Post mortem Changes in Meat

Pre rigor mortis

Vital functions stop

Deprivation of oxygen

Residual O_2 into haemoglobin and myoglobin

Presence of ATP and phosphocreatine

Aerobic metabolism

Actomyosin and myosin dissociation

Rigor Mortis

Start of muscle to meat

ATP and phosphocreatine reservoir exhausting

Anearobic metabolism

No actomyosin and myosin dissociation

Highest toughness

Tenderization phase

Toughness deceases

Activation of proteolitic enzymes

Calpains

Cathepsins

Caspeses

Proteosomes

Introducing proteolytic enzymes externally

Post mortem changes

- Slaughter of food animal is followed by a series of physical and chemical changes over a period of several hours or even days resulting in the conversion of muscle to meat.
- There is immediate loss of oxygen supply to the muscle due to exsanguination (bleeding).
- As the stored oxygen in myoglobin gets depleted, there is inhibition of aerobic pathway through citrate cycle as well as cytochrome system.
- The store of creatine phosphate (CP) used for rephosphorylation of ADP to ATP (creatine phosphate + ADP = ATP+ creatine) gets soon exhausted.
- Energy metabolism is then shifted to anaerobic pathway resulting in the breakdown of glycogen to lactic acid.
- This process continues till all the glycogen stored in the muscle is exhausted.
- This resynthesis of ATP by anaerobic pathway is not enough to maintain the required ATP level and as it depletes, there is formation of actomyosin resulting in the onset of rigor mortis.

Important changes during post mortem

- Loss of Homeostasis
- Post-mortem glycolysis and pH Decline
- Rigor Mortis
- Loss of Protection from invading Microorganisms
- Degradation due to Photolytic Enzymes
- Loss of Structural Integrity

