Meat Processing

Meat

Meat is the flesh of animals and birds that is eaten by humans.

Why Isn't Seafood Considered Meat?

- According to the United States Conference of Catholic Bishops, <u>abstinence laws say</u>

- Meat is considered something that comes only from animals that live on land, like chicken, cows, sheep or pigs.

- Fish are considered a different category of animal.

Sources of meat

- **Cattle:**
  This is the major source of meat in Bangladesh. Meat from cattle is known as beef. Example: Cow and Buffalo.
- **Goats and sheep:**
  Sometimes referred to as shoats. Meat from sheep is known as mutton.
- **Poultry:**
  These include chicken, turkey, ducks and other domestic birds.
- Pigs give meat known as pork.
- Camels.
- Small animals like rabbits.
- Donkey.

Sources of meat

Meat	Source	Characteristics
Beef	Cattle more than one year old.	Hearty flavor; firm texture; bright, deep red color with firm, creamy white fat.
Veal	Calves (young cattle), usually one to three months old.	Mild flavor; firm texture; light, gray-pink color with very little fat.
Baby beef	Calves between six and twelve months old.	Pink-red color; stronger flavor and coarser texture than veal.
Lamb	Sheep less than a year old.	Unique, mild flavor; bright, pink-red color; brittle white fat. Sometimes covered with a fell, a thin membrane under the hide, which helps retain juices during cooking.
Mutton	Sheep over two years old.	Less tender than lamb; stronger flavor.
Pork	Pigs less than a year old.	Tender texture; mild flavor; gray-pink color; soft white fat. Older animals have meat with a darker pink color.

Sources of meat and meat products in Bangladesh
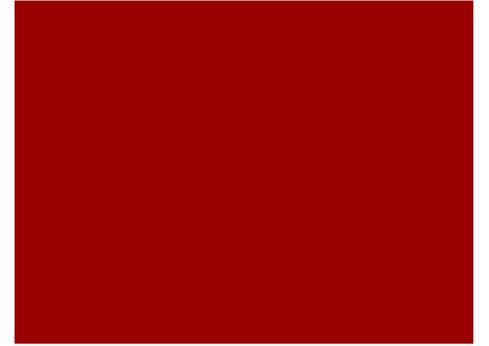
- Bangladesh has a diverse livestock production system, contributing significantly to the country's meat supply.

- The production systems include cattle, goats, buffaloes, sheep, chickens, and ducks.

1. Cattle Production:

- Cattle farming is prevalent in both subsistence and smallholder systems.

- Commercial meat processing industries like Bengal Meat and Deshi Meat contribute to the production and export of quality beef.

Sources of meat and meat products in Bangladesh
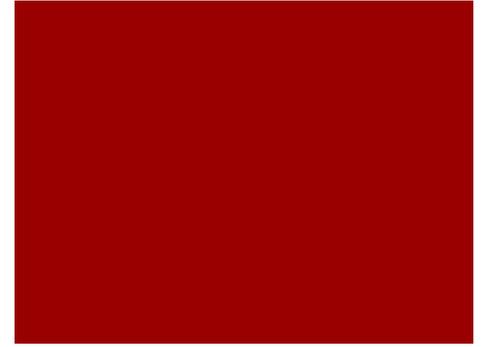
2. Buffalo Production:
- Water buffaloes are a valuable genetic resource in Bangladesh, with 1.471 million heads.
- Concentrated in various agro-ecological zones, buffaloes are used for draught and dairy purposes.

3. Goat Production:
- Goats are integral to the agro-based economy, with 25.766 million goats in Bangladesh.
- The native Black Bengal goat is known for early maturity, high prolificacy, and adaptability.
- Commercial goat farms, supported by government policies, aim at poverty alleviation through goat rearing.

Sources of meat and meat products in Bangladesh

4. Sheep Production:
- Bangladesh has 3.335 million indigenous Bangla sheep, with a higher concentration in specific regions.
- Sheep are reared in extensive systems without significant input support.

5. Chicken Production:
- Commercial chicken production has seen rapid growth, with a focus on imported germplasm.
- Family chicken production, semi-scavenging systems, and commercial farming coexist.

6. Duck Production:
- Ducks are mainly raised in traditional and smallholder systems, often in scavenging conditions.
- The unique smallholder duck production system utilizes natural feed resources in low-lying water bodies.

Importance of meat industry in national economy

- **Source of Protein:** Meat from various sources serves as a primary protein source for the population, promoting nutrition and health.

- **Employment Generation:** Livestock farming provides employment opportunities, particularly for rural and smallholder farmers.

- **Contribution to GDP:** The diverse livestock production systems contribute significantly to the national GDP.

- **Economic Opportunities:** Commercial meat processing industries and export ventures create economic opportunities and contribute to foreign exchange earnings.

Compositions of meat

- Meat is composed of muscle fibers, connective tissue, and other components.
- Muscle fibers are bundles of myofibrils, consisting of thick and thin filaments (myosin and actin).
- Connective tissue surrounds muscle groups, forming silverskin, tendons, and collagen fibers.
- Larger bones reveal muscle groups in bundles, separated by connective tissue (silverskin).
- Tendons attach muscles to bones at or near joints.
- Meat contains 60% to 70% moisture, 10% to 20% protein, 2% to 22% fat, and 1% ash.

