sticking must only be carried out on animals that are stunned and should immediately follow the stunning process. The knife that is used must be clean and sharp and as specified previously be of sufficient length for the specie and size of the animal.

Figure 27: Bleeding of the arteries



Both carotid arteries and the vessels from which they arise (close to the heart) should be severed.

Following sticking, the animal must be allowed to bleed to death before further dressing of the animal begins. The minimum time for bleed out for sheep and goats is two minutes after sticking. The animal should be placed in a vertical or hanging position, which can be achieved by shackling the animal below the hock of one or both hind legs and hoisting it (head down) to a convenient height. Hoist bleeding is more hygienic and is recommended. It also facilitates collection of blood for further use. The actual bleeding operation is done by sticking or inserting the sticking knife through the neck behind the jaw bone and below the first neck bone. The objective is to sever the blood vessels of the neck and let out the blood. See figure 27

If the sticking is made at a lower position than indicated the oesophagus can be cut and with viscera contamination posing a risk.

Insufficient bleeding and slow death could be caused by incomplete severing of the blood vessels of the neck, particularly if the arteries are missed and only the veins are cut during sticking. Practice and experience can however perfect the technique.

M4-4: Methods of Skinning

M4-4.1: Hoist Skinning

In the process for skinning of sheep or goats, special care must be taken when the animals have long wool or hair to prevent contamination by contact with the carcass.

To make it easier to prevent contamination, the lower portion of one leg should be skinned out and the animal hung by the Achilles tendon from the rail rather than using the skinning cradle.

Figure 28: Beginning the process of skinning



With the animal body in the hoist position, and the skinning knife in hand, skinning should start from the rump leaving about $\frac{1}{2}$ inch of skin that is free from wool (or hair) around the anus. The head (with horns) is removed at the spine, washed and placed on a hook.

Skinning then proceeds along the flanks and back, gradually reaching the shoulders and neck. The forelegs are skinned and the lower legs removed at the knee joint (**See figure 29**). The foot is cut off at this joint and the tendon loosened and hung on a hook to suspend the leg. The process is repeated for the other leg while the cuts are continued on the inside of both legs towards the navel region. The body skin is removed next.

Using the knife, the brisket is skinned, but from this stage on, the knife is normally not used further. This is to protect the “fell” a fine membrane occurring between the skin and the carcass which helps to improve the appearance of the carcass and reduce surface shrinkage.

In place of the knife, further skinning is accomplished by fisting (i.e. by use of the human fist forced between the skin and the fell) to remove the skin. As illustrated in figure 30. Fisting also protects the skin from cuts and bruises which otherwise lower its value as a by-product. The process of fisting begins from the brisket to the navel, then over the sides of the carcass, the rear legs and around the shoulders, ending at the forelegs.

To drop the skin off, a cut is made around the tail and bung.

Figure 29: Hoist skinning process



M4-4.2: Horizontal Skinning

The animal is placed on its back on a skinning cradle. (See figure 30) Cutting and fisting then begin at the forelegs, working toward the belly and sides of the animal, ending at the hind legs. The tendon between the hock and the toes is exposed and loosened and the feet, bung and head cut at the designated points. The body skin is removed in a similar manner as in hoisted skinning, the exception is that the carcass is hoisted and the skin along the back bone pulled off.

