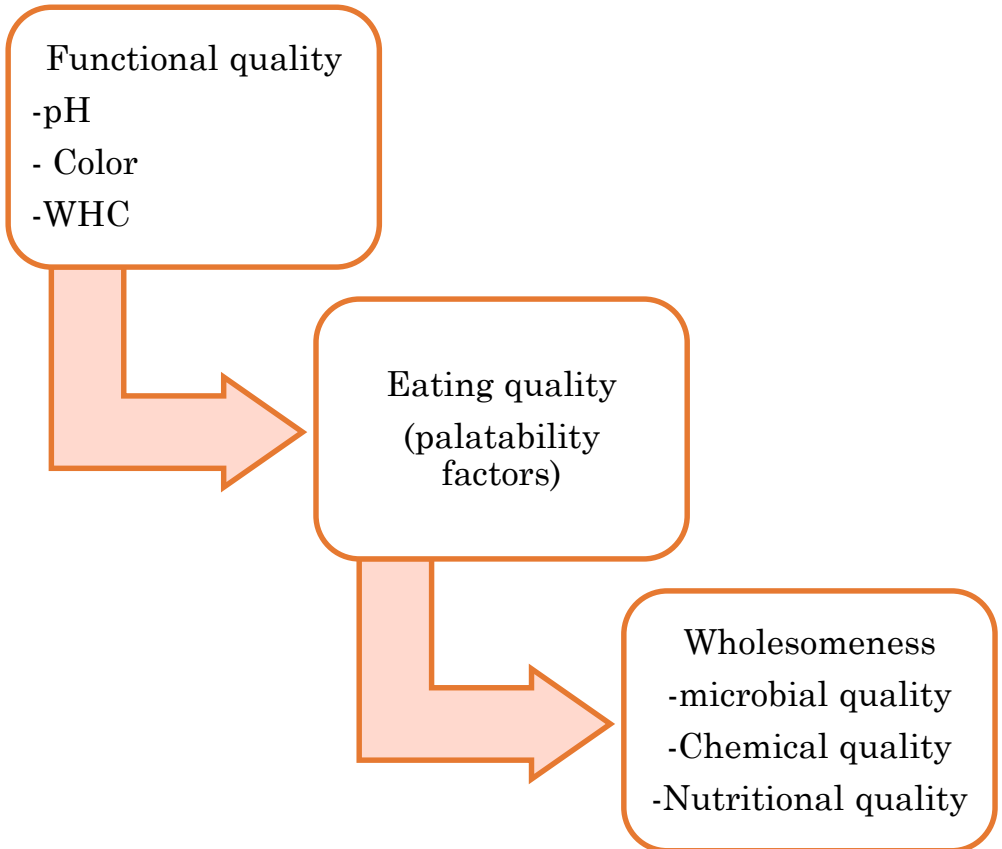
Meat quality defects

* DFD meat
* PSE meat
*Cold shortening
* Thaw rigor
* Heat ring

Meat quality

- Refers to some characteristics of meat (attractive color, tenderness, flavor, WHC).
- Based on these desirable characteristics, meat quality can be categorized as follows:



MEAT QUALITY IS AFFECTED BY:

Pre-slaughter factors

- Animal factors
  - Species, breed, age, location of muscle, sex
- Managemental factors
  - System of rearing
  - Feeding
  - Treatment
- Ante-mortem factors

Post-slaughter factors

- Temperature
- Ingress of contaminants
- Hot processing/accelerated processing
- Others

Pre-slaughter factors
animal factors:

Species: meats obtained from different species of animals have species specific quality. For example:

- Buffalo meat is lean, low in cholesterol and excellent blending quality for production of sausages.
- Goats tend to deposit most of their fat in omentum, mesentery and around kidney whereas, sheep deposit more fat in the carcass.
- Goats lack the tendency to deposit sub-cutaneous fat particularyl over the loin region as compared to sheep.
- meat from large animals (cattle and buffalo) are coarser in texture compared to small animals viz., pig, sheep, and goat.

Pre-slaughter factors
animal factors:

Breed: within the same species, different breeds of animals differ in meat quality.