Chemical Compositions of meat

| Food	Protein (%)	Fat (%)	Ash (%)	Carbohydrate(%)	Water (%)
Beef	20-22	2-7	1.1	--	70-72
Poultry	20-22	2-3	1	-	72-75
Goat	23	2.6	1.4	--	70
Lamb	21	6.1	0.9	--	72
Pork	19	15	0.9	--	65
Horse	22	5.5	1	1	71

Structure of Muscle Tissue

- Animal flesh consists of muscle tissue or fibres, connective tissue and fatty (adipose) tissue, Bones, Blood vessels and nerve tissue.
- More than 300 muscles.
- About 30-45% of the live weight.
- 35-60% of the carcass weight.
- Smooth and cardiac muscles are also present in blood vessels and heart respectively.
- Skeletal and cardiac muscles are referred as striated muscles.

Muscle fibers

Muscle

Connective tissue containing collagen

Myofibril

Actin

Blood vessels

Sarcomere

Myosins
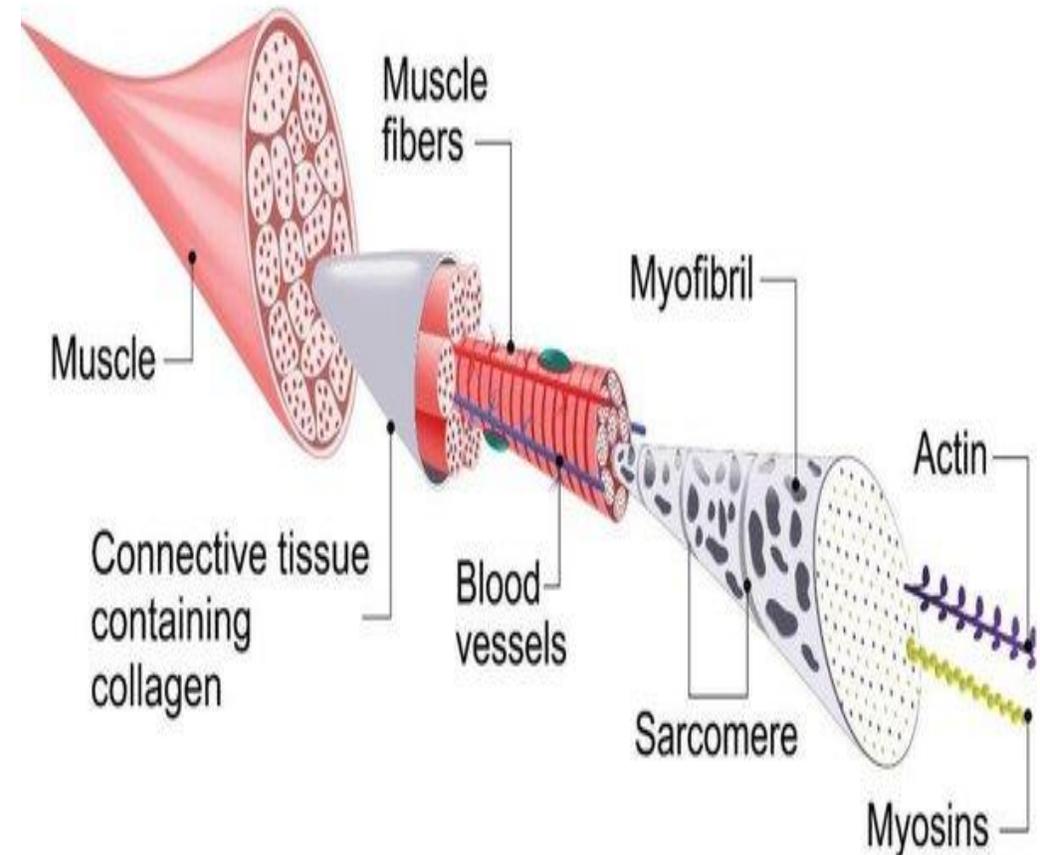
Skeletal Muscle and Associated Connective Tissue

