

HALAL SLAUGHTERING TECHNOLOGY

GENERAL SCOPE AND
OVERVIEW



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Hak cipta terpelihara. Tiada bahagian daripada terbitan ini boleh diterbitkan semula, disimpan untuk pengeluaran atau ditukarkan ke dalam sebarang bentuk atau dengan sebarang alat, sama ada dengan cara elektronik, gambar dan rakaman serta sebagainya tanpa kebenaran bertulis daripada Politeknik Tun Syed Nasir Syed Ismail (PTSN).

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Halal Slaughtering Technology

For persons who want to understand the Halal Slaughtering Technology
and

For students at higher education (pre university level, diploma level, degree level)
who pursuing in Food Technology course.

Thank you everyone that directly or indirectly involved
during the production of this e-book

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PREFACE

Book of slaughtering encompassed on the pre and post slaughtering process involved. Where included various process such as animal handling, animal characteristic, stunning, slaughtering and post handling process of animal according to *Shariah Law*.

This book can act as a guideline for the beginner in food industry to get some ideas and knowledge about *Shariah Law* for slaughtering.

Enjoy your reading!

DEFINITION OF HALAL SLAUGHTERING

INTRODUCTION OF SLAUGHTERING

Definition of slaughtering is to kill an animal for food by cutting the two main veins (carotoc and jugular) in the neck of the animal which is trachea and esophagus using a sharp knife.



Bleeding occurred at the main veins pror severed. The bleeding will continue until the animal die due to excessive blood loss.



Slaughtering animal can be ritual slaughtering according to respective beliefs such as Shechita (Jewish slaughtering), Zabihah (Islamic slaughtering), Jhatka Karna (Sikhs ritual slaughter) and etc. (Sam Jones, 2014)



ISLAMIC SLAUGHTERING

Known as ritual slaughtering that had been done by Muslim according to the condition that Allah S.W.T. has issued.

Best and most complete way to slaughter is to cut the trachea, esophagus and the two main blood veins in the neck, and must be performed on the front of the neck without cutting the spinal cord.

By cutting the throat of animals to sever the trachea, esophagus and the major blood vessels jugular veins and carotid arteries using sharp tools with niyyah (intention) for the sake of Allah S.W.T.

The spinal cord will be cut, if the slaughtering are performed from the back of the neck, thereby killing the animal before the actual slaughtering has been done.

Slaughtering in Islamic Law is Wajib (obligation) to all Muslim for Halal animal (prior consume the meat).

Animals failed to be slaughtered according to Islamic principles will be known as carrion and Najs (cannot be consumed by Muslim).

UNDERSTANDING HALAL SLAUGHTERING

According to the Quran (*Surah Al-Ma'idah 5:3*), it is forbidden to consume the meat of an animal if: the animal's head is smashed, leading to death, the animal is strangled (with a rope) to death, the animal is killed by beating the animal to death, and the animal is forced to fall from a height and died. All animal killed in this manner are regarded as carrions and it is strictly prohibited for Muslim to eat them.

Islam has taught the way on how to end the life of the animal in the proper manner and that is by slaughtering. Slaughtering is very sacred and crucial matter in Islam. In order for the slaughtering to be lawful, several measures must be taken by the one performing the slaughtering. This is to ensure the highest form of benefit for both the animal and the consumer (JAKIM 2017)

Islamic slaughtering is killing of an animal in according to the Islamic practices. It is performed either by **al-Dhabi** (slaughtering) or **al-Nahr** (slaying).

Slaughtering can also be done either in the traditional manner using hand or by commercial mode by using mechanical device.



PRE SLAUGHTERING **(ANIMAL BEHAVIOR)**



PRE SLAUGHTERING

Ritual (halal) slaughter is guided by the principles of compassion towards the animal and ensuring food safety for the consumer. According to hadith literature, Prophet Muhammad (peace be upon him) stated: "When you kill, do so properly, and when you slaughter, do so properly. Each of you should sharpen your blade and minimize the suffering of the animal being slaughtered." (Proper application of halal slaughter h. Aidaros)



ANIMAL WELL FARE: 5 ANIMAL FREEDOMS

- Free from hunger and thirst
- Free From discomfort
- Free From pain, injury and disease
- Free From fear and distress
- Behave like normal animal

PRINCIPLE OF ANIMAL BEHAVIOUR

- A **basic understanding** of animal behavior in typical conditions—from the farm to the market or slaughterhouse—can greatly **assist handlers in managing** livestock effectively, helping to **prevent unnecessary stress and injury**.
- Animals that are not used to regular human contact—such as those raised on ranches or through extensive farming systems—are typically more difficult to approach or handle, as they do not easily allow people to come near or touch them.
- These animals require more carefully designed loading ramps, pens, and handling races compared to domesticated or tame livestock.
- Those responsible for loading extensively raised animals must understand their behavior and psychology to avoid causing injury to either the animals or themselves.



ANIMAL STRESS AND PAIN

- In particular mammals, including live stocks, Animals possess brain structures that allow them to experience fear and pain, and it is likely that they suffer pain in a manner similar to humans. Fear and pain are major sources of stress in livestock, and such stress can negatively impact the quality of meat produced from these animals.
- When animals are exposed to unfamiliar conditions or environments as a result of human actions, it becomes a moral responsibility to safeguard their welfare and ensure they do not endure unnecessary discomfort, stress, or injury.
- Effective livestock handling—carried out by trained, calm, and experienced personnel using proper techniques and appropriate facilities—along with efforts to minimize pain and accidental harm, can significantly reduce animal stress and help maintain the quality of meat and by-products.



RELATION OF ANIMAL VISION TO STRESS AND INJURY

- Ruminant animals are capable of **distinguishing between different colors**, with their eyes being most sensitive to yellow-green and blue light.
- Research and practical experience show that livestock—especially cattle are highly sensitive to contrasts in lighting.
- This sensitivity can cause them to hesitate or shy away from features such as drains, gates, or sudden changes in flooring, such as from wet to dry surfaces or from concrete to metal.
- Lighting should be uniform and softly diffused, as ultraviolet (UV) or diffused light has a calming effect on animals such as poultry and ostriches.
- Sharp contrasts between light and dark areas should be avoided, as they can cause stress or hesitation in livestock.
- Some livestock species, such as cattle and ostriches, have a wide field of vision. To prevent them from becoming frightened, it is important to eliminate visual distractions within their environment, such as sudden movements, unfamiliar objects, or people within their line of sight.
- distractions outside confines,

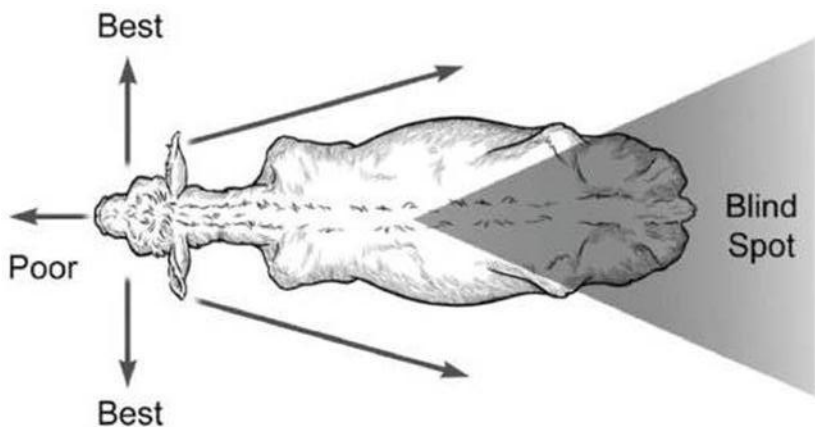


Fig: 1: view and blind spot for cattle

RELATION OF ANIMAL VISION TO STRESS AND INJURY

- Ruminants are easily **startled by movement and darkness**, often refusing to enter dimly lit or dark areas.
- Ruminants tend to move **from darker areas toward lighter ones**, as well-lit spaces are more soothing and comfortable for them.
- Using additional, **indirect lighting** can assist in guiding animals through pens. For example, placing a light to brighten the entrance of a race or removing a lamp that creates distracting reflections can significantly improve animal movement.
- Animals may **hesitate or refuse to move** if they see objects or features in the raceway that **frighten them**, such as:
 - ✓ dangling chains,
 - ✓ sparkling reflections,
 - ✓ moving people or equipment,
 - ✓ shadows or water dripping

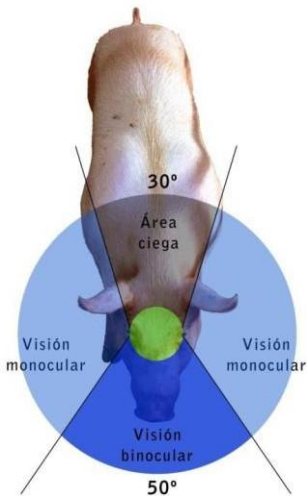


Fig 2: pen for cattle that block the ray of sun

RELATION OF ANIMAL VISION TO STRESS AND INJURY

Characteristic of Cow Eye

- Eyes in lateral position
- wide-angle panoramic vision (330°) (monocular)
- Narrow-angle binocular vision (50°) Very important for assessing objects distance
- Difficult focalization of close objects, take time to accommodate (strong reaction to too closed objects or moving too fast)
- Sensitive to contrasts of light and dark



- If air is blowing directly toward the animals, it should be redirected, as it may cause discomfort or hesitation.
- When animals hesitate to move, it is better to identify and remove the source of distraction rather than applying more force.
- Animals are easily frightened by rapidly moving objects, which can cause stress and reluctance to move forward.
- **Forcing** animals to approach a vehicle, pen, or building too quickly can lead to **panic** and unsafe behavior.

