Post Mortem muscle chemistry-1
Loss of homeostasis and post mortem glycolysis

Contents:

1. Introduction
2. Loss of homeostasis
3. Post mortem Glycolysis
    - 3.1 Pale, Soft, Exudative (PSE)
    - 3.2 Dark, Firm, Dry (DFD)
4. Importance of pH change in Muscle to meat conversion.

Introduction:

- Slaughter of animals is followed by series of physical and chemical changes over a period of several hours or may take even days.
- The process start with Exsanguination of animal where bleeding takes place. Myoglobin is thus decrease in oxygen and as a result inhibition of aerobic pathway by both citrate cycle and cytochrome system.
- This type of conditions thus leads to anaerobic pathway for energy production and results in breakdown of glycogen to lactic acid.

Loss of homeostasis:

- After slaughter, aerobic metabolism begins to fail due to the stored oxygen supply being depleted.
- In case of animal slaughtering the homeostasis ceases within 4-6 min. after bleeding, which is accompanied by loss in body heat and decrease in temperature takes place.
- To maintain homeostasis, anaerobic energy metabolism starts producing lactic acid, consuming the glycogen stored in the muscles.

Thus, the structural integrity of the cells is maintained for a period of time although less energy in the form of ATP is produced.

Post mortem Glycolysis:

- Glycogen is served as raw material which is being utilized by body through aerobic pathway for the production of ATPs which is achieved in living animals by aerobic Glycolysis.

Glycogen -------> Lactic acid

Muscle pH: 7.0 -------> 5.6 (because of lactic acid)

Muscle color: purple changes to bright red or pink (pH 7.0 -------> 5.6)