- Directly attached although to the bones
- Indirectly via ligament, cartilage, fascia and skin
- Surrounded by a sheath of connective tissue(epimysium)
- Inner surface of epimysium, connective tissue(perimysium) penetrates into muscle
- Perimysium contains major blood vessels and nerves.
- Muscle fibres surrounded by connective tissue (Endomysium).
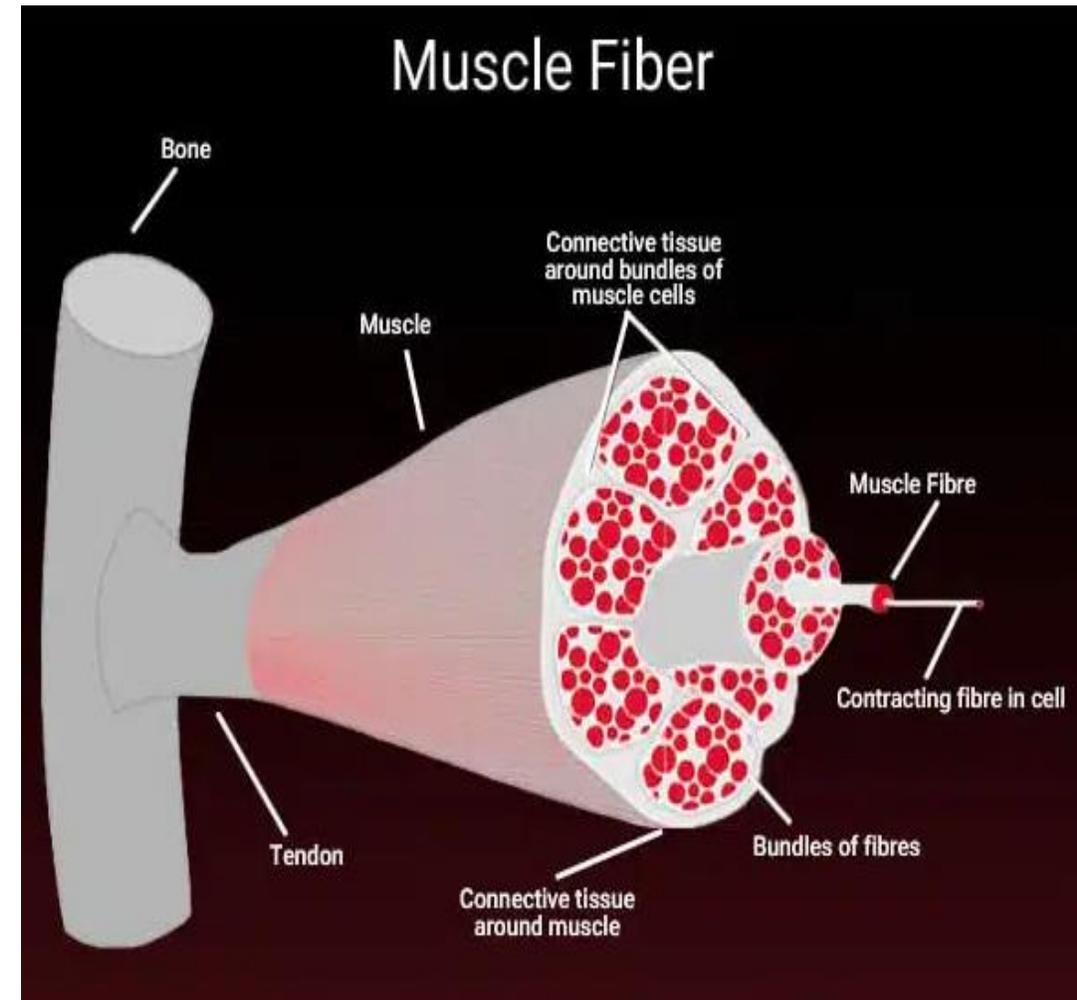
The structure of meat

- Lean meat is the muscle tissue of animals.
- Muscle cells comprise of:
- water
- proteins
- fat
- minerals
- vitamins
- the red protein called myoglobin (similar to the blood pigment haemoglobin)

Composition of Muscle Tissue

Water

- Two third to three fourth of muscle tissue

- 40.5% of the total water in muscle is so tightly bound

- Most of the water exists in immobilized and free forms

- 70% of water content in fresh meat is located within the myofibrils

- Water holding capacity is associated with juiciness and tenderness

Composition of Muscle Tissue

PROTEIN

Muscle proteins have been broadly classified gories: into three categories

1. Myofibrillar proteins soluble in dilute salt solution

2. Sarcoplasmic proteins soluble in water or very dilute salt

3. Stroma or connective tissue proteins almost insoluble

Composition of Muscle Tissue

LIPIDS

- Highly variable and is inversely proportional to the moisture content
- Neutral lipids and phospholipids
- Generally contain fatty acids
- Mutton and beef have odd number and branched chain fatty acids
- Saturated fatty acids are palmitic and stearic acids
- Unsaturated fatty acids are oleic, linoleic and linolenic acids
- Phospholipids are found in muscle tissue

Composition of Muscle Tissue

LIPIDS

- Structural and functional constituents

- Have a key role in the flavor and shelf stability

- Susceptible to oxidation than triglycerides

- Cholesterol is a minor but important component

- Patients with heart disease

Composition of Muscle Tissue

CARBOHYDRATES

- Very small amount

- Key role in attaining the ultimate muscle pH.

- Influence the color, tenderness and water holding capacity

Composition of Muscle Tissue

MINERALS

- About 3.5% of the total body weight

- Located in skeletal tissue (salts of calcium and phosphorus etc.)

- Serve a -variety of important functions

- Physical, chemical or biological

- Main function development of rigor mortis

Composition of Muscle Tissue
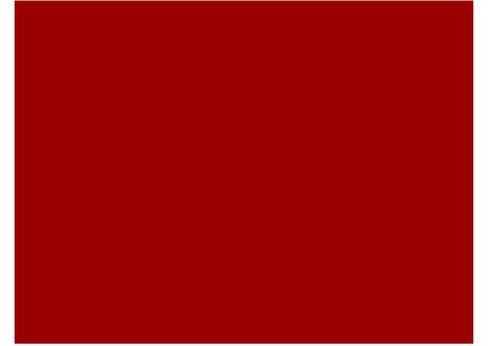
MINERALS

- Balance which cause a drop in ph

- Water holding capacity.