Image 3 the eye view of cattle

RELATION OF ANIMAL HEARING TO STRESS AND INJURY

- Cattle, sheep, and ostriches have highly sensitive hearing, especially to **high-frequency** sounds in the range of 7,000 to 8,000 Hz.
- intermittent high-pitched sounds—can cause discomfort or even pain to these animals.
- **Reducing noise** from equipment and people will improve animal movement, reduce stress and the risk of injury.
- People should **not yell**, whistle or make loud noises.
- **Clanging and banging** of equipment will unsettle animals and can be reduced by installing rubber stops.

Fig 4: Cow's ear



- However, it is well established that excessive noise generally **increases physiological stress levels in animals**.
- This applies equally to pre-slaughter handling and the handling of animals at the point of slaughter.
- Slaughter in a **small, quiet abattoir results in lower levels of stress hormones** in animals compared to slaughter in large, noisy commercial facilities.



RELATION OF ANIMAL SMELL TO STRESS AND INJURY

- Unfamiliar or strong smells can agitate animals, especially those not used to each other or their surroundings.
- Pre-mixing animals or rubbing pigs with litter from one source can reduce tension and fighting.
- Pre-mixing of these animals, or smearing pigs with litter from a single source will reduce tension and fighting amongst strangers.
- Animals may be disturbed by the smell of blood—cattle, for example, may refuse to enter a stunning box if the odor is blown toward them.
- Installing exhaust fans to remove such smells can help.
- Pigs and cattle commonly steer clear of places or objects contaminated with urine from stressed animals.



Fig 5: Cow's Nose

FARMING

- Animals raised on farms can impact meat quality;
- Nutrition plays a key role in the flavour intensity of sheep meat. Certain nutrients, such as those found in legumes and grains, can enhance flavour, while removing sheep from pasture before slaughter may reduce it.
- Vitamin E supplementation improves oxidative stability, preserving meat colour and preventing lipid and protein oxidation in both raw and cooked meat.
- Grass-fed animals often develop yellow-colored fat due to natural pigments in their diet.
- If animals are slaughtered immediately or shortly after chemical treatments, residues may remain in the carcass. This can reduce the meat's sensory, nutritional, and hygienic quality, and affect its suitability for further processing.

TRANSPORTATION

- Farm animals are often raised in remote locations, requiring transportation over long distances to access feed, markets, or slaughterhouses.
- Transportation begins with loading and unloading, which should be done carefully and calmly to reduce stress.
- During transport, animals face environmental stressors such as heat, cold, humidity, noise, and overcrowding.
- Driving behaviors such as speeding, abrupt braking, rapid acceleration, and long journeys without adequate rest can adversely affect carcass and meat quality.
- To reduce issues related to carcass and meat quality, it is essential to avoid speeding, sudden stops, quick acceleration, and prolonged travel without sufficient rest breaks.
- Strenuous measures must be made to protect the safety of animals during transportation in order to keep stress to a minimum.

MARKETING

- Animals are either sold at marketplaces or transported directly from farms to slaughterhouses.
- At marketplaces, they may be kept in groups or open enclosures, where they are exposed to harsh weather conditions such as direct sunlight or cold temperatures.
- They can experience stress due to loud noises, unfamiliar environments, and being regrouped with other animals.
- Prolonged withholding of feed and water may also lead to hunger and dehydration.
- Depending on how they are handled, animals may develop varying degrees of bruising on their skin while at the market.

SLAUGHTER PLANT

- A slaughterhouse is a facility where animals are processed for human consumption.
- The size and complexity of these buildings may vary depending on their location and the regulations set by local authorities.
- A well-equipped slaughterhouse should include, or have access to, the following essential facilities:
 - ✓ Slaughter area,
 - ✓ Emergency slaughter area
 - ✓ Scalding area
 - ✓ Refrigeration area including:
 - chiller
 - blast freezer
 - freezer
 - ✓ condemned meat area
 - ✓ space for holding suspect meat, offal, gut and tripe area, hide and skin area,
 - ✓ cutting room,
 - ✓ packaging room,
 - ✓ Dispatch area,
 - ✓ Staff amenities
 - ✓ Veterinary officer's room (preferably with a laboratory)
 - ✓ Lairage (accommodation for animals awaiting slaughter)



PRE SLAUGHTERING **(ANIMAL HANDLING)**



GENERAL PRINCIPLE

Animal Handling

- Handlers should move calmly and deliberately, avoiding sudden movements and loud noises to prevent exciting or stressing the animals.
- Livestock require approximately 30 minutes to calm down and for their heart rate to return to normal following rough handling.
- Calm animals are easier to move and are less likely to bunch together or resist being removed from a pen.

Electrical robe

- Electric prodders (or prods) should be used sparingly and only on animals that refuse to move.
- When necessary, a mild electric shock is considered more humane and causes less injury than striking the animal with a stick or twisting its tail.
- Battery-operated prods are preferred over those powered by mains electricity.
- The voltage should not exceed 32 volts and must never be applied to sensitive areas such as the eyes, muzzle, anus, or vulva.



Fig 6: Illustration of the Proper Use of an Electric Prod on Livestock
Image courtesy of the Guidelines for Humane Handling, Transport, and Slaughter of Livestock

GENERAL PRINCIPLE

Droving Aid

- Instead of electric prods, alternative droving aids should be used—such as flat straps, rolled-up plastic or newspaper, sticks with flags, or handling panels (especially for pigs).
- Hesitant animals can often be encouraged to enter pens or vehicles by leading in a tame animal first, as others are likely to follow.



Fig 7: shows the usage of electrical probe on livestock.

Courtesy of Guideline for humane handling, transport and slaughter of livestock

HANDLING IN CROWD PENS AND RACES

Livestock before being slaughter will be gathered in pens where the animal directed towards slaughtering house. The animal need to handle carefully to avoid injury and stress to animal.

Overloading

- **Overloading** the crowd pen is one of the most **common mistakes** in animal handling.
- To reduce stress and ensure smooth movement, fill the crowd pen and alley **only halfway**.

Animal forcing

- Handlers should avoid using crowd gates to force animal movement. Animals should walk up the race voluntarily, as pushing them too tightly makes handling more difficult.

Packed pens and races

- Animals packed too tightly may be unable to turn and enter the race.
- Hesitation to enter a single-file race is often caused by distractions ahead, such as a person in motion.

FLIGHT ZONE

- **The flight zone** is an animal's personal safety space, and handlers should work from its edge.
- If the animal faces the handler, it means the person is outside the flight zone.
- Entering the flight zone causes the animal to move away.
- If an animal becomes agitated when someone stands too close, it indicates the person is within the flight zone and should step back to reduce stress.

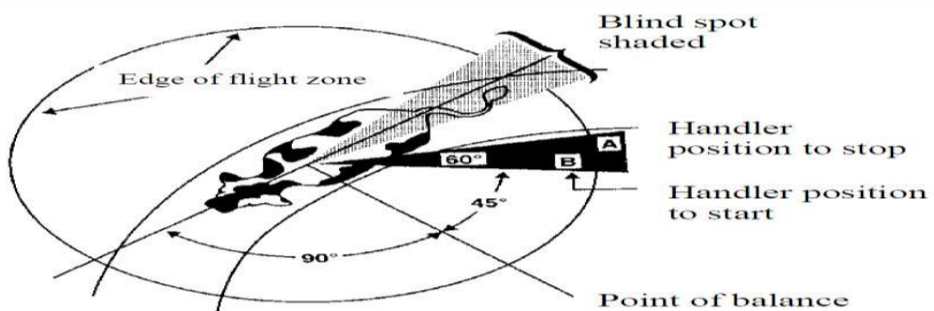


Figure 8 : Flight zone and point of balance

- **Installing solid** sides on races and **stunning boxes** helps calm animals by blocking their view of nearby people, reducing stress.
- The size of an animal's flight zone varies based on its temperament—wilder animals have larger flight zones, while tamer ones have smaller zones.



Figure 9 : Installation of solid side on ra ces

FLIGHT ZONE

- One cow is waiting at the end of the raceway, positioned in front of the stunning box, while another cow is already inside the stunning box.



Figure 10 : cattle at the end of raceway

- Animals that are regularly exposed to humans tend to have smaller flight zones, while those with little human contact have larger ones.
- Excited or stressed animals show an increased flight zone, whereas calm animals have a smaller one.
- Fully tame animals may have no flight zone at all, which can make them harder to move or drive.

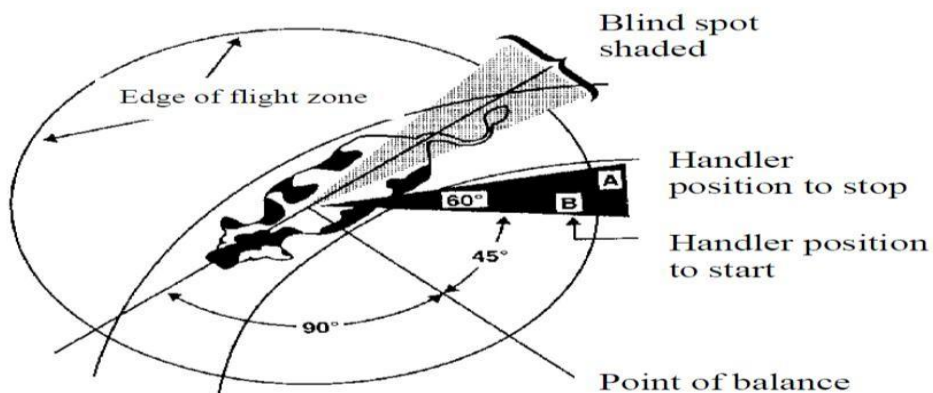


Figure 11 : Flight zone for cattle in raceway

POINT OF BALANCE

The **point of balance** is typically located at the animal's shoulder and is **influenced by its wide-angle vision**. Livestock will generally move forward when a handler stands behind this point, and move backward if the handler stands in front of it.

To **move an animal forward**, the handler should **stand behind the point of balance**, usually located at the shoulder. To make the animal back up, the handler must stand in front of this point. Cattle, sheep, and pigs will often move forward in a raceway when a handler walks **past them in the opposite direction** of their intended movement. The handler must **move quickly past the shoulder** to effectively trigger forward motion.