- The best quality beef is often obtained from traditional beef breeds of cattle.

- Beef breeds produce higher meat-bone ratio and such meat is more tender, juicy and flavourful due to higher degree of marbling.

- Different breeds of animal have different inherent amounts of intra-muscular fat.

Pre-slaughter factors

Animal factors:

Age: As used in meat grading standards, maturity is defined as the physiological age of the animals or birds from which carcasses are produced.

- Maturity or age at slaughter is very closely related to meat tenderness.
- In general, tenderness decreases with increasing age.
- Therefore, meat from a young animal is more tender than from a mature animal of the same species and breed.
- This is mainly because of changes in inter-molecular cross-linkages in collagen fibres

Pre-slaughter factors
Animal factors:

Age:

- Age has profound effect on the colour and flavour of meat.

- With the advancement of animal's age, the muscle colour becomes darker due to increasing myoglobin (Mb) concentration.

Pre-slaughter factors
animal factors:

Location of muscle:

- Location of muscles in the carcass is also important as there are distinct differences in tenderness between muscles.

- Muscle of the limbs, neck, etc. (where the workload) are more become tougher due to high degree of movement with the advancement of age compared to muscles of loin which require little or no mobilization (movement) during day-today activities.

Pre-slaughter factors
animal factors:

Sex:

- **Sex** of the animal determines the rate and extent of fat deposition, growth rate as well as development of some odourous compounds in the body related to sexual maturity which affect the quality of meat.

Pre-slaughter factors
Managemental factors:

System of rearing: Intensive or extensive systems

- Free range animals: have more muscle pigments than their stall-fed counterparts.

Feeding:

- Feeding of high energy carbohydrate diets leads to faster growth and fat deposition in all livestock.
- Feeding of meat animals with fish meal, certain plants such as sting weed, certain strains of clove and other legumes may produce meat with abnormal flavour (taint).
- Use of high concentration of animal manure as a source of organic nitrogen may also lead to tainting of meat.

Pre-slaughter factors managemental factors:

Treatment:

- Some volatile chemicals such as turpentine, linseed oil, ammonia (gas) used in veterinary practices may lead to tainting of meat.
- This can also be managed by chilling of affected dressed carcasses for 24 hours.
- Care must be taken to provide adequate gap between medication and slaughter, so that veterinary drug residues are not present in the meat.

Pre-slaughter factors

Ante-mortem factors:

Pre-slaughter handling:

- Pre-slaughter handling of meat animals include
  - the process of loading at farm,
  - the journey to the abattoir lairage and
  - subsequent handling upto the point of slaughter.
- Animals exposed to long term pre-slaughter stress have reduced glycogen content in the muscles at slaughter.
- As a result, upon onset of rigor mortis, pH decline does not proceed at a normal rate and the ultimate pH is higher than normal (≥6.5) resulting in Dark, Firm and Dry (DFD) meat.
- Animals exposed to short term stress results in Pale, Soft and Exudative (PSE) meat.

DFD MEAT DEFECT

- Dark, Firm, and Dry (DFD)
- Generally occurs in cattle and mutton meats
- Glycogen depletion ante-mortem characterized by very low levels of glycogen in the muscle.
- The low levels of glycogen present in the meat restrict the growth of lactic acid-producing.
- This encourages the growth of bacteria that metabolize amino acids and proteins.
- These produce unpleasant smelling waste products.
- The high pH value and water holding capacity of the meat promotes the bacterial growth.

PSE MEAT DEFECT

- Short term stress results in Pale, Soft and Exudative (PSE) meat which has a lower pH than normal.
- The meat is pale in colour with very poor water holding capacity.
- During cooking, PSE meat loses a high amount of moisture resulting in drier, tougher and less flavourful meat.
- Improper rough handling, mixing of animals of different social orders during transportation and in the lairage, poorly designed holding and handling facilities in the lairage and other conditions that induce stress just prior to slaughter result in PSE meat.

PSE AND DFD MEAT DEFECTS

- Poor ante-mortem handling can produce PSE or DFD meat and may influence eating quality.
- PSE affects pigs and poultry (chicken and turkey).
- Both PSE and DFD meat are caused by stress experienced live animal at and before slaughter.