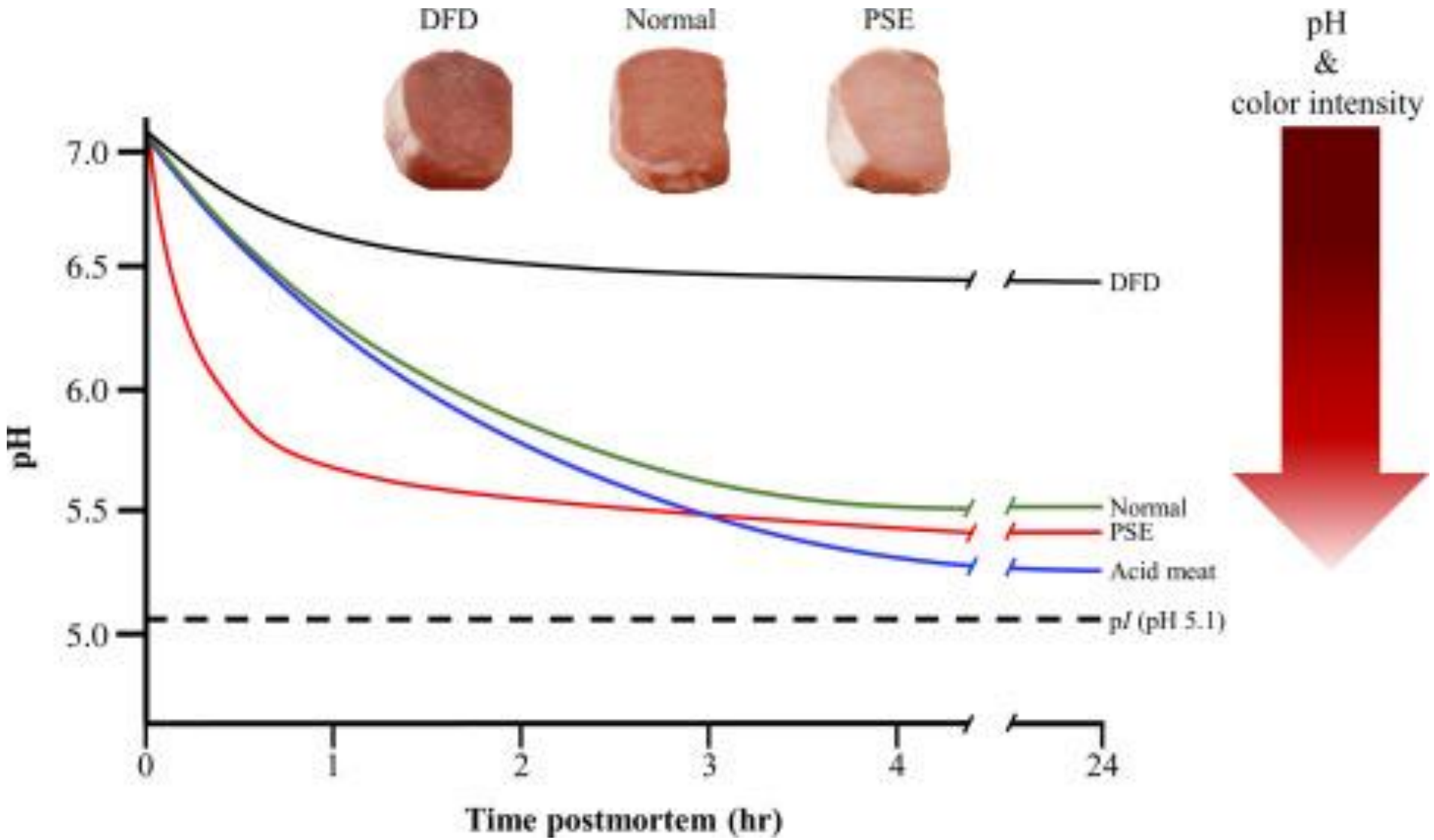
Loss of Homeostasis

- Homeostatic mechanism, a system for the physiologically balanced internal environment which helps the body to cope up with the stresses of oxygen deficiency, extreme variation in temperature, energy supply, etc. is lost.
- The homeostasis is controlled by nervous system which ceases within 4-6 minutes after bleeding.
- In the absence of blood supply, there is loss of body heat and temperature starts declining.

Postmortem Glycolysis and pH Decline

- In the absence of oxygen, anaerobic glycolysis leads to the formation of lactic acid from the glycogen reserves:
- Glycogen-------> lactic acid + 2 ATP (anaerobic condition)
- The accumulation of lactic acid lowers down the muscle pH which is an important postmortem change during the conversion of muscle to meat.
- The rate and extent of pH decline are variable, being influenced by the species of food animal, various pre-slaughter factors, environmental temperature etc.
- In most species, a gradual decline continues from approximately pH 7 in the living muscle during first few hours (5-6 hours) and then there is a little drop in the next 15-20 hours, giving an ultimate pH in the range of 5.5 - 5.7.

Postmortem Glycolysis and pH Decline



Postmortem Glycolysis and pH Decline

- The rate of pH decline is enhanced at high environmental temperature.
- A low ultimate pH is desired to have a check on the proliferating microorganisms during storage.
- A sharp decline in postmortem pH even before the dissipation of body heat through carcass chilling may cause denaturation of muscle proteins.
- So, the muscles depict pale, soft and exudative (PSE) condition.
- Contrary to this, muscles which maintain a consistently high pH during postmortem conversion to meat depicts a dark, firm and dry (DFD) condition.
- Both the conditions are undesirable.

Rigor Mortis

- Rigor mortis is the stiffening of muscles after death, crucial in the conversion of muscle to meat.
- ATP complexed with Mg++ is required to break actomyosin bonds for muscle relaxation.
- Gradual drop in ATP levels leads to permanent actomyosin cross bridges, reducing muscle extensibility.
- The delay phase of rigor mortis is characterized by slow actomyosin formation, with relatively extensible muscles.
- The fast onset phase sees increased actomyosin formation, causing decreased muscle extensibility.
- Complete depletion of creatine phosphate (CP) marks the end of rigor mortis, leading to muscle stiffness.
- Pre-rigor meat is quite tender but its toughness keeps on increasing until rigor mortis is completed. It continues to be tough for some more time. However, with the resolution of rigor due to denaturation or degradation or ageing, meat again becomes tender.
- The onset of rigor mortis is also accompanied by a decrease in water holding capacity.

Loss of Protection from invading Microorganisms

- During post-mortem period, body defence mechanism steps operating and membrane properties are altered.
- So, during conversion to meat, muscle is quite susceptible to invading microorganism.
- Except for low pH, most of the other post-mortem changes favour bacterial growth.
- Hence, utmost handling precautions are necessary to prevent contamination of meat.

Degradation due to Proteolytic Enzymes

- Several autolytic lysosomal enzymes called cathepsins which remain inactive in a living muscle tissue, are activated as the muscle pH declines.
- These enzymes initiate the degradation of muscle protein structure.
- In fact, catheptic enzymes are capable of breaking down even collagenous connective tissue of the muscle and cause tenderisation of meat during aging.

Loss of Structural Integrity

- Postmortem alteration of membrane properties initiates the degradation of muscular proteins.
- There is a progressive disruption of myofibrillar structure.
- The resolution of rigor mortis is known to occur due to disintegration of Z-line structure.
- A rapid decline in muscle pH also causes denaturation of collagenous connective tissue.