An animal will not move forward until the handler passes its point of balance, located at the shoulder, and reaches the hip area. Cattle begin to move forward when the handler walks past the shoulder, along the side of the single-file raceway, in the opposite direction of the desired movement.

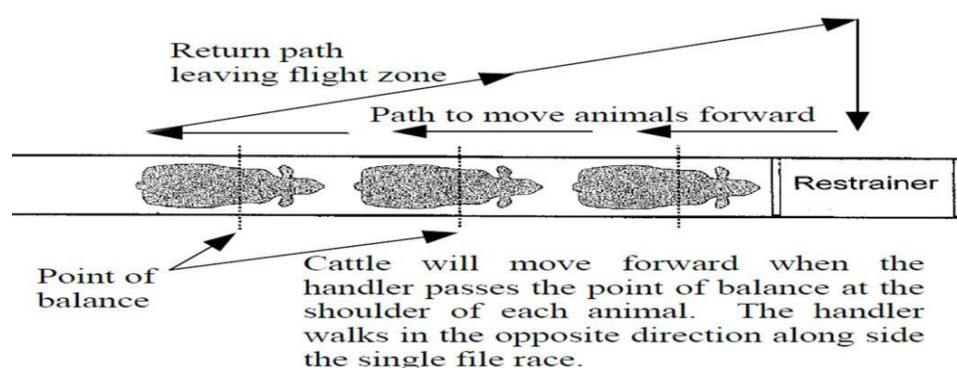


Figure 12: Proper handler movement patterns can effectively reduce the need for electric prods or goads when moving livestock.

DESIGN OF HANDLING FACILITIES

Improper handling of livestock can lead to high risks of injury and stress, resulting in financial losses for producers, transporters, and slaughterhouses.



Examples of handling facilities design:

- Poorly designed or inadequate pen fencing
- Loading ramps that are too low or unstable
- Expose to excessive heat and direct sunlight

Well-designed and properly constructed facilities on farms, auction yards, and slaughterhouses contribute significantly to the safe handling of livestock, helping to reduce the risk of injuries and stress for both animals and workers.



PROPER DESIGN OF HANDLING FACILITIES



Fig 13: A well-constructed pen or platform is essential for the safe offloading and holding of cattle, minimizing stress and the risk of injury.



Fig 14: **Holding pens** for livestock awaiting slaughter



Fig 15: Smooth **tubular rails** for pens partition



IMPROPER DESIGN OF HANDLING FACILITIES



Fig 16: Poorly designed pen fencing



Fig 17: Open pen – No shade
(Exposure of livestock to excessive heat and direct sunlight can lead to heat stress, affecting animal welfare and meat quality.)



DESIGN OF HANDLING FACILITIES : PENS

Livestock pens on farms, feedlots, auction yards, and slaughterhouses should meet the following welfare requirements:

- Provide enough space for animals to lie down comfortably.
- Bulls and boars should be housed individually, and if tied, must still be able to lie down.
- Clean drinking water must be easily accessible at all times.
- Water troughs should be raised or secured to prevent animals from falling in and drowning.
- In cold climates, pens should have walls and roofs to shield animals from harsh weather.
- In tropical regions, roofing is essential—especially for pigs—to prevent heat stroke and sunburn.
- Even free-range cattle can suffer in open pens without adequate shade or shelter.

DESIGN OF HANDLING FACILITIES : PARTITION

Rails made of tubular iron, wood or concrete should be smooth and without projections such as hinges, broken ends or wire.

Spaces should be adjusted to prevent animals from getting through or stuck and injuring themselves

	Rail distance	Rail height
Cattle	20 cm away	Top rail should be 1.5 m high
Sheep/goat	15 cm away	Top rail should be 0.9 m high
Pigs	15 cm away	Top rail should be 0.9 m high
Ostriches	20 cm away	Top rail should be 1.5 m high

Table 1: measurement for building partition

DESIGN OF HANDLING FACILITIES : FLOOR

Pen floors should be non-slip with a gradient not exceeding 1:10. Slippery surfaces can lead to bruises, fractures, dislocations, or skin damage in animals.

Concrete floors should be engraved with patterns or covered with mesh to provide adequate traction while allowing for easy cleaning.

If these options are not available, flat stone flooring can be used as an alternative.



Fig 17: non slip flooring design
for livestock handling areas

DESIGN OF HANDLING FACILITIES : RACEWAYS

Lanes are essential for guiding animals on or off vehicles, platforms, into holding pens, or slaughter facilities.

Races must be narrow enough to prevent animals from turning around or becoming wedged side by side, which can lead to injury, especially if they panic or are forced.

Recommended race width for cattle is approximately 76 cm, but this may vary depending on the breed and size.

Curved raceways are preferred, as they promote smoother animal movement by utilizing the animal's natural tendency to follow curves.

Solid sides on raceways—particularly in slaughterhouses and pre-stunning areas—help reduce distractions and prevent animals from balking or becoming frightened.



Fig. 20: One cow is positioned at the end of the raceway, waiting in front of the stunning box, while another cow remains inside the stunning box.

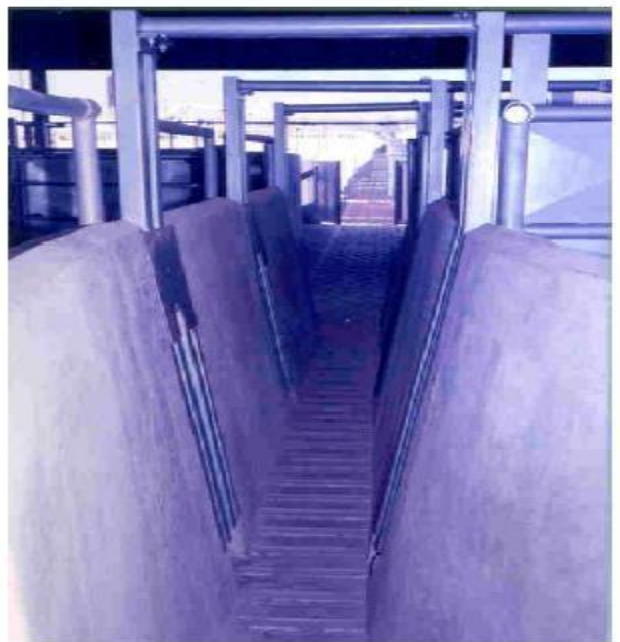


Fig 19: Raceways for cattle from holding pens for stunning area

DESIGN OF HANDLING FACILITIES :

RAMP AND PLATFORM

Both structures—the raceway and the stunning box—are essential for safely loading and unloading livestock from transport vehicles or guiding them toward slaughter facilities.



Ramps should be equipped with cross slats or steps measuring approximately 10 cm in height and 30 cm in depth to aid animal movement and prevent slipping.

The ramp should have a slope of no more than 20 degrees to ensure safe and comfortable movement for the animals.





HALAL SLAUGHTERING PROCESS



HALAL SLAUGHTERING METHOD

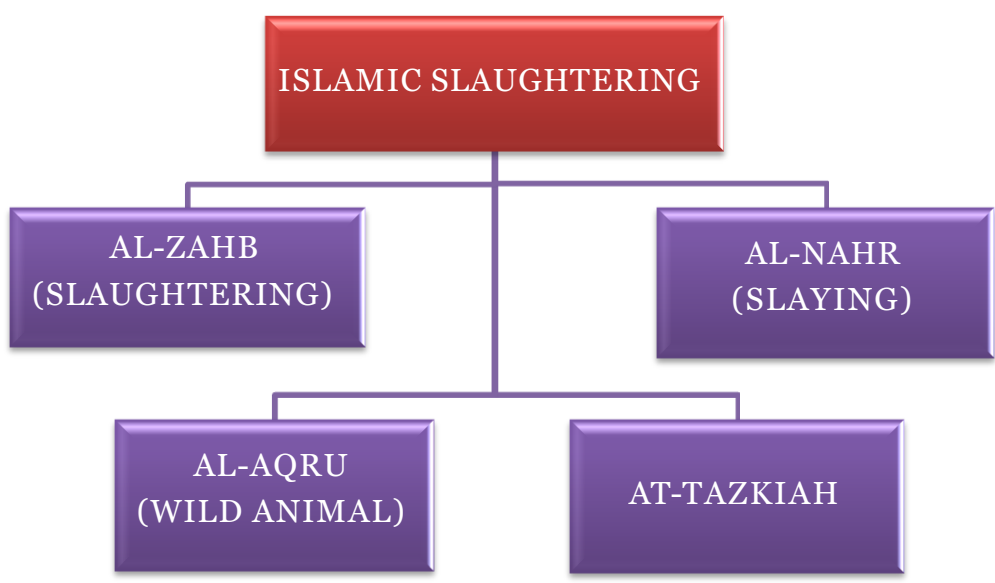


Figure 21: Types slaughter of Islamic slaughtering

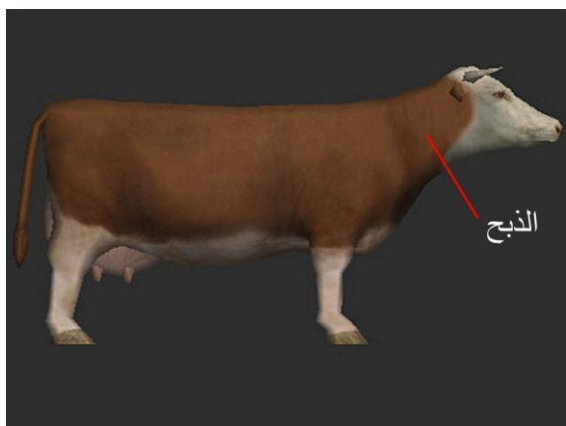
TERM FOR DIFFERENT APPLICATION FOR HALAL SLAUGHTERING

حَبْلًا (Al-Zabh)	Is the slaughtering involves severing or cutting the throat of the animal to sever the trachea, esophagus, jugular veins, and carotid arteries. This method is commonly applied to sheep, cattle, and poultry.
رَحْلًا (Al-Nahr)	Is the slaughtering involves stabbing to the throat and then slaying it up to the top of the chest. Usually, it will be practiced on camels and other animals with a long neck.
رَقْلًا (Al-'Aqru)	Wounding at any parts of an animal which cannot be controlled, whether it be a wild animal whose hunting is allowed or domestically animal that has gone wild e.g hunted with weapon
تَزْكِيًا (At-Tazkiah) / Al-Zakah	Slaughtering an animal in accordance to the Islamic Law whether by al-Zabh and al-Nahr (for animal can be controlled) or al-Aqru (for uncontrolled animal)

DIFFERENCE SITUATION OF SLAUGHTERING

UNDER CONTROL SITUATION	OUT OF CONTROL SITUATION
The animal is calm, does not writhe and can be well managed such as cow, camel, goat, chicken and etc.	The animal is in a state of agitation, fear and not being well managed for slaughtering such as wild animal and etc.
Usually livestock where taken care in farm.	Usually hunting wild animals or trapped animal.
Slaughtering method used is Al-Zabh and Al-Narh.	Slaughtering method used is Al-Aqru.