Figure 30: Skinning Cradle

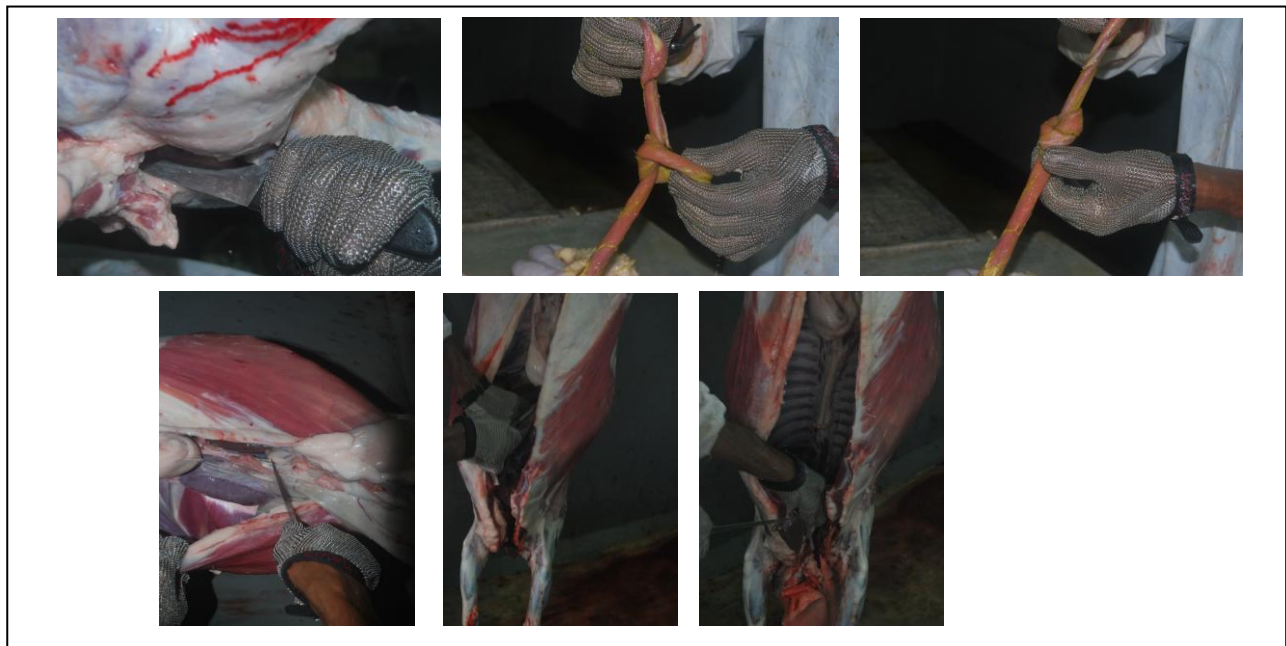


M4-5: Evisceration

With the external structures, skin, feet and head removed, the next step is to cut open the animal's body to dislodge the contents and produce the carcass. Try to avoid contamination of the carcass through accidental cuts or punctures of the stomach and intestines. For this, it is important that the carcass is placed in the hanging position then tie off the rectum and esophagus.

The first step in evisceration is to cut around the tied bung or rectum and free it completely from all attachments and drop it in the pelvic cavity. See figure 31

Figure 31: Evisceration Steps



The body cavity is entered into, to sever the ureter connections to the kidneys while the intestines are loosened up further. The stomach and intestinal mass (also known as the paunch) are then pushed slightly out of the midline opening. The kidneys, and sometimes the spleen which are often left in the sheep carcass are placed in the trough, see figure 34.

Figure 33: Removing offals

In the next step the liver is held out, severed of its connecting tissues and then pulled out together with the freed contents of the abdominal cavity. It is placed into the tray of the portable cart with other edible offal. (see figure 34).

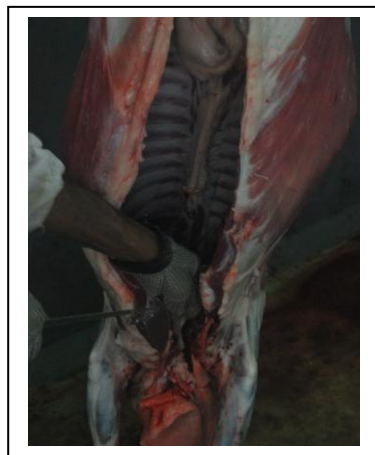


Figure 34: edible offal portable trough



The gall-bladder is cut from the liver, taking care not to spill its bitter contents on to the carcass and spoil the taste of the meat (See figure 35). The final stage in evisceration is the removal of the contents of the chest cavity. By cutting the thin muscle sheet, or diaphragm, separating this cavity from the belly, the heart, lungs, trachea and oesophagus (i.e. the pluck) can be pulled out as a unit. The carcass is then washed and made ready for post mortem inspection by the Meat Inspector (See figure 36).