- Meat color and tenderlsation.

Composition of Muscle Tissue

VITAMINS

- Water-soluble vitamins are localized in lean tissues

- Fat-soluble vitamins in fatty tissues.

- Substantial amounts of b-complex vitamins

- Pork contains 5-10 times than mutton

- Most of the vitamins in meat are relatively stable during processing

- Thiamine, B6 susceptible to heat treatment.

Muscle fibres in connection & action

- Meat muscle is made up of bundles of muscle fibres held together by creamy white connective tissue.
- Individual muscle fibres are made up of cells which contain the proteins actin and myosin.
- In live animals, actin and myosin work together to make the muscle contract and relax.
- Tendons join the muscle (made up of bundles of muscle fibres, surrounded by connective tissue) to the bones of animals.
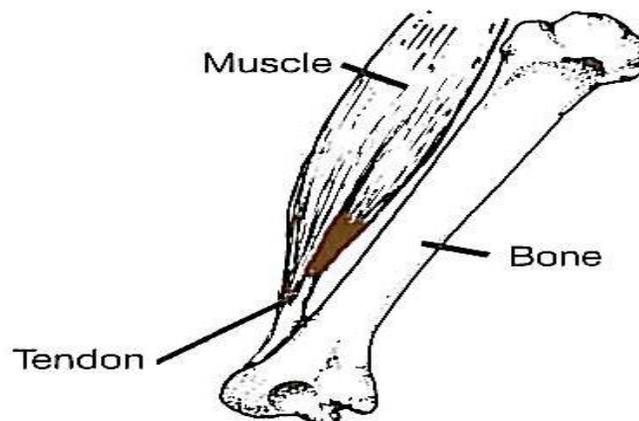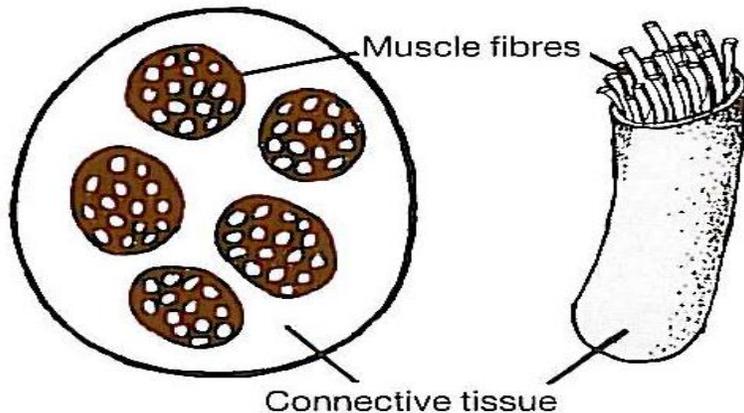
Muscle fibres in cooking

Connective tissue is made up of two proteins called collagen and elastin.

Collagen

The connective tissue in and around the muscle fibres and tendons is mostly collagen. When meat is cooked, the collagen becomes soft and soluble, and forms gelatin.

Elastin

This is much more elastic connective tissue. It is yellow in colour and remains tough, even when cooked. The ligaments which join two bones together are mostly made up of elastin.

Muscle fibres

Muscle fibres are very small – and can only be seen under a microscope. The length of muscle fibres varies.

Fine muscle fibres

- These tend to come from the muscles of young animals, or in older animals from the muscles which do least work.
- They contain little collagen and are tender even when cooking times short, e.g. grilling.

Thick muscle fibres

- These tend to be from older animals and also muscles which do the most 'work' – such as neck and shin.
- They have more connective tissue to prevent muscle damage.
- This type of meat is tougher and needs long, slow cooking with moisture to make it tender, e.g. casserole.
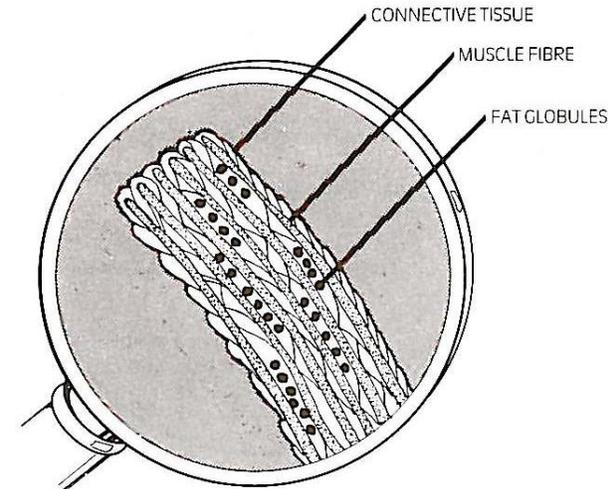
Smooth Muscles