Types slaughter of Islamic slaughtering



Al-Zabh



Al-Nahr

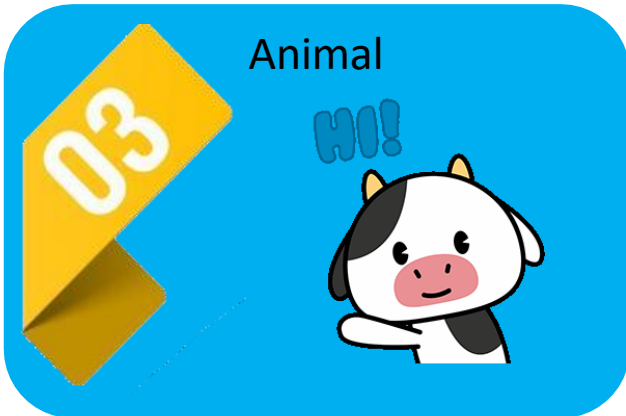


Al-Aqru



REQUIREMENT OF HALAL SLAUGHTERING

There are four requirements of Halal slaughtering which is slaughterer, tools and equipment for slaughter, animals to be slaughtered and slaughter process.



These requirements are obligate in order to complete the Halal slaughtering, otherwise the animals that been slaughtered is known as carrion or najs, prohibited to all Muslim for use it to their own benefits (JAKIM, 2017).

REQUIREMENTS OF SLAUGHTERER

Muslim

- Slaughterer is a person who in charge to slaughter the animals should be Muslim (both male or female).

Mentally sound

- Not having mental disorder which able to differentiate good and bad

Capable

- fully understands the fundamental rules and conditions related to the slaughter of animals in Islam

Intentions

- Each slaughtering be carried out with *niyyah* (intention) in the name of Allah for every slaughterer.

Certificated

- To meet the requirements of the Malaysian Standard for halal products, the slaughterer must hold a halal slaughter certificate issued by a recognized competent authority.

Meat from an animal slaughtered by an idolater, a nonbeliever, or someone who has renounced Islam is not considered permissible in Islam.

CRITERIA OF TOOLS AND EQUIPMENT

Dedicated for halal slaughter

- Use for halal slaughter only not interchangeable with non halal slaughtering.
- the impurities from non halal animal will contaminate with halal animal during slaughtering.
- cause halal status of meat will change to haram due of impurities from non halal animal residue at knife

Sharp

- knife or blade shall be properly sharpened (to ensure perfect cutting and least painful killing)
- Using blunt knife, the cut of knife will be rough and the blood will be coated around the vein because of heat generate by many sawing action during slaughtering process.
- If the blood clot coated around the vein occurs, the bleeding process will be slow and animal will need more time to die.

Clean

- Shall be free from blood and other impurities, because cold blood will make the knife dull making slaughtering can not done in proper way resulting prolong the bleeding time.

Sharp objects such as bones, nails, and teeth are not permitted to be used as tools for slaughter. It is because; those objects made from living things and consists blood veins inside it. The residue blood inside those objects may interact with slaughtered animal that may harmful to consumer (Jurhamid, 2020).

ANIMAL TO BE SLAUGHTERED

Halal Animal

- Any halal land animals are permitted to be slaughtered using Islamic slaughtering such as cattle, buffalo, goat, sheep, camel, bird and etc.

Hayat Mustaqirrah

- Animals must be alive (with a beating heart) or considered alive (*hayat mustaqirrah*) at the time of slaughter.
- Additionally, they must be certified as healthy by a competent authority, such as the Department of Veterinary Services (DVS).
- Haram to slaughter the animal if it's not deemed to be alive (*hayat mazbuh*)

Complete Bleeding Process

- Blood is najs in Islam causing eating animal that not proper slaughtering is Haram to consume due to residue of blood in animal's body.
- Blood is a diseases-carrying medium where the presence of disease and harmful microorganism can be detected in blood, this is one evidence why Muslim prohibited to eat blood.

Slaughtering animal at *hayat mazbuh* is Haram because bleeding process does not take place perfectly due to weak heart beats causing the blood still remains in the body (Saiyid, 2018)

CRITERIA OF HALAL LAND ANIMAL

ALL LAND ANIMALS ARE *HALAL* AS FOOD **EXCEPT**

- 1) Animals that are **not slaughtered** according to *Shariah* law
- 2) *Najs al-mughallazah* animal, i.e. pigs and dogs their descendants
- 3) Animals with **long pointed teeth or tusks** which are used to **kill prey** such as tigers, bears, elephants, cats, monkeys, etc
- 4) **Predator birds** such as eagles, owls and etc
- 5) **Pests and/or poisonous** animals such as rats, cockroaches, centipedes, scorpions, snakes, wasps and other similar animals
- 6) Animals that are **forbidden to be killed** in Islam such as bees (*al-nahlah*), woodpeckers (*hud-hud*), etc.
- 7) Creatures that are considered **repulsive** such as lice, flies, etc.
- 8) Farmed *halal* animals which are intentionally and **continually fed with najs**.
- 9) Other animals **forbidden to be eaten** in accordance to *Shariah* law such as donkeys

DIFFERENTIATIONS OF *HAYAT MUSTAQIRRAH* AND *HAYAT MAZBUH*

<i>Hayat Mustaqirrah</i>	<i>Hayat Mazbuh</i>
<i>Hayat Mustaqirrah</i> is that the animal is still strong and energetic whether after being slaughtered, hit by an vehicle or eaten by a wild animal with its physical condition is really strong with tis energetic movement and its blood is still squirting and flowing strongly.	<i>Hayat Mazbuh</i> is that animal already looks weak and seems to be dead but his snort can still be heard.
The ejaculation or blood flow is still strong squirting and flowing.	The ejaculation of blood flow is weak squirting and animals looks lethargic and lifeless and lacks of energy when it is slaughtered.
Had physical movement and animal is still strong floundering and energetic.	Had nonphysical movement and animal is weak and lethargic.
Bleeding process complete.	Bleeding process partial.
Halal to consume.	Haram to consume.

SLAUGHTER PROCESS

Welfare

- Slaughter should consider animal welfare in accordance with Shariah law, where every animal is to be treated with care, compassion, and respect.
- Taking care animal welfare will make animal calm and slaughtering process can done easily.

Facing *Qiblah* and *Tasmiyyah*

- Slaughtering process is performed while animal facing to the *Qiblah* and slaughter must invoked *Tasmiyyah* immediately before slaughtering which is (*Bismillahi Alluhuakbar*).

Niyyah

- Niyyah (intention) for the sake of Allah S.W.T. should be done to every animal before slaughtering

Sawing Action

- A sawing motion is permitted during halal slaughter, provided the knife is not lifted from the animal's throat during the process.
- The cut should begin at the neck, just below the glottis (Adam's apple), or slightly after it in long-necked animals.
- The slaughter is completed by severing the trachea (halqum), esophagus (mari'), and both the carotid arteries and jugular veins (wadajain) to ensure rapid bleeding and minimize the animal's suffering
- Slaughtering is fail and haram if either trachea or esophagus are not severe.

Inspection

- To ensure animals are slaughtered properly according to Shariah law, a trained Muslim inspector (Halal Checker) must be appointed and held responsible for overseeing the halal slaughtering process.