Figure 35: Removing Gall-bladder



M4-5: 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 good hygiene practice 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 never be used.**

Figure 36: Carcass washing



Only potable should be used in the preparation of the carcasses. Soiled carcasses should be sprayed/washed with potable water immediately after dressing before the soiling material dries, thus minimizing the time for bacterial growth.

A wet surface favors bacterial growth so the water should be allowed to drain from the carcass.

M4-6: Postmortem Inspection

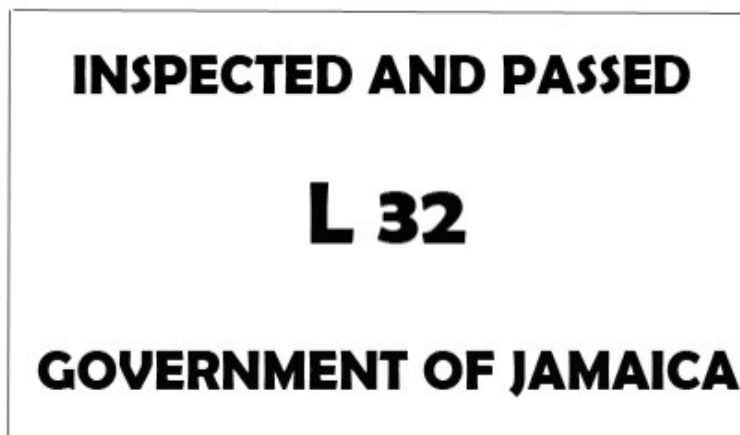
Postmortem inspection should be carried out as soon as possible after the completion of carcass dressing. Besides, the carcass parts of the animal body which are assembled for inspection are the tongue, head, pluck, liver and stomach and intestines. The carcass is held in the suspended position, while the

visceral organs including the head and tongue are placed on hooks in a separate area and the stomach and intestines remain in the basin or bucket. Each carcass must be identifiable with its set of organs for post-mortem inspection as the results of either will have implications on the action taken for the other.

Inspection is normally carried out by trained Public Health Inspectors. Their duty is to examine the slaughter products for evidence of disease and abnormality and eliminate them from the public meat supply.

If the carcass is deemed fit for human consumption, the inspector places a stamp on the carcass bearing the words **Passed by the government of** e.g. Jamaica and it bears the unique identification number of the stamp assigned to the particular inspector. See figure 37. The ink used is of food grade.

Figure 37: Example of stamp



M4-7: Special Measures

Carcasses and edible offal that are considered fit for human use are stamped as “INSPECTED” and/or “PASSED” prior to its dispatch to the markets. Unfit meat or those found unwholesome are placed in a designated container marked “CONDEMNED” (with the words written in red ink), such meat is denatured and destroyed.

M4-8: Sanitation after Slaughter

FLOORS must be completely free of meat scraps, blood, fat and all manure or dirt at the end of each slaughter session .To be effective, sanitizing agents must be warm enough and must be in contact with the surface to be sanitized for at least 45 seconds.

SUITABLE SANITIZERS INCLUDE: hot water [77°C (171°F) or higher], chlorine solution [≥ 100 ppm at $\geq 24^{\circ}\text{C}$] or a solution of any other appropriate non-toxic sanitizing agent that provides a bactericidal result equivalent to or better than chlorine. Whichever agent used must be approved for use in food establishments.