PSE MEAT DEFECT

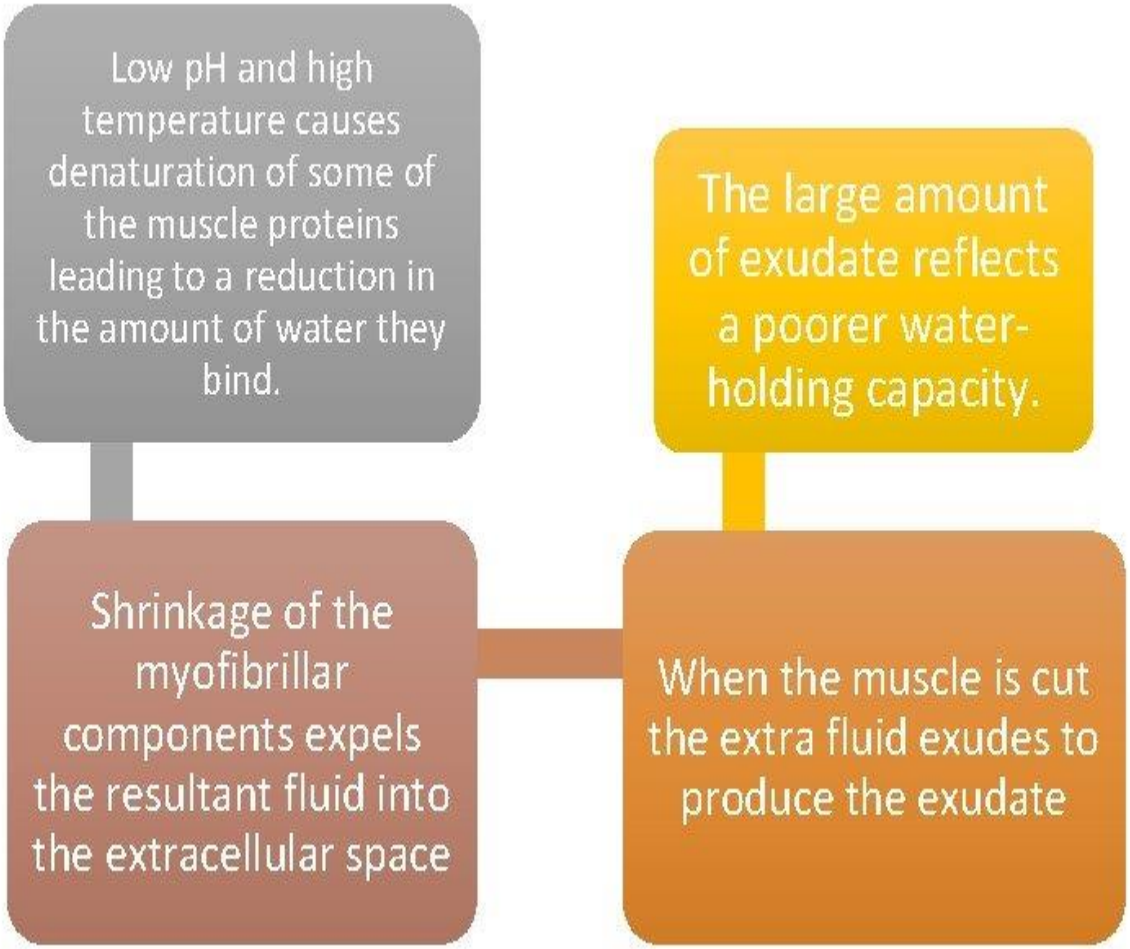
- Generally occurs in Pigs and poultry
- The problem is greater in stress-susceptible genotypes.

- Poultry and pigs carry one or two copies of the Malignant Hypothermia (halothane) gene.

- PSE meat reduced yield both of fresh meat and of processed products like hams and bacon.

- PSE meat tends to taste dry and have poor texture after cooking.