SLAUGHTER PROCESS

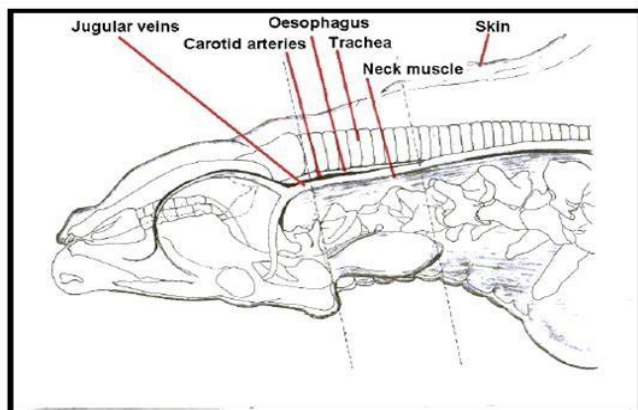


Fig 23: Anatomy of Cattle Throat

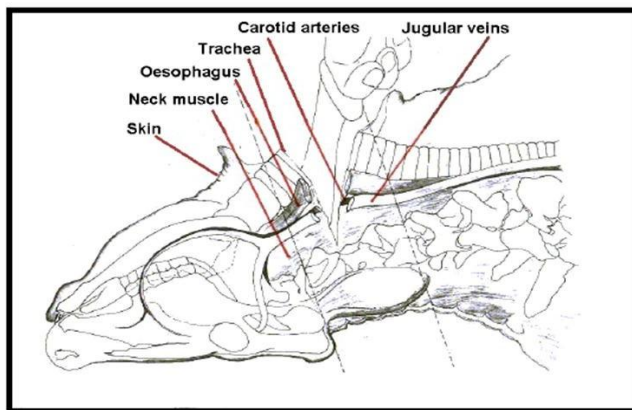


Fig 24: Anatomy of Cattle Throat During Slaughtering

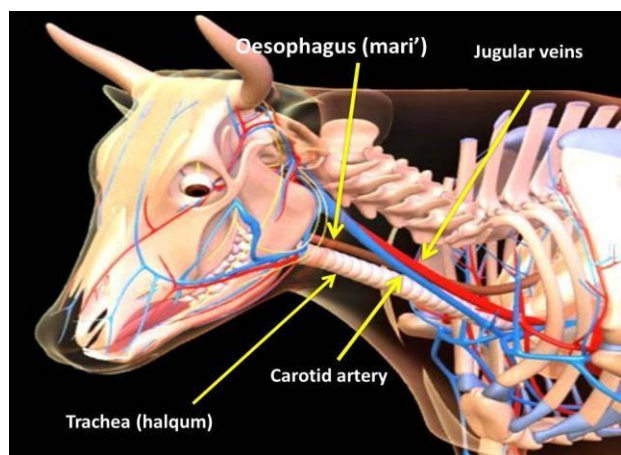


Fig 23: Location Veins and Artery

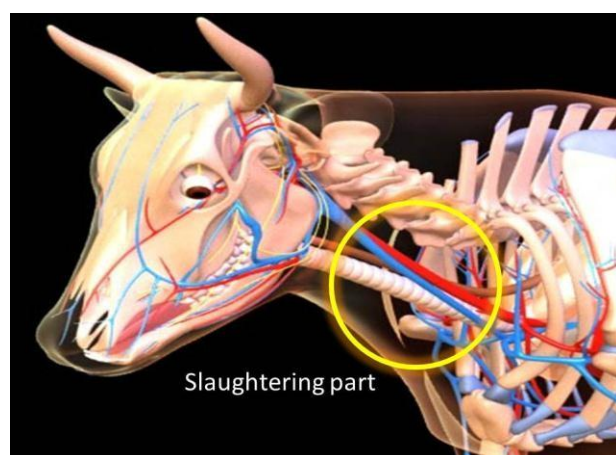


Fig24: Location Slaughtering Taking Part

The spinal cord should not be severed during slaughter, as this may cause cardiac arrest and result in incomplete bleeding due to blood stagnation in the vessels. After slaughtering been done, the bleeding shall be spontaneous and must complete until last drop of blood removal of blood as much as possible is required because blood is one of medium for bacteria growth).

Figure above shown the anatomy of cattle throat for better understanding where show exactly location for trachea, esophagus, carotid arteries and jugular veins. The trachea is part of the respiratory system, extending from the back of the oral cavity to the lungs. The esophagus is a muscular tube that carries food from the throat (larynx), passes through the diaphragm, and connects to the stomach. The carotid arteries supply oxygenated blood from the heart to the brain, while the jugular veins return deoxygenated blood (containing carbon dioxide) from the brain back to the heart.

PURPOSES (HIKMAH) OF SLAUGHTERING

Less Pain

- The animal becomes unconsciously immediately, without suffering any pain.
- Rapid blood loss causes the animal's brain to be unable to operate against its body due to lack of oxygen supply.

Effective drain blood

- By slaughtering the blood is effectively drained out from animal body, ensures the animal dies and keeps the meat clean to avoid contamination risk from any disease

Quality

- Due to blood was drained out, the animal meat becomes more quality because it has no blood in meat and is able to prolong the meat shelf life.

Differentiate between *Halal* and *Haram*

- Able to differentiate the Halal and Haram meat and slaughter method.

Animal Welfare

- Animal welfare is taking care by produce less pain to animal due to slaughtering technique than other killing technique.
- Following all Islamic Law will create the value of kindness (*ihsan*) to animals.

"Verily, Allah has made it obligatory to do benevolence over all things, so when you kill, do good killing, and when you slaughter, do good slaughter, and let one of you sharpen his knife and let him comfort the slaughtered animal"

(Narrated by Muslim)

SUNAT, MAKRUH AND HARAM IN SLAUGHTERING

1. SUNAT (RECOMMENDED IN SLAUGHTERING)

1. Invoke the name of Allah
2. Slaughter in day light
3. Facing the Qiblah
4. Gently lay the animal on its left side at the slaughter area to avoid injury.
5. Handle the animal with care and properly

2. MAKRUH (DISCOURAGE OR DISLIKE) IN SLAUGHTERING

- | | |
|--|---|
| 1. Not invoke the name of Allah | or proceed to next process |
| 2. Slaughter in night | until it has died |
| 3. Not facing the <i>Qiblah</i> | 8. Beheaded the animal |
| 4. Treat the animals hardly | 9. Slaughtering of blind person |
| 5. Do not sharpen the knife in front of the animal to be slaughtered | unto controlled animal |
| 6. Slaughter the animal in front of other animals | 10. <i>Hadas besar</i> , haidh or junub |

3. HARAM (PROHIBITED OR UNLAWFUL) IN SLAUGHTERING

1. In Ihram
2. Slaughter for the sake of other than Allah S.W.T
3. Slaughtering using blunt blade or knife
4. Slaughter by disorder person while healthy person nearby.
5. Not perfect cutting the trachea and esophagus
6. Slaughtering act done in two times
7. Slaughtered by non believer or non muslim

CONSEQUENCES OF EXSANGUINATION (BLEEDING)

DEFINITION OF EXSANGUINATION

Exsanguination comes from the Latin *exsanguinatus*, meaning "drained of blood," derived from *ex-* (out of) and *sanguin-* or *sanguis* (blood). It refers to the process of draining or losing blood, typically used in medical or slaughter contexts.

"Bleeding is the process of sufficient blood loss to cause death, commonly known as 'bleeding out'. It occurs when both carotid arteries or their branches are severed to ensure death and proper blood drainage from the carcass."

Bleeding happen when both carotids or vessels from where they arise are cut in the purpose to kill the animal **or to empty the carcass of blood** (Federation Of Veterinarians Of Europe, 2007)

After the slaughtering been done properly, **blood will flow freely** lead the death of animal within seconds because lack of oxygen. The heart will pump out the blood from body until last drops.

However, the bleeding **process may take several minutes if complications occur**—such as arterial occlusion caused by a blunt knife's incision at the blood vessels.

Immediately after the animal is rendered insensible, it is **hung upside down** by its hind limbs and moved along a conveyor line to accelerate exsanguination.

INTRODUCTION OF EXSANGUINATION

Bleeding is one of slaughtering part, which leading death to animal.

In Islamic Slaughtering, animal must cause of death from bleeding not from drowning due to pile bunch of animal.

"In conclusion, bleeding (exsanguination) is an essential requirement in halal slaughter to ensure the proper conversion of food animals into edible products and valuable by-products."

Bleeding is taking part when the main blood vessels of neck is severe. The blood will splash out from body due to hearth beat occur while animal is still alive, pump out the blood from body at incision of knife or blade.

Animal will dizzy due lack of oxygen in body, because blood which is responsible to carry the oxygen was remove from body.

In some cases, before the fatal incision, animals may be rendered **insensible to pain** through stunning methods such as:

- Captive bolt - applied to the skull to penetrate and damage brain tissue.
- Electricity - commonly used for pigs, chickens, and sheep
- Chemical - applied to injured livestock

EFFECT USING BLUNT SLAUGHTERING TOOLS

Prolong incision

- Using blunt knife will prolong the incision where the sawing action had done in many times.
- Causing pain to animal.

Sawing action

- Too many sawing action will produce heat at incision, those heat will make the blood clotting.

Rough end cut

- The end cut of blood vessels become rough due to blunt knife tear out the blood vessels and rough sawing action had been done.
- Rough cuts and heat produce allow blood to clot in the fracture spaces on the blood vessel cut, causing blockage.

Delaying unconsciousness

- The blockage of clotted blood, delaying the bleeding out thus delaying the animal to become dizzy state and fainted
- This situation will causing painful to animal due to prolonging the onset of unconsciousness and insensitivity.

BLEEDING (ACCORDING TO STANDARD)

Standards for Halal Slaughtering in Malaysia is refer to :

1. MS 1500 : 2019 Halal Food - General Guidelines (Third Revision)
2. Malaysian Protocol for Halal Meat Production and poultry Production (MPFHMPAPP)

Slaughtering process

- The act of slaughter must sever the trachea (halqum), esophagus (mari'), and both the carotid arteries and jugular veins (wadajain) to ensure rapid bleeding and a quick, humane death of the animal (2.5 Slaughtering definition and 3.5.2.1(n) Slaughtering process MS 1500:2009, 4.5.2(j) Halal Slaughtering Process MPFHMPAPP)

Bleeding process

- **Bleeding** must spontaneous and complete; (3.5.2.1(n) Slaughtering process MS 1500:2009, 4.5.2(j) Halal Slaughtering Process MPFHMPAPP)

Dressing

- According to Clause 3.2 (Carcass Definition) of MPFHMPAPP, the carcass refers to the body of the animal after bleeding and dressing. This includes meat and bones, but excludes offal, hide, skin, wool, hair, hooves, horns, and other parts of the animal, whether separately or otherwise.

•Stunning

- According to Clause 3.8 (Stunning Definition) of MPFHMPAPP, stunning is the process of rendering animals immobile or unconscious prior to slaughter. Various methods are used with the aim of allowing the animals to bleed out while still alive. Animals that die before bleeding out are not suitable for Halal consumption.

•Verification

- According to Clause 4.5.4(a) (Halal Check) and Clause 5.5(c) (Muslim Halal Checker) of MPFHMPAPP, a Muslim Halal checker must be present in the slaughter hall. The checker is responsible for monitoring the stunning process, ensuring halal slaughter and proper bleeding, verifying the animal's death before dressing, managing non-compliant carcasses, and maintaining records in accordance with the halal protocol.