M4-8.1: Hot Water Treatment

When using hot water as a sanitizing agent, the water must be clean and a temperature of at least 77°C (171°F) must be maintained. The surface to be sanitized must be in contact with the water for at least 45 seconds.

M4-8.2: Chlorine Solution

Household bleach (about 5% chlorine by weight) can be used to make a sanitizing solution. To make a chlorine solution that has at least 100 parts per million from household bleach would require 9 mL (2 teaspoons) of bleach in 4.5 litres (1 gallon) of water. To be effective, the solution must be kept at a temperature of 24°C (75°F) or more and must be kept clean.

M4-8.3: Storage of meat

Slaughter operations are not considered complete until carcass or meat leaves the

premises for the markets. Traditionally in many developing countries, meat is preferred in the freshly slaughtered state; hence it is delivered to markets soon after inspection. In those cases, slaughter premises may have no need for cold storage and thus cold storage is not provided for in the design. In this case butchers tailor their supplies to the daily needs of the community and surpluses must be disposed of because such meat is no longer suitable to be frozen for sale.

M4-8.4: Chilling of Carcasses

Cooling of carcasses is necessary before it is taken to the market. Considerations must be given to the fact that freshly slaughtered carcasses are warm with temperatures close to ordinary body temperatures (37°C or 98.6°F) of the live animals and are subject to the growth and multiplication of bacteria. Therefore they should be cooled rapidly under natural ventilation on the hoist in a well-spaced position until the surface is dry. Where refrigeration is available the cooling should reach a temperature of about 10°C (or 50°F). However, if it goes below this point, the carcass might “sweat” on the surface when taken outside, and this could cause bacterial growth.

M4-8.5: Chilling and Freezing of Meat

Sheep and goat carcasses should be cooled to a temperature of between -2°C and +2°C (or approximately 28°F to 35°F) for a period of 18 to 24 hours prior to being taken to market. During the cooling process cold air should flow rapidly and in so doing prevents surface spoilage and deterioration in deep tissues. After cooling the carcasses must be refrigerated.

The carcasses can be frozen whole or cut transversely along the last rib into two and packed in such a way to allow free air movement around them. It should be noted that slow freezing in contrast to rapid freezing causes the formation of large ice crystals within spaces in the muscle fibers that upon thawing, these fibers sometimes rupture resulting in low quality meat.

M4-8.6: Storage of Edible Offal

Apart from the carcass, other edible meats include red offals (liver, kidney and heart), grey offals (stomach, intestine, lungs and spleen) and dark offals (head and feet). The red offals can be given the same cooling treatment as the carcass, but the others should be sold quickly. If storage is desired the grey and dark offals should be held in a separate chamber and spread out to allow for more effective cold action.

Module 5: Hygiene provisions in the slaughter of animals, personal hygiene, slaughter house sanitation and waste disposal

Module Objectives:

- 1. To recap the hygiene provisions in the slaughter of animals**
- 2. To provide guidance on personal hygiene of butchers**
- 3. To provide guidance on slaughterhouse sanitation and waste disposal**

At the end of this module readers are expected to know:

- 4. How wastes from the slaughterhouse should be treated**
 - 5. 1. The major sources of the contamination of the meat during slaughter**
 - 6. 2. Good personal hygiene practices to be adhered to during the slaughter of animals**
 - 7. 3. Cleaning and sanitation of slaughter house**
 - 8. 4. How wastes from the slaughterhouse can be treated**

M5-1: Principles of Slaughter Hygiene

M5-1.1: Basis and Criteria

The subject of hygiene because of its importance has been covered in every module of this manual. Because of possible gaps and omissions, this section is presented to consolidate the subject matter and broaden its scope.

There are three basic criteria upon which hygienic measures in slaughterhouse operations are based. These are the need to:

- a. Eliminate the risk of bacterial infection and chemical residue accumulation and consequential food poisoning with meat as the vehicle of transmission.
- b. Prevent spoilage or putrefaction and thereby enhance the keeping quality and safety of meat.
- c. Secure meat of good eating quality, appearance and aesthetic value through proper handling.