- Found in the gastro-intestinal tract, blood vessels, lymphatics and skin

- Muscle fiber are long

- Unevenly thickened in the Centre

- Tapering on both the sides

Smooth Muscle Structure
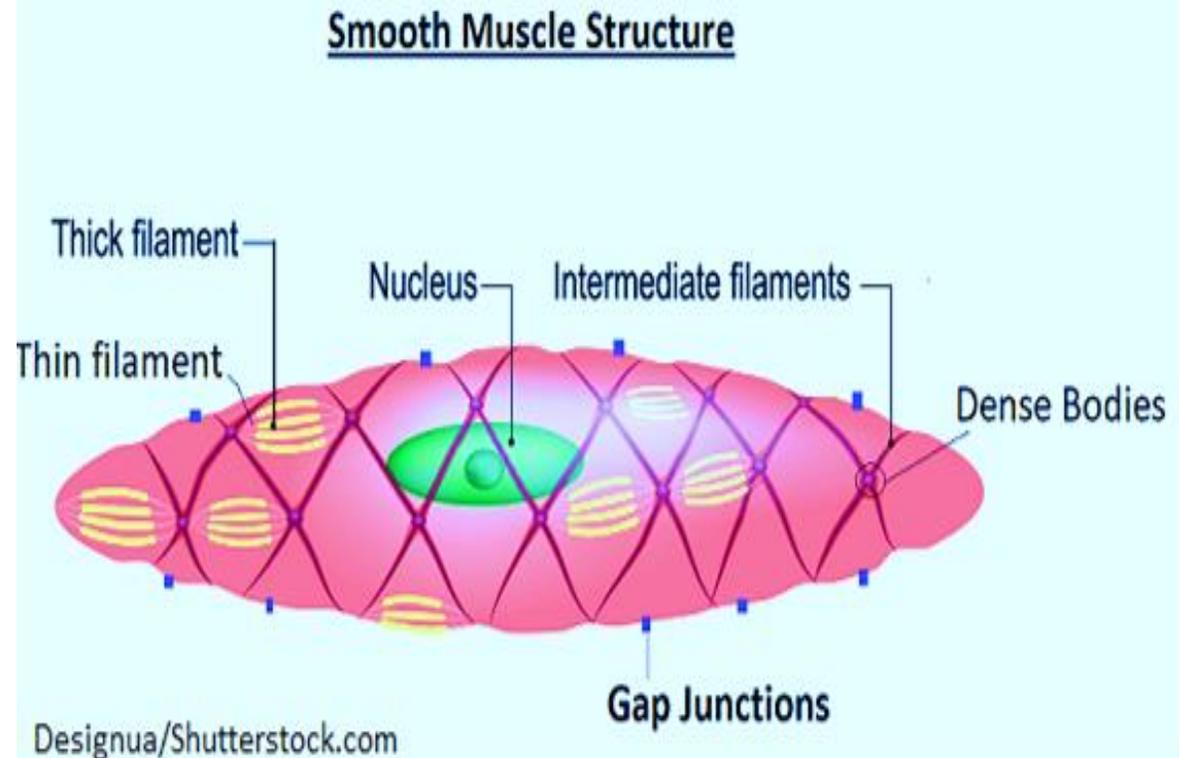
Cardiac Muscles

- Found in the heart

- Irregular in shape and give off branches

- Nuclei are placed in the Centre

Cross-strations

Nuclei

Myocytes

Intercalated disks
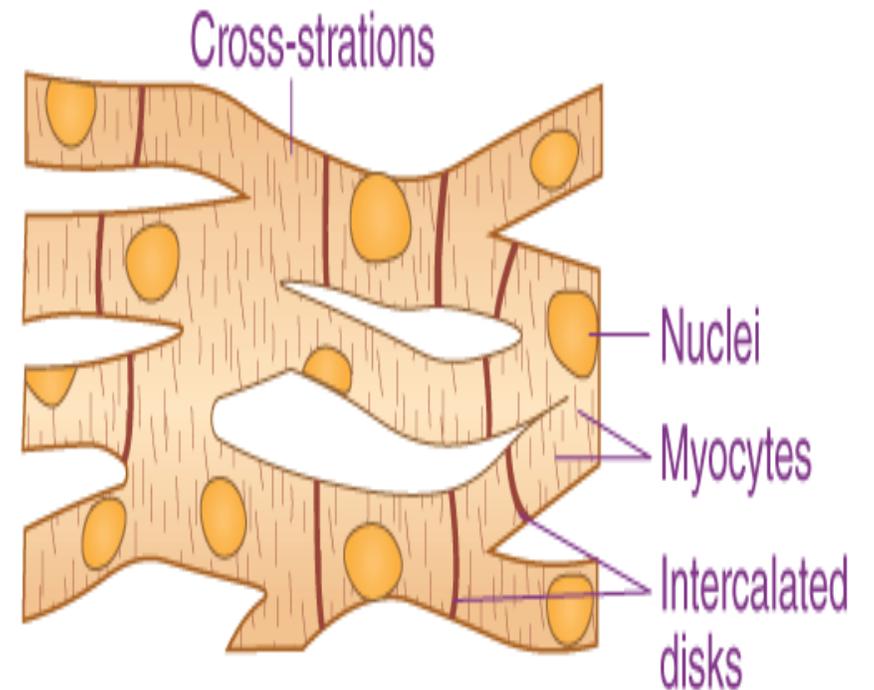
The Colour of Meat

- The colour of meat is largely due to the red protein called myoglobin and some hemoglobin (blood) left in the muscle.