BLEEDING TIME

The bleeding time or period is range of times required for fully depleting blood in slaughtered animal.

The bleeding area must adequate to let the bleeding times of :

- i. 6 to 8 minutes for cattle.
- ii. 4 to 5 minutes for sheep or goat.

The bleeding time is subjected to the weight of the animal.

However, this period **may extend by a few minutes if complications** occur, such as arterial occlusion.

Bleeding time can be fasten by quickly hung upside down the animal right after slaughtered to ease the blood drain out from body due present of gravity pull out the blood.

Due to a long period of time, many slaughter house was applied some extra method to fasten bleed time such as **thoracic sticking** allowing the slaughtering process to be done quickly.



Fig 25 : Cow and Buffalo hung after slaughtered

THORACIC STICKING

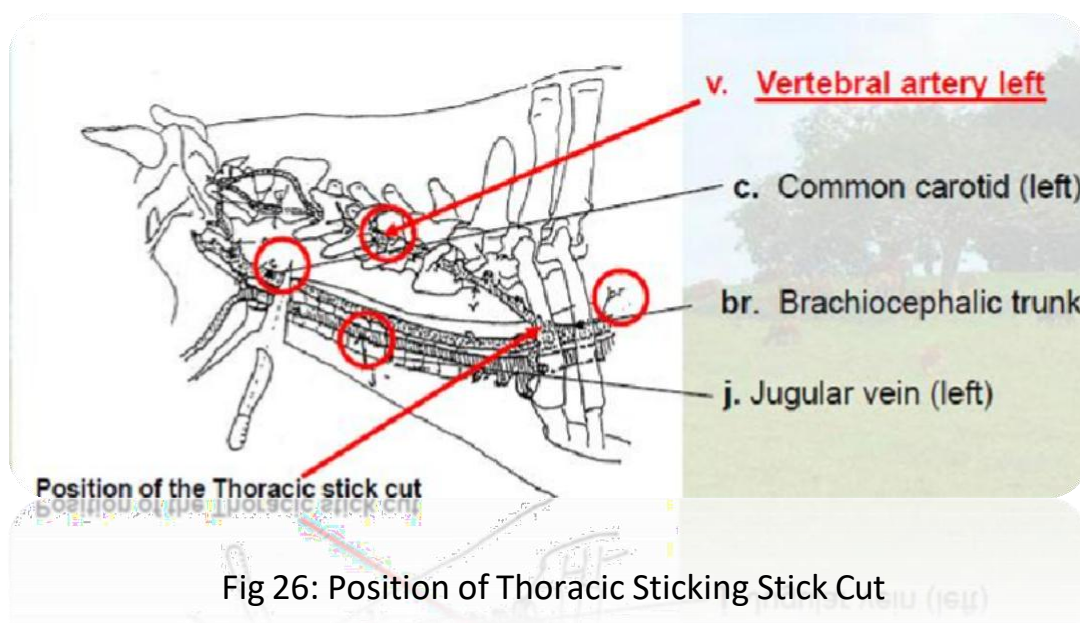
Thoracic sticking is a procedure used to sever multiple major blood vessels using an extremely sharp knife. The knife is inserted parallel to the ground, just behind the jaw and below the neck bones.

From this position, it is drawn forward—away from the spine—to sever the jugular veins, carotid arteries, and trachea, ensuring rapid and effective bleeding.

Causing more incision that allows for **maximal blood removal** from the body.

In order to make sure Halal requirement, thoracic sticking procedure must avoid stabbing the heart. If heart are fail to function, this may cause blood unable to pump from body. Death of animal is due to heart failure not from loss of blood (Haram).

Usually this practice is done to ruminant animals such as cattle, buffalo and etc. with vertebral artery structure where blood is supply to the brain.



THORACIC STICKING



Fig 27: Ideal Thoracic Sticking

BENEFITS OF THORACIC STICKING

Animal Welfare

- Animal in dizzy state which render it from feel any pain.
- Fasten death of animal (reduce suffering).

Economy

- Shorten the slaughtering process.
- Increasing the slaughtering capacity for slaughterhouse.

Quality

- Faster blood is removed, the better quality of the meat.
- The microorganism did not have time to growth.

In Islamic Slaughtering the method is refer to “Thoracic Sticking” and need to comply with Fatwa

THORACIC STICKING BASED ON FATWA MALAYSIA

Special Conference (Muzakarah Khas) of Fatwa
Committee of the National Council for Islamic Affairs
(Decision Date: 29 September 2005)

*"The Muzakarah **agreed** that the **Thoracic Sticking** procedure is **allowed** as an **additional step after slaughter**, and the meat is **halal** for consumption, subject to the following conditions:"*

Complete Slaughtering

- All four major veins Mari', trachea, and oesophagus been properly severe/ cut.

Complete Bleeding

- Thoracic Sticking can be applied after complete bleeding or 30 seconds after slaughtering.

Death Due to Slaughtering

- The death of the animal has been confirm due to slaughtering and the Thoracic Sticking only to hasten the death

Supervise by Competent Person

- The method need to be supervised by competent Muslim workers

DETERMINATION OF DEATH

Signs of death should be determined by carefully observing the animal for the following indicators:

Absence Blood Pulsing

- If blood continues to flow from the severed carotid arteries, it indicates that the heart is still beating



Fully dilated pupils

- The pupils of dead cow is covering whole the eye



Flaccid tongue

- The tongue of dead cow is stick out.

Absence of Movements

- Dead cow has no any movements of carcass.

Absence of pupillary and corneal reflexes

- No have any movement when touching the retina of cow.

Responses

- Reflexes caused by cutting major nerves are not considered signs of life.

**ADDITIONAL
SLAUGHTERING
PROCESS
(STUNNING)**

INTRODUCTION

STUNNING

Stunning is the process of rendering animals immobile or unconscious, with or without killing the animal, when or immediately before slaughtering them for food.

Stunning is additional method before slaughtering in order to allow easier and safer manipulation of the animal (especially for human handling of large animals) for efficient slaughtering process.

Stunning is used to animal for eliminate pain, discomfort and stress from the slaughtering process.

Animal should be rendered unconscious for long enough to ensure enough loss of blood after bleeding and death is due to slaughtering not from stunning.

In halal slaughtering stunning is allowed but must follow the legislation for pre-slaughtering stunning and stunning, provided by authorised.

Stunning has irreversible and reversible effect on animal life where animal may gain conscious again or not (death).

There are three main mechanisms of stunning used for slaughtering which are, **percussion (mechanical)**, **electrical** and **gas**.

PERCUSSION STUNNING (MECHANICAL)

Percussion stunning using mechanical mechanism which produces a physical shock to the brain causing unconscious to animal.

There are two types of this stunning

- 1) Captive Bolt (metal rod)
- 2) Pneumatic Percussive (air pressure)

Captive Bolt

Works on the principle of a gun and fires a blank cartridge and it propels a short bolt (metal rod) from the barrel.

Come with two variations of stunner which are:

- 1) Handle and trigger where stunner is joined with air pressure cable, use air pressure to push out the metal rod.
- 2) Hand-held barrel where stunner uses explosion force to push out the metal rod.

There are two types of captive bolt which are:

Penetrative captive bolt

- Bolt penetrates the skull bone and causes bruising of the brain.
- Brain becomes malfunction due to bleeding causing unconscious state to animal.

Non-penetrative captive bolt

- Bolt does not penetrate the skull bone, but may be damaged.
- Brain is not penetrated, but high impact from bolt may vibrate the brain and cause unconscious state to animal.



Fig 28: Hand-held barrel stunner (Philip G. 2001)



Fig 29: Handle and Trigger Stunner (Philip G. 2001)

PENETRATIVE AND NON PENETRATIVE CAPTIVE BOLT

Penetrative-Captive Bolt

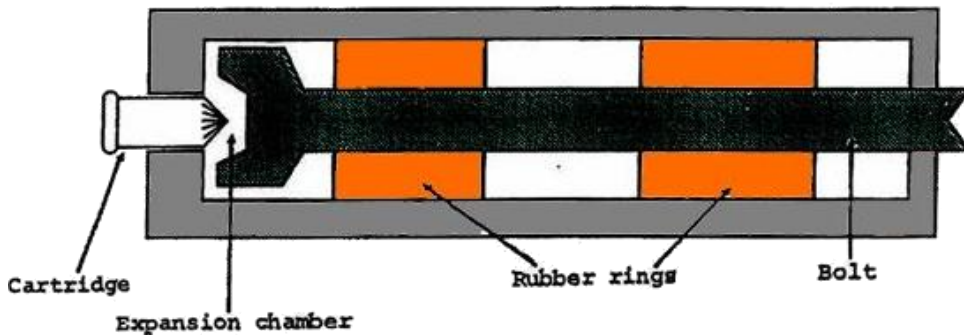


Fig:
Penetrative
Captive Bolt

Non Penetrative-Captive Bolt

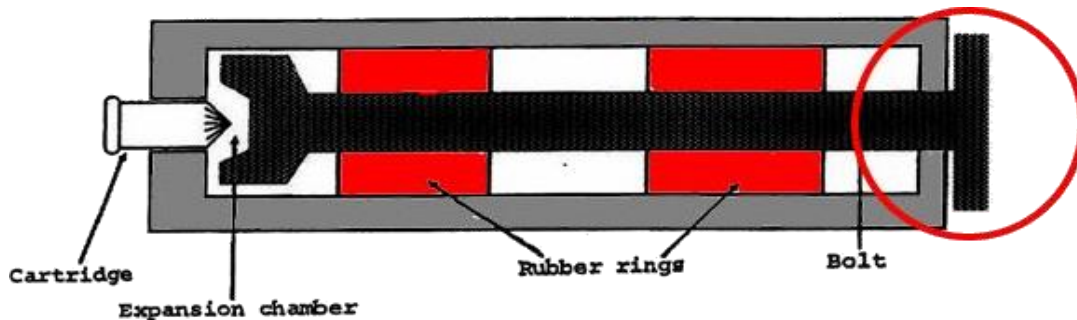


Fig: Non
Penetrative
Captive Bolt

Penetrative-Captive Bolt	Non Penetrative-Captive Bolt
The bolt penetrates the skull bone	The bolt percussion the skull bone
Produces concussion by damaging the brain or increasing intracranial pressure	Animal is not killed and brain is not penetrated BUT high possibility of damaging skull (permanent physical injury)
Causing bruising of the brain	Strong blow to the skull - unconsciousness of animal
Irreversible stunning	Irreversible stunning
Status : NON-HALAL	Status : NON-HALAL

PNEUMATIC PERCUSSIVE STUNNER

Works on the principle of a gun and fires a **high air pressure** to give strong blow to the skull, to render animal unconsciousness.