M5-2: Sources of Bacterial Contamination of Meat and Ways to avoid them

Unless otherwise infected, the meat of freshly slaughtered animals is basically sterile. The presence of micro-organisms on post-slaughter carcasses is thus due to cross-contamination occurring immediately before, during and after slaughter. The major sources of cross-contamination are:

The animal itself, tools and equipment used in slaughter, the workers and the slaughterhouse environment itself.

Dirt, soil, body discharges and excreta from animals in holding pens or lairages are the primary sources of contamination of carcasses during slaughter. This often happens irrespective of whether the animals are fit and have passed ante-mortem inspection. In some cases the animals are washed just before stunning and bleeding. This step has the added effect of cooling or calming down the animals which is important in the production of good quality carcasses.

Animal carcasses should never be dressed on the floor. The hoisting of the animal during sticking, skinning, evisceration, washing and inspection is recommended to minimize contamination of the meat. For the hygienic slaughter of animals the abattoir should have adequate floor space with suitable equipment to handle the animal. Therefore, only the minimum number of persons should be allowed on the kill floor to handle the slaughter and offal cleaning. Some precautions that must be taken in slaughtering involve the following:

- a. Sticking:** The knife should be cleaned after each animal and rinsed in hot water. Contaminated knives can transmit bacteria into the animal tissues during the early stages of bleeding when the pumping action of the heart is strongest, if this should happen, deterioration in deep tissues can result. Knives should be appropriately stored and be sanitized regularly.
- b. Skinning:** Uncontrolled knife skinning or even fisting can similarly introduce spoilage organisms onto the surface of the carcass. Roasting and scraping of the animal head and feet as is practiced in the Caribbean and other developing countries should be done in a way to avoid splits in the skin by fire action.
- c. Evisceration:** Care should be exercised not to puncture the intestines. The butcher should follow the procedure by first tying the bung (rectal end of the intestine) and the cut end of the esophagus before removing the intestine and stomach then the trachea, heart, lungs, etc. These organs should be hung on a hook while the stomach and intestines should be dropped in a container designated for this purpose. The stomach and intestines should not be opened while carcass dressing is in operation as this can cause cross-contamination of the meat.
- d. Washing:** Carcasses should be washed with clean potable water under slight pressure if possible.
- e. Offal handling:** The various classes of edible offal, red, grey and dark are cleaned separately. The red offals (liver, kidney and heart) can be washed on a separate line in the slaughter room after inspection, but grey offals which include the stomach and intestines must be moved to an area

provided for this purpose. Initially they should be emptied of their contents then flushed with water.

- f. **The dark offal**, (head and feet) should be roasted, scraped and washed outside the premises. The dark and grey offals are utilized as byproducts and should therefore be disposed of as soon as possible or be refrigerated.
- g. **By-products**: Blood is used for food. It coagulates soon after leaving the animal.
- h. **Condemned and inedible offals and waste**. These are variable and include the gut contents, blood and trimmings that are not used for food. Coagulated blood and other solids must be strained out before disposal into the sewage system.

M5-2: Personal Hygiene

Personal hygiene of workers is a very important factor in slaughter operations. Contamination of the meat can be caused both by human element as well as from the tools and methods of slaughter.

Persons who come into direct or indirect contact with edible parts of animals or meat should:

- i. Maintain an appropriate standard of personal cleanliness.
- ii. Wear appropriate protective clothing and ensure that non-disposable protective clothing is cleaned before and during work.
- iii. Immediately wash and sanitize hands and wear protective gear when there has been contact with diseased animal parts (e.g. abscess, tumors) which are likely to harbor germs.
- iv. Cover cuts and wounds with waterproof dressings. All persons, particularly the butcher, involved in the preparation of the carcass must be in possession of a valid food handlers permit issued by the Ministry of Health.