- Some muscles contain more of these red pigments than others.

- Colour differences can be due to age and exercise, but are mainly due to the metabolism of the species and the function of the particular muscle.

- Meat from older animals is usually a darker colour.

- During the time meat is stored the colour changes to a darker brown-red because of the formation of metmyoglobin.

- When meat is cut and exposed to oxygen in the air, it takes about twenty minutes for myoglobin to change to oxymyoglobin, which is brighter red in colour.

- After some time, the meat becomes a browner colour again as metmyoglobin is formed.

- These colour changes do not make any difference to the taste or texture.

Chicken breast is much whiter in color than the leg or wing.

- Also chicken is much lighter than duck due to the fact that they are not a bird of flight; whereas duck is a darker meat due to the fact that it moves more.

Types of meat Based on Color

1. Red meat includes flesh from
   - Cattle (beef)
   - Sheep (lamb)
2. White meat encompasses flesh from
   - Poultry (chicken, turkey, duck)
   - Pigs (pork)
   - Calves (veal)
3. Dark meat that may come from
   - Rabbits
   - Kangaroo
   - Crocodiles
   - Deer
   - Wild birds

The benefits of red meat

- The protein in red meat is of high biological value.

- This means that it contains all the essential amino acids, in contrast to the protein of legumes and cereals, the body needs to synthesize its own proteins.

- Red meat is also an important source of iron.

- Low iron intake can cause problems with anemia and subsequent fatigue failure.

- Red meat is the best source of iron with better bioavailability. This means that the iron uptake by red meat is better absorbed than iron found in plant foods.

- The meat also contains zinc, which is an essential ingredient for development, maintenance of the immune system, wound healing and appetite control.

- 90gm red meat provides 40% of the recommended daily intake of zinc.

- Finally red meat contains a variety of B vitamins, which are involved in various

Dangers of red meat

- The intake of red meat, has been consistently associated with colon cancer and possibly other cancers and coronary heart disease.

- Red meat has more saturated fat, so it increases the risk for stroke (atherosclerosis) and cancer.

- **Women eating red and processed meat may increase the risk** for brain infarction.

- Both red and processed meat are associated with increased risk for hypertension, i.e high pressure.

- Hypertension is the main cause of strokes.

Dangers of red meat

- Processed meats are particularly rich in sodium, which is in excess raises blood pressure.

- Also red and processed meats are rich in iron. Iron can accelerate the production of free radicals during metabolism. These compounds cause changes to the tissues and DNA.

- The increased consumption of saturated animal fats helps in the development of atherosclerosis, which causes blockage of the arteries.

- People who consume more than two servings in daily (more than 160 grams per day) of red or processed meat such as sausages, at 35% greater risk of contracting colon cancer than people who consume less than one serving per week.

How much is a serve of lean meat and poultry, fish, eggs, nuts and seeds, and legumes/beans?

- A standard serve is (120 –145 Kcal):
- 65g cooked (about 90-100g raw) lean meats such as beef, lamb, veal, pork, goat
- 80g cooked (100g raw) lean poultry such as chicken or turkey
- 100g cooked fish fillet (about 115g raw) or one small can of fish
- 2 large (120g) eggs
- 1 cup (150g) cooked or canned legumes/beans such as lentils, chick peas or split peas (preferably with no added salt)
- 30g nuts, seeds, peanut or almond butter or other nut or seed paste (no added salt)*
- *(note: this amount for nuts and seeds gives approximately the same amount of energy as the other foods in this group but will provide less protein, iron or zinc).
- More information: https://www.eatforhealth.gov.au/food-essentials/how-much-do-we-need-each-day/serve-sizes

Changes during cooking of meat

1. Texture:
   - ❖Protein solidifies and becomes firm (coagulates).
   - ❖If overcooked the protein shrinks and releases water leaving a dry meat.
   - ❖Collagen denatures and converts to gelatin, over long times meat goes from soft and mushy to firm, moist and easy to bite

2. Color
   - ❖Surface browning is due to the Millard reaction.
   - ❖Myoglobin pigment denatures and changes colour from red to brown.

3. Flavor
   - ❖Cooking intensifies flavor and enhances aroma.
   - ❖Dry heat develops best flavor due to surface browning in Millard reaction.

4. Nutritive value
   - ❖No loss of protein
   - ❖Some loss of B-vitamins

Slaughtering of Animals

- The process of converting live animals into meat products for human consumption.

