University of Tikrit
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Conversion of Muscle to Meat
Meat Hygiene

Lec2

Muscle Contraction

- Many events happen during contraction to allow for cooperative action of individual **sarcomeres** to generate movement.
- Some of the events are important in the understanding of the conversion of muscle to meat.
- The first step in contraction is the **transfer** of the **nerve impulse** from the brain to the muscle.
- Through many **hormonal and chemical changes** an impulse reaches the organelle that stores **calcium** in the muscle cell.
- This causes the release of calcium into the **sarcoplasm.**
- The calcium interacts with regulatory proteins in the myofibril to allow **crossbridges** to form between the main contractile proteins, **myosin and actin**.
- The calcium also **activates enzymes** that start energy metabolism.
- This allows for coordination of energy metabolism with muscle contraction. The high energy phosphate compound, adenosine triphosphate (ATP).
- ATP is **hydrolyzed** to create the **power stroke** of contraction and causes the thick filaments to move past the thin filaments and shorten the sarcomere

- Many **sarcomeres shortening together** are what causes contraction in the muscle.
- To **break the crossbridge** formed between myosin and actin, ATP must be present.
- If energy is **depleted and no ATP** can be manufactured from **glycogen** than no **relaxation** of the muscle occurs.
- If **muscle is working slowly**, and **oxygen** is supplied in adequate amounts, **aerobic metabolism** can adequately supply most of its energy requirements.
- However, when muscle is contacting rapidly, its oxygen supply becomes inadequate for support of ATP **re-synthesis via aerobic metabolism**.
- Under these conditions of oxygen shortage, a mechanism, **anaerobic metabolism**, is able to supply energy for a short time.
- A major feature of anaerobic metabolism is accumulation of **lactic acid.**
- The amount of energy available in this anaerobic route is **limited.**
- Lactic acid **accumulation** in the muscle lowers its **pH**, and at pH values of less than **6.0 to 6.5**, the rate of **glycolysis** is drastically **reduced,** with a proportional reduction in ATP re-synthesis. Under these conditions, **fatigue** develops quite rapidly.
- During muscle's recovery from fatigue, lactic acid that has accumulated is transported out of the muscle via the **blood stream**, and is converted to **glucose** in the **liver** or metabolized to **carbon dioxide and water by the heart (via a specialized enzyme system).**
- ATP and energy stores are **replenished** by the process of normal aerobic metabolism.

- The recovery process may occur quite rapidly for a slight fatigue but may require extended periods if the fatigue is severe.

Conversion of Muscle to Meat (Rigor mortis).

<u>Changes of pH</u>

1-

- Immediately **post-mortem (post slaughtering)** the muscle contains a small amount of muscle specific carbohydrate, called **glycogen (about 1%),** most of which is broken down to lactic acid in the muscle meat in the first hours **(up to 12 hours)** after slaughtering.
- This biochemical process serves an important function in establishing **acidity (low pH) in the meat**.

2-

- The so-called **glycolytic cycle** starts immediately after **slaughter** in the muscle tissue, in which glycogen, the main energy supplier to the muscle, is broken down to lactic acid.
- The buildup of lactic acid in the muscle produces an increase in its acidity, as measured by the pH.
- **The pH of normal muscle at slaughter is about 7.0 but this will decrease in meat.**
- In a **normal animal**, the ultimate pH (expressed as pH24 = 24 hours after slaughter) falls to around pH 5.8-5.4.
- The degree of reduction of muscle pH after slaughter has a significant effect on the **quality** of the resulting meat.

3-

- The pH is important for the **storage life** of meat. The lower the pH, the less favourable conditions for the growth of **harmful bacteria.**
- Meat of animals, which had depleted their glycogen reserves before slaughtering (after stressful transport/handling in holding pens) will

not have a sufficient fall in pH and will be **highly prone to bacterial deterioration**

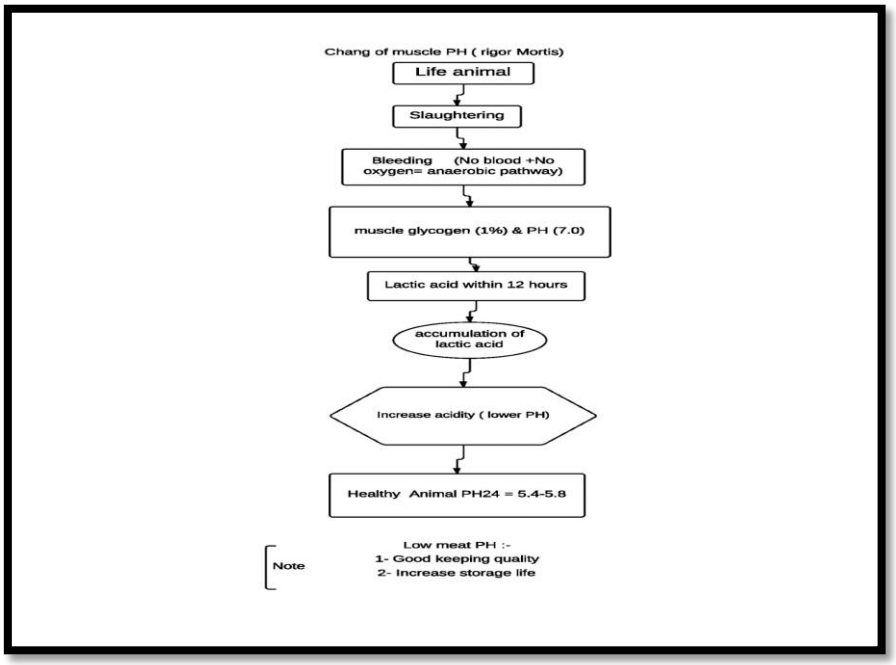
Rigor mortis:

Literal translation is "death stiffening". Rigor has three phases:

Delay phase: while there is plenty of ATP in the muscle (complexed with Mg++), the muscle will remain in the relaxed state and no crossbridges between the thick and thin myofilaments will occur.

Onset phase: As stores of ATP and Creatine Phosphate (CP is used to rephosphoryate ADP to ATP) are used up, rigor bonds between the thick and thin myofilaments are formed. As more bonds are formed, the muscle loses extensibility.

Completion: When all of the CP is gone, the muscle has no way of regenerating ATP. Thus, full rigor mortis will set in.



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