Slaughter and dressing of animals and handling and inspection of meat, presents many opportunities for cross-contamination. Personal hygiene practices should prevent undue general contamination, and prevent cross-contamination with human pathogens that may cause food borne-related disease.

Persons who come into direct or indirect contact with edible parts of animals or meat in the course of their work should maintain appropriate personal cleanliness and behaviour, and should not be clinically affected by communicable diseases likely to be transmitted by meat.

NB: Persons who come into direct or indirect contact with edible parts of animals or meat should:

- Maintain an appropriate standard of personal cleanliness;
- Wear protective clothing appropriate to the circumstances, and ensure that non-disposable protective clothing is cleaned before and during work.

M5-2.1: Sick Persons

Sick persons clinically affected by, or suspected to be carrying a disease likely to be transmitted through meat should not be engaged in the slaughter of animals. If a person is not well, particularly if the illness is associated with diarrhea, that person should not engage in the slaughter of animals for human consumption. It should be noted that some people become lifelong carriers of diseases such as typhoid (salmonella).

M5-2.2: Cuts, grazes and other skin lesions

Cuts, grazes and other skin lesions should be covered, using blue waterproof adhesive tape, or waterproof gloves. This is because, during the healing process of skin lesions, the organism *Staphylococcus aureus* multiplies around the wound. This organism could then easily be transferred to meat where it produces a toxin that is responsible for food poisoning. The appropriate and regular washing of hands are mandatory activities by all facilities workers.

M5-2.3: Wear Protective Clothing

Personal clothing can carry micro-organisms. Therefore, to protect the meat from this risk, protective coveralls should be worn. The coveralls should be light

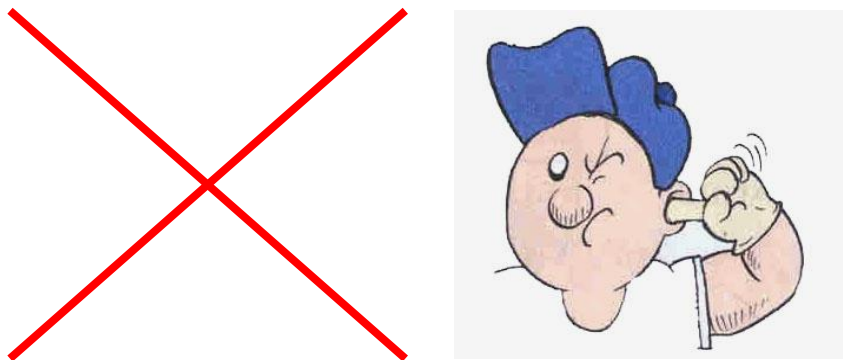
in color so that contamination can be easily identified and the coveralls cleaned and sanitized. Clean waterproof footwear should be worn, and should either be replaced (disposal shoe covers) or cleaned and sanitized before starting or resuming work after a break, and similarly at the end of such work period. Protective clothing should be worn outside of slaughter or processing areas.

M5-2.4: Wearing of Jewellery

The wearing of jewellery and watches are not allowed in a slaughterhouse because dirt and organisms such as *S. aureus*, can build up on and around such items. They also pose a risk of foreign body contamination of the meat product if they fall into the food. Cosmetics, false nails or eyelashes and strong perfumes should not be allowed because of the risk of contamination and even tainting of the food. In this regard workers should be prevented from wearing of rings, chains and other personal paraphernalia in the slaughter and processing area. Hair and beard restraint should be made mandatory.

M5-2.5: Touching of Body Parts

Figure 38: Inappropriate touching



All parts of the body carry numerous microorganisms including *S. aureus*. While it is impossible for a person to remove all of these micro-organisms, careful attention to personal hygiene will minimize the risk of contamination.