- Key Stages

- Ante-mortem inspection (before slaughtering)

- Post-mortem inspection (after slaughtering)

- Meat fabrication

- Grading

Basic Requirements in Slaughtering

- Cleanliness of the Meat Produced

- Hygiene of Production

- Efficiency of Meat Inspection

- Adequacy of Meat Preservation

- Need for Skilled Butchers and Proper Tools and Equipment

Ante-Mortem Inspection

- Selection of Animals for Slaughter

a. **Age of Animals**
- Swine: 6 to 12 months
- Cattle/Carabao(Philippine water buffalo): <3 but not >3 years
- Goats: 1 year

b. **Sex of Animals**
- Barrows(male pigs)/Gilts(female pigs): Best sources of meat for curing
- Boars(male pigs): Young boars (<200 days) can still be used, but older boars have pronounced "boar taint"
- Sows(adult female pigs): Meat is tough, and during the advance stage of pregnancy, the meat has a fishy odor.

Ante-Mortem Inspection

c. **Size**

- Hogs: 80-100 kg

- Cattle/Carabao: 300 to 450 kg

d. **Degree of Fatness**

- Most flavor compounds are found in fatty tissue.

- Fat stimulates saliva flow, giving the impression of juiciness.

e. **Health of the Animal**

- Animals for slaughter must be substantially healthy.

- Unhealthy animals must be treated and brought to normal condition before slaughter.

Management of Animals Prior to Slaughter

a. Fasting:
- Withdrawal of solid feed, providing only water ad libitum.
- Hogs fasted for 12 to 24 hours; ruminants for 24 to 48 hours.
- Advantages: Long shelf-life, low shrinkage, savings of feed, ease of cleaning, thorough bleeding.

b. **Relaxing the Animal**
- Avoid stress; if unavoidable, allow animals time to relax before slaughter (PSE(Pale, Soft, Exudative) – stress not severe, DFD(Dark, Firm, Dry) – stress is severe).

c. **Handling the Animals Gently**
- Avoid whipping, kicking, or boxing to prevent blood clots and red spots in meat.

d. **Clean Animals**
- Keep animals clean by washing off dirt to minimize possible carcass contamination.

Slaughtering Procedures

- Stunning(unconscious or insensible)
- Sticking(act of bleeding)
- Flaying/Skinning (Hide Removal)
- Removal of the Shank(lower part of the leg) and Head
- Evisceration(removal of internal organs)
- Splitting/Quartering
- Shrouding (Wrapping the Carcass with Cheesecloth)
- Chilling

Post-Mortem Inspection

- Conducted by veterinary doctors under proper lighting and with sterilized tools.
- Examination sequence: visual inspection, palpation(feeling parts of the body with the hands), incisions(cut or a surgical wound) if necessary, and laboratory tests.
- Focus on detecting abnormalities like color changes, lesions, or cysts.
- Specific examination criteria for different organs, including the head, lungs, heart, liver, and intestines.
- Special attention to zoonotic diseases(transmitted between animals and humans) and potential contamination.
- Post-mortem judgment determines carcass fate: fit, partially condemned, or unfit for consumption.
- Special procedures for animals reacting to screening tests, ensuring heightened scrutiny.
- Critical for ensuring food safety and consumer health in the meat industry.

Meat Cut

- Common Beef Cuts:
- Round, Loin, Sirloin, Chuck Arm: Lean beef cuts, suitable for roasts and steaks.
- Tender Cuts: More expensive; examples include ribeye and T-bone steaks.
- Tough Cuts: Affordable; benefit from slow cooking methods for tenderness.
- Lamb Cuts:
- Leg, Loin, Foreshank: Lean lamb cuts.
- Veal: Generally lean, excluding ground veal.
- Economic Choice: Learn recipes for tough cuts, as they are more budget-friendly.
- Pork Cuts:
- Tenderloin, Center Loin, Ham: Lean pork options.
- Preferable Cuts: Vary based on desired tenderness and flavor.
- Storage: Ground pork should be used within two days for optimal freshness.

Wholesale Cuts of Lamb Carcass

- Fore saddle and hind saddle(USDA and many other international standards)

- Fore saddle (53%) Hind saddle (47%)

- Fore saddle -Neck, Shoulder(between 5th and 6th ribs), Rack(6th to 12th rib), Breast(last rib to 1 /2" above elbow joint), foreshank