Due percussive by air pressure, animal brain is not penetrated and as the animal is not killed. This method is reversible stunning where animal may gain consciousness again.

According to Malaysian Protocol for Halal Meat Production and poultry Production (MPFHMPAPP,2009), pneumatic percussive stunner is **accepted in halal slaughtering**.



Fig 30: Pneumatic Percussive Stunner

CONDITIONS OF PNEUMATIC PERCUSSIVE STUNNER

Bovine animal only

- Pneumatic percussive stunning is **only suitable for all bovine** animals.

Air Pressure

- The air pressure that powers the stunner **should not be more than 225 psi** and should be kept to the minimum required to stun the animal.

Stunner Head

- The head of the stunner shall be **flat or slightly convex**.
- There shall be a **protective collar** around head of the stunner so that it shouldn't protrude more than 3 mm beyond it.

Animal Condition

- The **heads** of animal to be stunned shall be **held still** before the stunner can be applied.

Stunning Location

- The centre of the stunner shall be in contact with the animal at a point of **intersection of lines drawn from the medial corners of the eyes and the base of the ears**.
- The stunner shall be applied so that the head of the stunner is perpendicular to the **frontal bone**.

Not Repeating

- The animal shall be **stunned once**.

ASSESSMENT OF SKULL DAMAGE

ASSESSMENT

- Skull damage shall be assessed by removing the skin of the forehead of the animal and examining and asses (base on the criteria in Appendix 1.2 of protocol – MPPHM)

RATING

- A rating system of 1 to 6 will be used.

HALAL STATUS

- Where skull damage **rating is 1 or 2**, the carcasses and their offals shall be **Halal**.
- Carcasses and offals from animals where the skull damage is rated 3, 4, 5 or 6 shall be non-Halal.

ASSESSMENT OF SKULL DAMAGE

RATING

- 1

DESCRIPTION OF DAMAGE

- No visible damage

ACCEPTABILITY

- Acceptable

Fig 31 : Skull
assessment
Rating 1



RATING

- 2

DESCRIPTION OF DAMAGE

- Indentation, no cracking

ACCEPTABILITY

- Acceptable



Fig 32 : Skull
assessment
Rating 2

ASSESSMENT OF SKULL DAMAGE

RATING

- 3

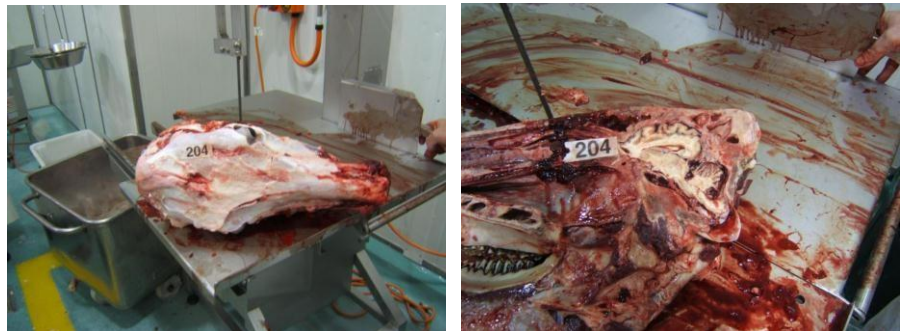
DESCRIPTION OF DAMAGE

- Indentation with cracking but no displacement

ACCEPTABILITY

- Not-Acceptable

Fig 33: Skull
assessment
Rating 3



RATING

- 4

DESCRIPTION OF DAMAGE

- Indentation with cracking and displacement of bone no more than its own thickness

ACCEPTABILITY

- Not-Acceptable



Fig 34 : Skull
assessment
Rating 4

ASSESSMENT OF SKULL DAMAGE

RATING

- 5

DESCRIPTION OF DAMAGE

- Indentation with cracking and displacement of bone more than its own thickness

ACCEPTABILITY

- Not-Acceptable



Fig 35 : Skull assessment
Rating 3

RATING

- 6

DESCRIPTION OF DAMAGE

- Indentation, cracking and brain exposure

ACCEPTABILITY

- Not-Acceptable

ELECTRICAL STUNNING

Stunning with electricity is known as electronarcosis, and killing with electricity is known as electrocution. Electronarcosis is a fully reversible procedure, by Induces **electroplectic shock or epileptic state** in the brain immediately disrupting normal brain function for a short period. Electrocution leads to cardiac arrest, stopping the heart pumping blood around the body and causing rapid death; it is often referred to as a stun-kill.

TYPES OF ELECTRICAL SHOCK STUNNING

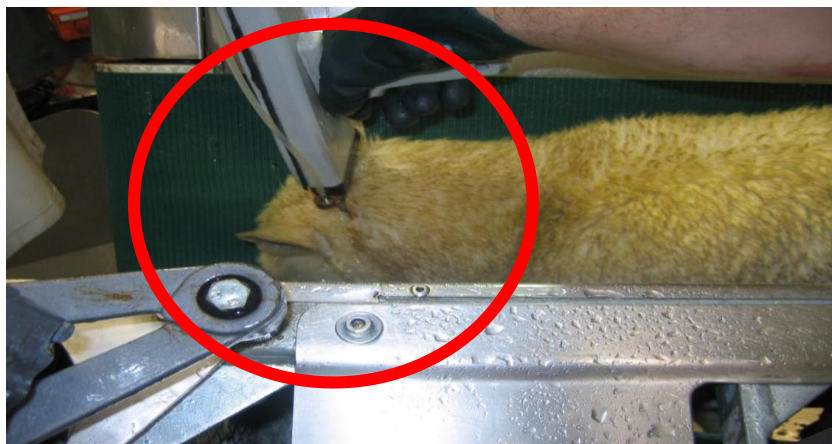
Reversible Electrical Shock

- Head-only stunning where the animal will regain consciousness.
- Stunned animals should be slaughter after stunning
- **HALAL by condition**

Irreversible Electrical Shock

- The animal will not regain consciousness.
- Causes cardiac arrest.
- A third electrode is placed elsewhere on the body.
- Electrodes are applied in the form of tongs
- Stunned animals highly possibly should not be slaughter after stunning.
- **NON-HALAL**

Fig 36: Electrode placed at head of animal



REVERSIBLE ELECTRICAL SHOCK

Head-Only Stunning

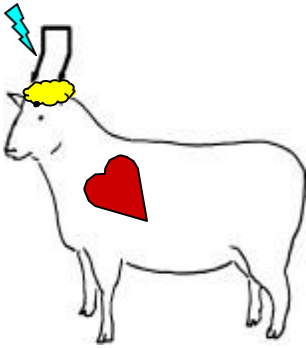


Fig 37: Head only
stunning

- The electric current through the brain only where heart are free from current.
- Due to heart are not affected, the blood is splash during bleeding.
- Animal will get conscious for certain period of time after stunning.
- Because of ability to regain conscious, the animal must immediately slaughter right after stunning.
- Status for this stunning is **HALAL** (by condition) and accepted for additional step in Halal slaughtering.

Not Head-Only Stunning

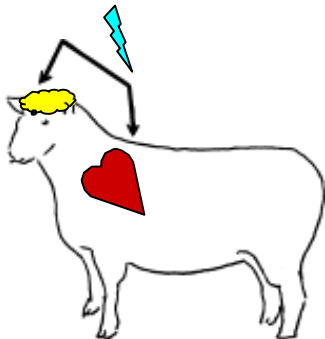


Fig 38: Not heat
only stunning

- The electric current through the brain and possibly through the heart.
- Due to heart are affected, the blood is not splash during bleeding.
- Animal may not regain conscious and possibility lead to death.
- Because of lose ability to regain conscious, the slaughtering is not require immediately done.
- Status for this stunning is **HARAM** and not accepted for additional step in Halal slaughtering due to death of animal.



EFFECTS OF STRESS AND INJURY ON MEAT QUALITY



TOPIC OF DISCUSSIONS

- Introduction
- Post Mortem Change
- Pale, Soft Exudative (PSE) meat
- Dark, Firm and Dry (DFD) meat
- Spoilage of meat
- Bruising and injury

INTRODUCTION

Energy

- Used for muscle activity in the live animal.

Sugar

- Such as **carbohydrate** obtained from what animal ate convert to energy.

Glycogen

- **Fat** (anabolism from sugar) which develop from excess **energy** stored in muscle (adipose tissues).
- **Glycogen** can be use as energy source again (catabolism of glycogen).

Rigor Mortis

- Is process that produce **lactic acid** by convert **glycogen** in muscle after animal been slaughtered in **aerobic condition** (present of oxygen).

Lactic Acid

- Used to increasing the **quality** of meats, by acid properties to inhibit undesired reaction in animal's carcass

POST-MORTEM CHANGES

The post-mortem changes that take place when **muscle is converted** into meat have a marked effect on the quality of the meat.

After slaughter the **glycogen** in the muscle is **converted** into **lactic acid** causing a fall in pH from an initial value of pH 6.8 - 7.3 to about 5.4 - 5.8 at rigor mortis.