Care should be taken not to touch the ears, nose, mouth, eyes and hair while

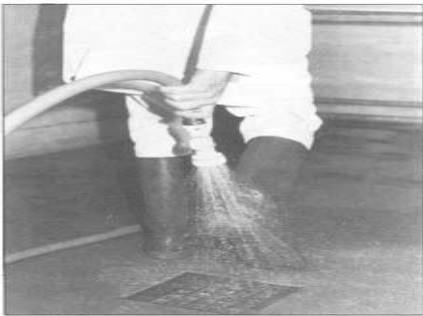
working in slaughter and processing facility areas. (See Figure 38).

These parts of the body may carry a higher number of organisms that could be transferred to the meat through miss-handling and cross-contamination. Therefore in this light, chewing, eating, spitting and smoking should also be discouraged. Hands should be kept clean, and fingernails short (see appendix 1 for the WHO ten steps to proper hand washing). The following approach to hand washing is recommended. Wash hands:

- i. Before the slaughter of animals;**
- ii. After using the toilet;**
- iii. After coughing, sneezing or touching the face or hair;**
- iv. And after handling any waste or contaminated material. Even if gloves are to be worn the hands must be kept clean and the gloves washed as for hands or changed.**

At the end of slaughter the butcher should wash his boots with water under pressure, as illustrated in **Figure 39**. Also use should be made of foot baths provided at entry and exits to slaughter and processing areas.

Figure 39: Washing boots



M5-3: Sanitation and Waste Disposal

M5-3.1: Cleaning and Sanitizing Operations

Large quantities of clean water are required for the cleaning of floors, walls, equipment and tools and appropriate chemicals for the sanitizing of all meat contact areas. The operation should begin with removal of solid waste such as meat and fat trimmings, bone chips, blood clots and so on by brushing them off the floor. High pressure hosing of water is then applied, starting from the walls and other rigid surfaces and ending with the floors. Hot hosing under pressure is more ideal as it melts down fat and removes sticky waste from corners and drains.

For scrubbing of tables, working surfaces and tools, hard fiber brushes and detergents are recommended. Liquid detergents are more useful than ordinary soaps, because they dissolve more easily in water by reducing the hardness while absorbing dirt or attaching themselves to it for removal by flushing with water. If liquid detergents are not available, powdered soap may be dissolved in water and used. After rinsing the washed items should then be disinfected. Knives must be sharpened and sterilized in boiling water.

M5-3.2: Maintenance and sanitization of establishments, facilities and equipment

- Establishments, facilities and equipment should be maintained and sanitized in such a manner that contamination of meat is minimized to the greatest extent practicable.
- Documented programmes for effective and appropriate maintenance and sanitation should be in place.
- Monitoring of the effectiveness of maintenance and sanitation
- Special sanitation requirements should be applied to the slaughter and dressing of animals that are condemned or designated as suspects.

M5-3.2.1: Maintenance and sanitization of equipment

Maintenance and sanitation

Establishments, facilities and equipment should be kept in an appropriate state of repair and condition to facilitate all sanitation procedures and prevent contamination of meat, e.g., from metal shards, flaking paint and chemical contaminants. All equipment should be easily accessible for cleaning and sanitizing.

SSOP's should specify the scope of the cleaning programme, cleaning specifications, persons responsible and monitoring and record keeping requirements.

M5-3.2.2: Cleaning procedures and programmes

Cleaning procedures and programmes should:

- Be specified in SSOP's as appropriate to the circumstances;
- Provide for removal and storage of waste;
- Ensure that there is no consequential contamination of meat with detergents or sanitizing agents.
- Be monitored for their effectiveness, e.g., organoleptic checks and microbiological sampling of meat contact surfaces.

Specific documented cleaning programmes are required for equipment used in the slaughter and dressing of carcasses e.g., knives, saws, machine cutters, evisceration machines if used.