- Hind saddle (Loin, Leg , Flank, Suet and kidney)
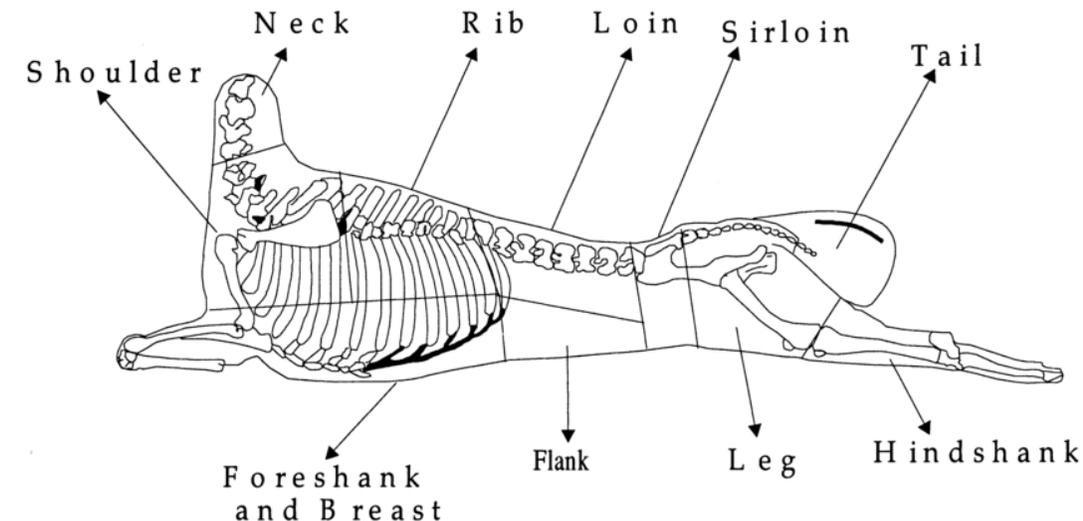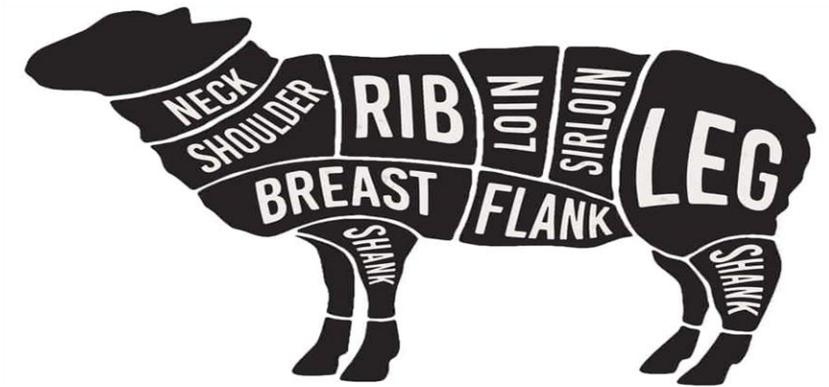
Wholesale Cuts of Buffalo or Beef Carcass

A. Carcass sides are separated

- Right side is called closed (kidney close)

- Left side is called open (kidney free)

B. fore quarter and hind quarter are separated by making a cut between 12th and 13th ribs.

- Fore quarter is cut between 5th and 6th ribs

1 - Neck
2 - Fore shin
3a - Bolo
3b - Shoulder
4 - Chuck
5a - Flat rib
5b - Brisket
6 - Prime rib
7 - Wing rib
8 - Loin
9 - Thin flank
10 - Rump
11 - Fillet
12 - Thick flank
13 - Topside
14 - Silverside
15 - Hind shin
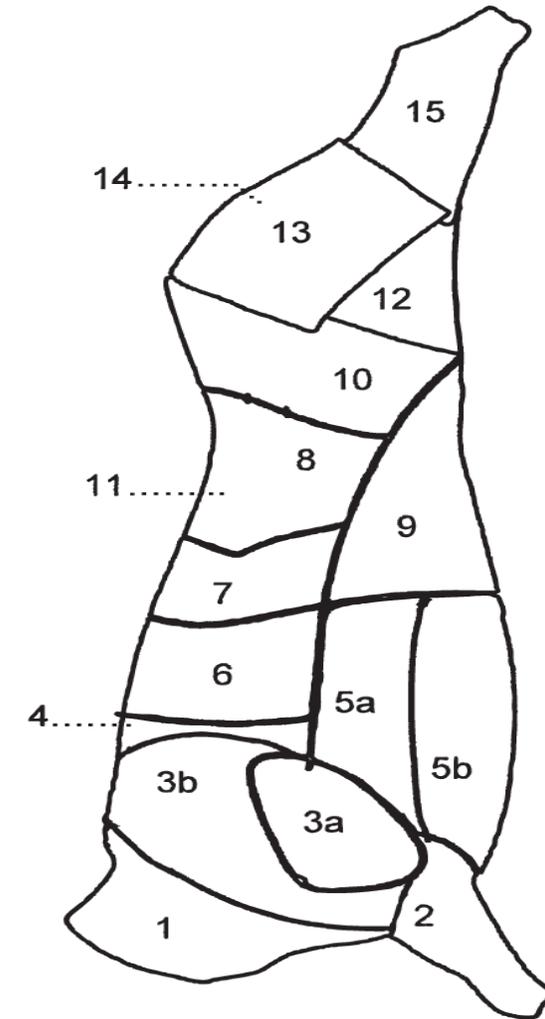
Grading of Meat

- Meat, a crucial component in various diets, undergoes a comprehensive grading process to ensure quality and safety.

- Grading involves evaluating characteristics such as tenderness, flavor, and marbling.

- Beef Grading:

- Grades: Prime, Choice, Select, Standard, Commercial, Utility, Cutter, Canner.

- Factors Considered:

- Marbling: Prime has the highest, while Select has the least.

- Maturity: Younger animals typically yield higher-quality meat.

Grading of Meat

Meat Grading System

- USDA Grading: Conducted by the United States Department of Agriculture.

- Quality Grades:

- **Prime:** Highest quality, abundant marbling.

- **Choice:** High quality, less marbling than Prime.

- **Select:** Leaner with minimal marbling.

- **Yield Grades:** Indicate cutability and the amount of usable meat.