If animals are **stressed immediately prior to slaughter** as when they are roughly handled or fight one another the **muscle glycogen is released into the blood stream** and, after slaughter, is rapidly **broken down to lactic acid while the carcass is still warm**.

This high level of acidity causes a **partial breakdown of muscle structure** which results in pale, soft and exudative meat (termed PSE)

Long-term stress before slaughter or starvation **uses up the glycogen** so that **less lactic acid** is formed after slaughter resulting in an abnormal muscle condition in which it remains dark purplish-red on exposure to air instead of a bright red color. This is termed dark, firm and dry (DFD). This meat have a pH above 6.0 and spoil quickly since the low acidity favors rapid bacterial growth.

PSE and DFD meat are perfectly safe to eat but limited in their processing capacity. PSE meat has higher drip and cooking losses due to the reduced water-binding capacity (WBC). As well as the pale color the meat has less flavor than usual.

DFD meat has normal or increased WBC and so is suitable for scalded/boiled sausages and other cooked products but it has poor meat flavor. While there is no remedy for these defects in the meat, DFD and PSE meats can be blended with normal meat for the preparation of products of good quality.

Arnold B. (1992). Meat and meat products in human nutrition in developing countries

RIGOR MORTIS

FLOW

Rigor mortis is a postmortem change resulting in the stiffening of the body muscles due to chemical changes in their myofibrils

Oxygen

- When animal died, the oxygen unable to supply through muscle due to heart beat failure.
- The enzyme metabolism taking part in muscle when oxygen supply has been cut off in muscle.

Enzyme Metabolism

- Metabolism of enzyme will breakdown the glycogen (cumulative sugar in muscle) to produce lactic acid

Rigor Mortis

- Rigor mortis happen after 4 hours animal die for 12- 24 hours and is resolved by periods that depend on the temperature:- 10-13 days at 0°C, 4-5 days at 10°C, 30-40 hours at 20°C and 10-11 hours at 30°C .

Rigor Mortis Period

- Rigor mortis period extend to several days if store in chill temperature.
- As a conclusion, the longer rigor mortis period, greater the decomposition of glycogen to lactic acid.

CHANGES OCCUR DURING RIGOR MORTIS

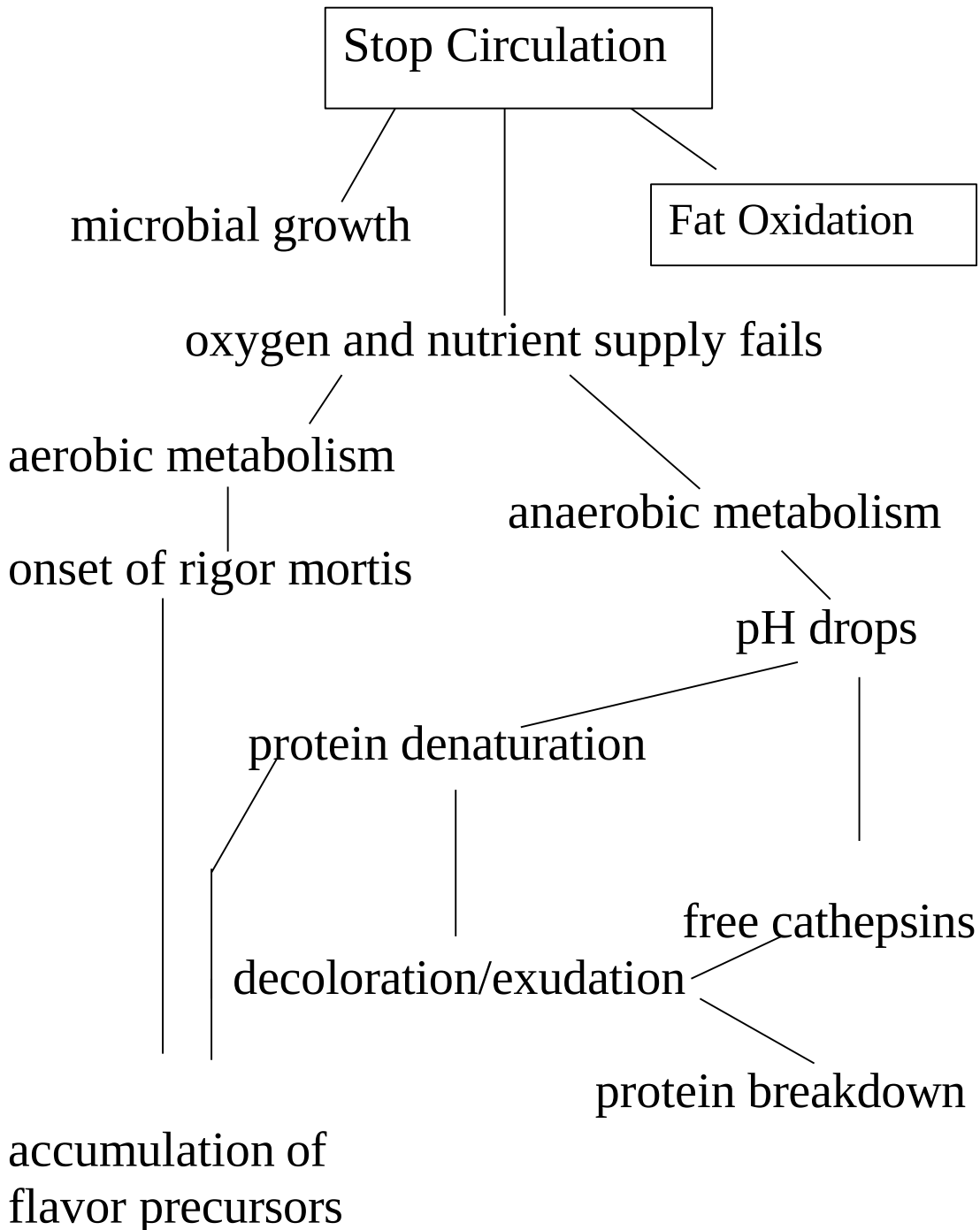


Fig 39: Changes during Rigor Mortis

FUNCTION OF LACTIC ACID IN MEAT

After slaughtering, major component will be changes in meat, for example **pH, tenderness and color of meat.**

Those attribute are affected by present of **Lactic Acid** and 'capthepsin'. Lactic acid bacteria **metabolism glycogen** in muscle as their fuel to **produce lactic acid.**

Due to present of lactic acid in muscles from lactic acid bacteria will drop the pH of meat from initial value of pH **6.8 - 7.3 to about 5.4 - 5.8** at rigor mortis.

As the pH of muscle drops, the proteolytic enzymes called 'capthepsin' are held in the **inactive state change to active state** and begin to **degrade the protein structure** of the muscle.

The tenderization that occurs during the postmortem of muscle may be partly due to the **breakdown of some collagen connective tissues of muscle.**

The retention of red color of meat is due to lactic acid **denature the myoglobin** prevent it from react with **oxygen**. Oxygen may cause browning reaction on meat surface and produce off flavor if myoglobin are react with oxygen.

During the conversion of muscles to meat, certain aspects of meat quality characteristics such as the tenderness, juiciness, flavor, color, water holding capacity and binding properties may be affected.

Therefore, the various factors affecting conversion of muscles to meat are extremely important from the view points of controlling and improving the quality of meat.

Dr Narendra (2015) Conversion of Muscle To Meat. Department of LPT. College of Veterinary Science& A. H Mhow

PALE, SOFT AND EXTRUDATIVE (PSE)

PSE meat was know as spoilage meat where it has pale appearance, the meat texture is too soft due to degradation of protein happened before slaughter and the texture of meat is foggy where it has high water drip like sponge properties.

The meat can be PSE if animal used large amount of energy right before slaughter where **muscle glycogen was released into the blood stream** and, after slaughter, is rapidly **broken down to lactic acid while the carcass is still warm.**

Present of lactic acid during initial stage of post mortem cause activation of **capthepsin to breakdown the protein** of meat.

The pH for PSE meat is around 5.3 - 5.6, where **indicate** the meat has lot of lactic acid.

Due to huge number of lactic acid, the **denaturing** of myoglobin are **uncontrolled** that produce pale color of meat. **Corrosive ability** from lactic acid also affecting the meat texture produce foggy characteristic.

Animal faces **muscles cramp** before while alive are consider one of PSE symptom where muscle that location **undergoes acidic condition.**



Fig 40 : PSE meat

PSE caused by severe, short-term stress just prior to slaughter, for example during off-loading, handling, holding in pens and stunning by allowing them to rest (one hour prior to slaughter) and quiet handling is alternative method to reduce risk of PSE.

DARK, FIRM AND DRY (DFD)

DFD meat is known as spoilage meat where it has dark appearance due to oxidation of myoglobin, the meat texture is too firm due to degradation of protein, and the meat looks dry due to water holding capacity of meat being too low.

The meat can be DFD if an animal is tired for a long time period (used a lot of energy for long time) called long-term stress before slaughter or starvation. Those conditions cause the animal body to consume the glycogen as energy. Due to less glycogen content in muscle, the production of lactic acid is reduced after slaughtering. Resulting in an abnormally high pH (above 6.0) value of muscle which it remains dark purplish-red on exposure to air instead of a bright red color (free myoglobin reacts with oxygen), less pronounced taste (plain taste) and has a shorter shelf life because of an abnormally high pH value (desire condition for harmful bacteria to grow).

Metabolism of lactic acid at a slow rate, may cause delaying activation of cathepsin to breakdown the meat protein. This results from delaying activation of enzyme, the degradation period happens in a short period during rigor mortis. So that meat is too firm and has less water holding capacity due to **collagen connective tissues of muscle** are not degraded.



Fig 41 : DFD meat

DFD caused by severe, long-term stress before slaughter, for example during bad handling, starvation and injury for long. Allowing them to rest enough, give right amount of food and heal the injury is an alternative method to reduce risk of DFD.

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