The equipment used should be cleaned and sanitized:

- Before each new period of work by immersion in hot water or alternative methods, with appropriate frequency during and/ or between periods of work;
- Immediately cleaned and sanitized when coming into contact with abnormal or diseased tissue that may harbour food-borne pathogens; and
- Stored in designated areas in such a manner that it will not become contaminated.

Containers and equipment should not be moved from an area where inedible products are handled to the edible products area before being cleaned and sanitized.

General Principles of Food Hygiene

In particular:

- The programme should be properly documented and verified by the operator of the slaughterhouse;
- Treatment of areas, rooms, facilities and equipment, with an approved pesticide should be carried out according to the conditions of use; and
- Pesticides and other pest control chemicals should be kept in secure storage, with access limited only to authorized persons.

M5-3.4: Slaughterhouse Waste Disposal

The wastes from a slaughter house are usually heavily polluted. Therefore, waste water from a slaughter house should not be allowed directly into a municipal drainage system without previous treatment.

In the slaughter premises, the general principles regarding waste disposal are;

1. The solid waste (e.g. sweepings from the floor of the dressing area etc.) must be separated from its liquid counterpart.
2. Secondly, the liquid waste must be separated from the conventional drainage system of the toilets and bathrooms.
3. The two lines should be separate and be identified before being joined together on the outside.

The purpose of this is to prevent contamination of the premises in the event of a back-up of conventional sewage in the early stages of discharge. A trap gully basin should be provided to collect residual solids, (especially fat) to prevent clogging of the system. Clogging can also result from discharge and coagulation of blood in the drainage system creating further back-up problems. It is therefore better to collect blood in special containers for disposal.

The second phase of treatment involves bacterial breakdown of dissolved substances in the liquid phase. This process requires oxygen to convert organic

matter into simple inorganic substances, which are removed by physical treatment or by chemical means. Only at this stage the water is considered treated, although it is not recommended for human use. This water can be used for agricultural purposes or be discharged into the sea, rivers or streams.

M5-3.4.1: Manure/Waste Disposal

Digestive and excretory wastes of ruminants, collectively referred to as manure, are a mixture of dung and urine and occur in two forms:

- i. As sweepings from lairages which are built into heaps outside the slaughter building and collected from time to time in small quantities by small farmers to be used as fertilizer.
- ii. And as kraal manure which is less preferred, as it involves manure remaining permanently on the holding grounds, which may create problems of collection.

Manure is usually utilized for composting but can also be used for biogas (fuel) production.

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6. WHO Guidelines On Hand Hygiene in Health Care (advanced draft): a summary, Clean Hands Are Safer Hands, page 19, 2005.

Appendix 1

Handwashing Technique with Soap and Water



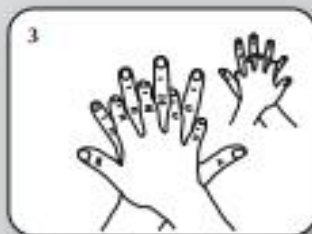
Wet hands with water



apply enough soap to cover all hand surfaces



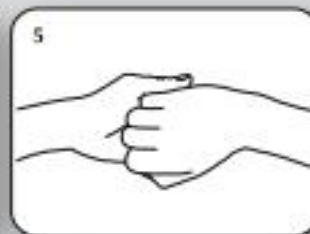
rub hands palm to palm



right palm over left dorsum with interlaced fingers and vice versa



palm to palm with fingers interlaced



backs of fingers to opposing palms with fingers interlocked



rotational rubbing of left thumb clasped in right palm and vice versa



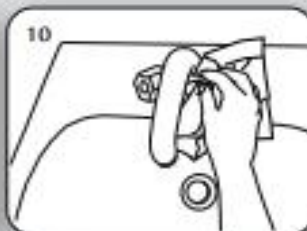
rotational rubbing, backwards and forwards with clasped fingers of right hand in left palm and vice versa



rinse hands with water



dry thoroughly with a single use towel



use towel to turn off faucet



...and your hands are safe.