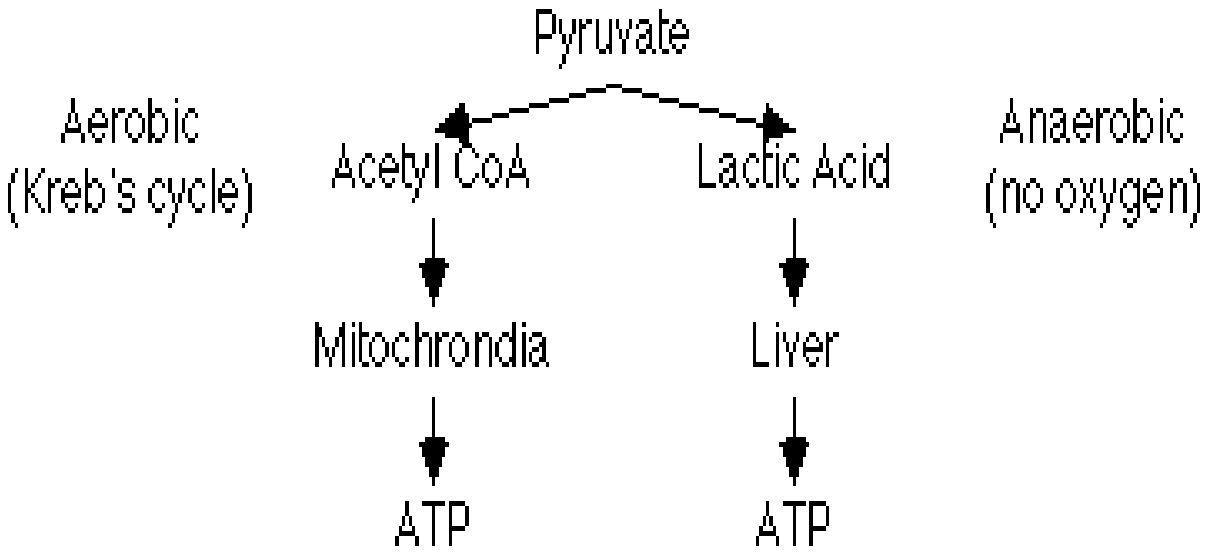


Figure1. Difference of aerobic and anaerobic pathway

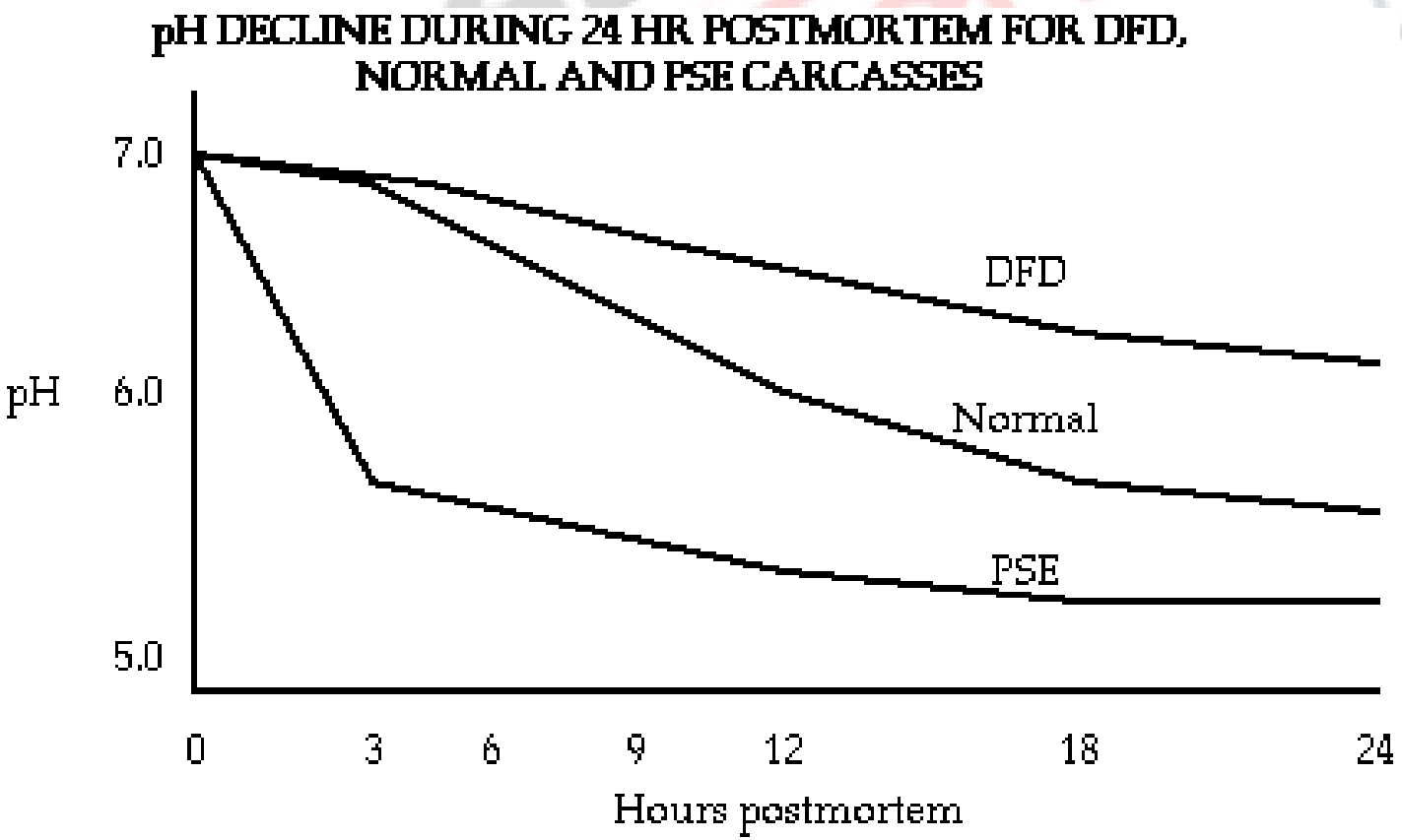
- The breakdown of glycogen produces enough energy to contract the muscles, and also produces lactic acid.
- If the acid content is too high, the meat loses its water-binding ability and becomes pale and watery.
- The structural integrity of the cells is maintained for a period of time although less energy in the form of ATP is produced.
- Lactic acid buildup also releases calcium, which causes muscle contraction. As glycogen supplies are depleted, ATP regeneration stops, and the actin and myosin remain locked in a permanent contraction called ***Rigor mortis.***

(Pale, Soft, Exudative) PSE meat

- A sharp decline in postmortem pH even before the dissipation of body heat through carcass chilling may cause denaturation of muscle proteins.
- This kind of meat exhibit Pale, Soft, Exudative (PSE) condition. The low pH prevents or retards microbial growth.
- The rate of pH change *post mortem* also influences meat quality. Development of a low pH (acid) in muscle causes denaturisation of muscle proteins. This denaturisation causes loss of protein solubility, loss of water- and protein-binding capacity, loss in intensity of muscle pigment coloration.