PSE MEAT DEFECT



PSE in turkey meat

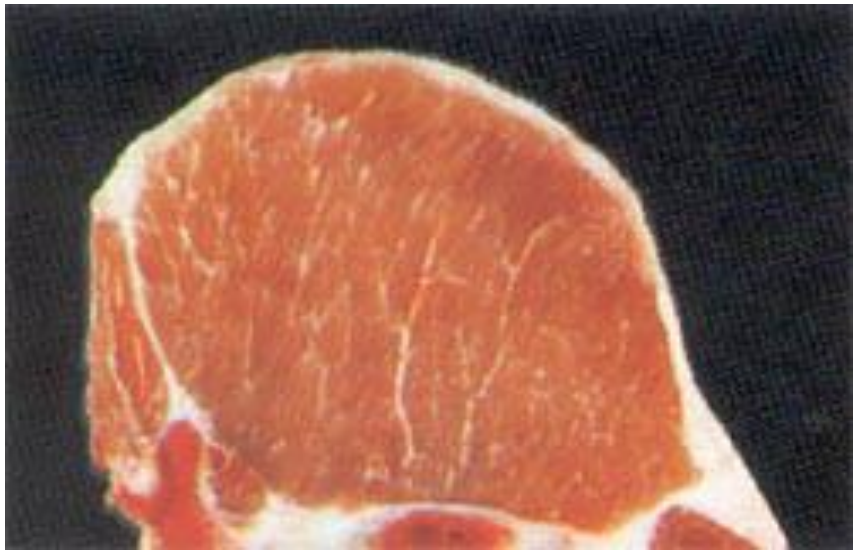
Normal PSE

Muscle color, glycogen content, lactate production, and pH decline

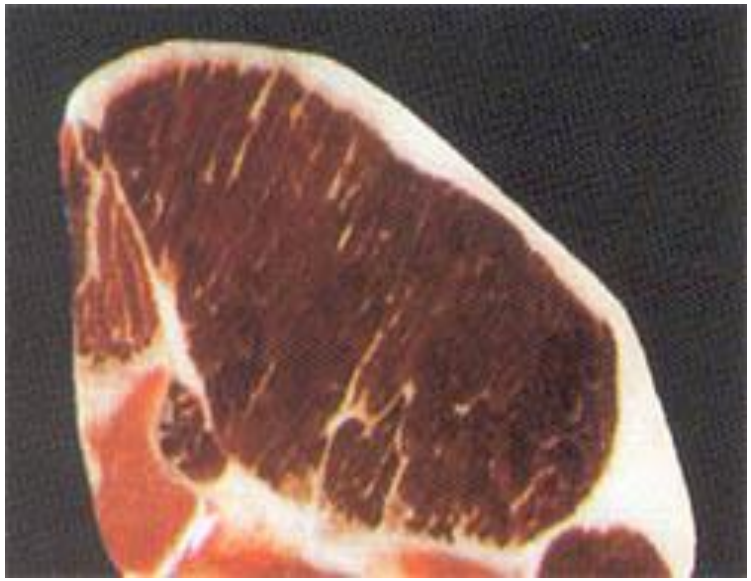
Muscle color	Glycogen at death	Glycogen at 24 hours postmortem	Lactate production	Ultimate pH
Normal	1.0%	0.1%	High	5.6
Dark	0.3%	0.1%	Low	6.0 to 6.5
Pale	0.6%	0.1%	Very high	5.2

PSE	DFD
• Acute stress	• Chronic stress
• Rapid initial acidification	• Reduced glycogen
• Low initial pH at high carcass temperature	• High ultimate pH
• Proteins denature	• Proteins do not denature
• Low water-holding capacity	• High water-holding capacity
• 'Bound' water lost	• Water held by proteins
• Muscle fibres separate	• Fibres tightly packed
• Large extracellular space	• Small extracellular space
• Light scattering high	• Light scattering low
• Surface appears pale	• Surface dark