Dark, Firm, Dry (DFD) Meat

- Contrary to PSE condition, muscles which maintain a consistently high pH during post mortem changes or conversion of muscle to meat depicts dark, firm, dry (DFD) meat.
- In such cases the pH values affect many meat properties including color and drip loss.
- Muscles that maintain a high pH during conversion of muscle to meat may be very dark in color, and very dry on the exposed cut surface, because the water is kept tightly bound to proteins.


pH DECLINE DURING 24 HR POSTMORTEM FOR DFD, NORMAL AND PSE CARCASSES
7.0
6.0
5.0
pH
DFD
Normal
PSE
0
3
6
9
12
18
24
Hours postmortem

Importance of pH change in Muscle to meat conversion.

pH also is important in determining the **water-holding capacity** of meat, the ability of meat to retain its water during application of external forces such as cutting, heating, grinding, or pressing. There are three locations of water found in meat:

1. Bound
2. Immobililzed
3. Free

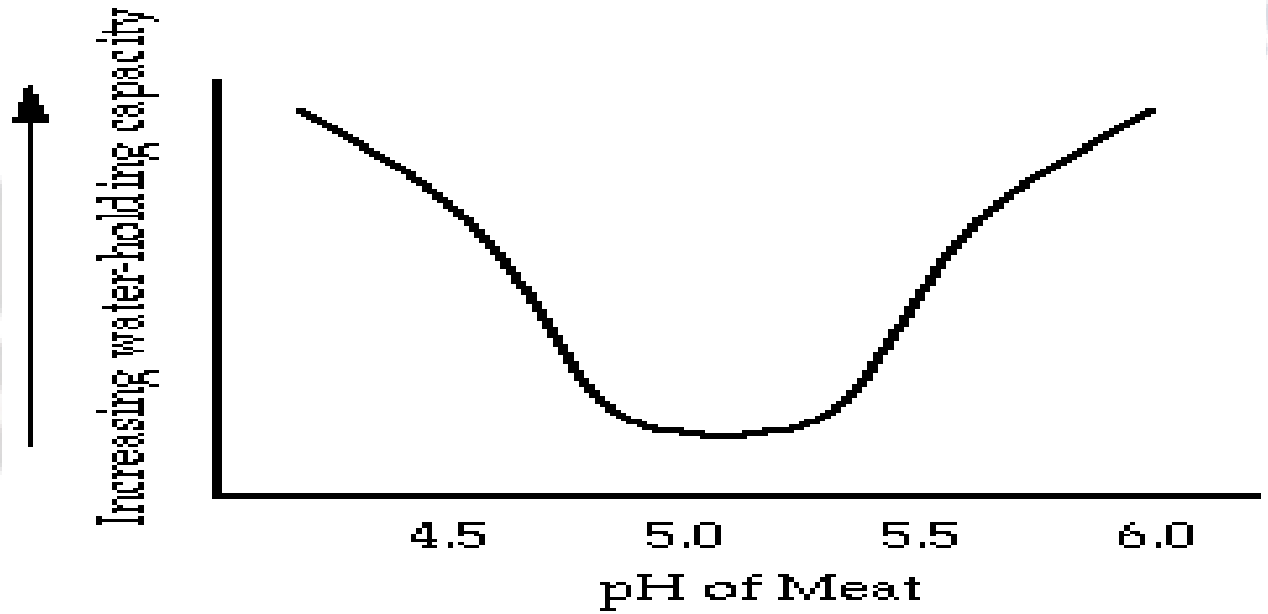


Figure 2. Relation of water holding capacity of meat as influenced by pH.

References

1. Bate-Smith, E.C., "Physiology and chemistry of rigor Mortis," Advances in Food Research, 1, 1-34 (1948).
2. Crocker, E.C., " Flavor of Meat," Food research, 21,122-132 (1956).
3. Urbain, W.M., " Meat and meat products'" in Jacobs, M.B., ed., " Chemistry and technology of food and food products,' Interscience publication., Inc., New York, N.Y., 1951.
4. Whitaker, J.R., "Chemical Changes associated with ageing of meat with emphasis on the protein,' Advances in Food research, 9 (1959).
5. Wierbicki, E.., Kunkle , L. E., cahill, V.R. and deatherage, F.E., " The relation of tenderness to protein alteration during postmortem aging," Food techno.,8,506-511 (1954) 10:80-86 (1956).