Normal meat

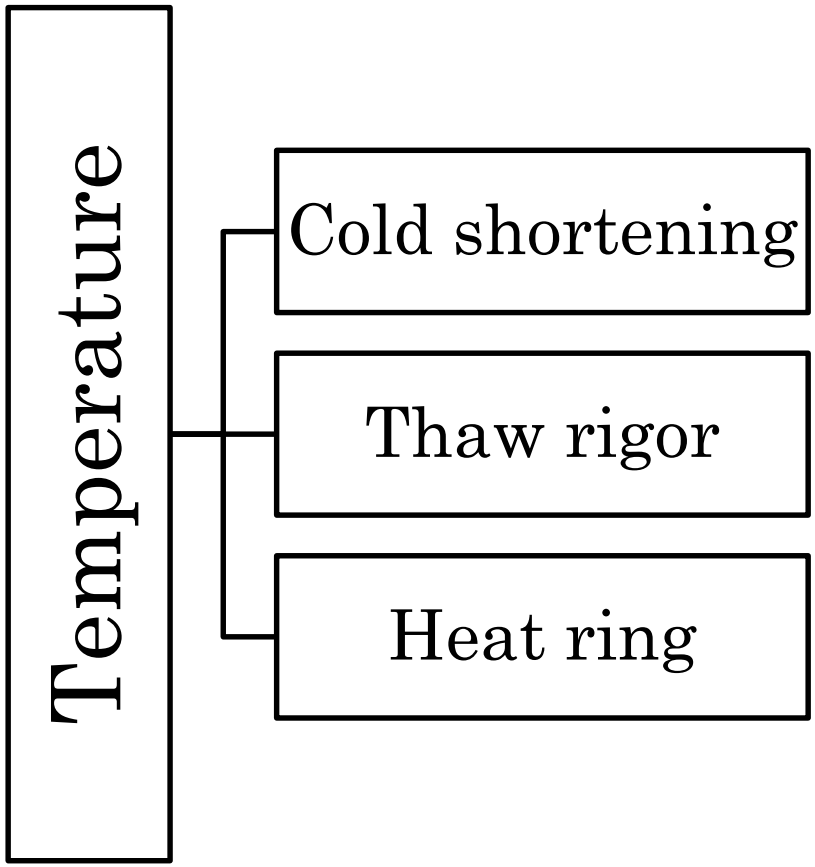


DFD meat



PSE meat

Temperature related defects



COLD SHORTENING

- Animal muscle which is exposed immediately after slaughter can undergo a detrimental occurence known as cold shortening if it is promptly cooled to a temperature range of $0^{o}C$ to $5^{o}C$.

- results in toughness in lamb and beef carcass.

- pH is about 6.3 and ATP levels are high, lowering of temperature causes the muscle to contract.

COLD SHORTENING

- Usually seen in beef carcass.
- Beef carcass do not chilled quickly because of the thickness of the muscles.
- Because of too quick chilling, the SR is unable to hold the calcium.
- Muscle contraction occus while ATP still is available.

Thaw rigor

- Muscle is frozen before rigor mortis occurs.
- ATP hasn't been used in rigor mortis events and is high when the muscle is frozen.
- Freezing damages the SR.
- When thawing occurs, calcium is released from SR, causing a massive contraction because of the high ATP level.
- Toughening results.

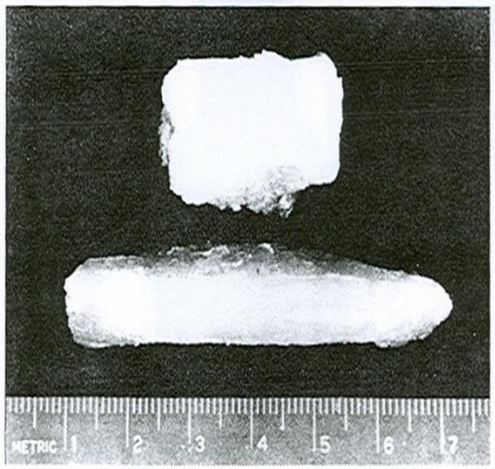


Figure 13-10

Heat ring

- Found in carcasses with a thin rind (lean carcass not chilled properly).
- Beef carcasses need at least 1 cm of backfat whereas lambs need at least 0.5 cm of backfat.
- Outer ring of muscle gets cold too quickly
  - has slower glycolytic rate
  - slower pH decline
  - longer time until rigor develops