

Lecture 5

Post Mortem Changes in Meat/Conversion of Muscle to Meat

The conversion of muscle to meat involves a number of physical and chemical changes which take place over a period of several hours or even days. The maintenance of a physiologically balanced environment is termed HOMEOSTASIS. This could be regarded as a system that ensures uniformity and stability of the internal environment thereby providing the body with a means of coping with abnormal (stressful) conditions.

1.) Exsanguinations: Is the act of removing as much blood as possible from the animal. The loss of blood and resultant loss in blood pressure sends signals to the circulatory system via the brain and it adjusts its function in an attempt to maintain a blood supply to the organs. Exsanguinations marks the beginning of a series of post mortem changes in the muscle only about 50% of the total blood volume can be removed from the body, the remainder is held mainly in vital organs.

2.) Circulatory Failure to the Muscles

The function of the circulatory system is to transport essential nutrients to the muscle and carry waste products away from the muscle, but exsanguinations eliminates this line of communication between the muscle and its external environment.

In the living cell of a living animal, O₂ is picked up in the lungs and carried to the cells of the body by the haemoglobin pigment of the blood. The myoglobin of the muscle cells has a greater attraction for O₂ than does haemoglobin, a characteristic that helps transfer O₂ from the blood of the muscle cells. The myoglobin provides a place for storing the O₂ until it is used by the cells for metabolism. As the stored O₂ supply becomes depleted after exsanguinations the aerobic pathway through the citrate cycle and the cytochrome system must stop functioning. Energy metabolism is then shifted to the anaerobic pathway considerably less energy that will maintain the structural integrity and temperature of the cells for some time.

3.) pH Decline:- Since the circulatory system is no longer functioning lactic acid produced by anaerobic metabolism, instead of being transported to the liver for the synthesis of glucose and glycogen remains in the muscle and increases in concentration as metabolism proceeds. The lactic acid produced causes the lowering of the pH in meat, making the meat acidic. Thereby cause the denaturing of muscle proteins leading to loss of water holding capacity and the result is a muscle with pale colour. The pH of a living muscle from pork decrease from pH 7 to about 5.6 -5.7 within 6 - 8 hours post-mortem and then to an ultimate pH (reached after 24hours post-mortem) of about 5.3 -5.7. Muscle which have a

very rapid and extensive pH decline will be pale in colour, will have very low WHC on the other hand, muscle to meat will be very dark coloured and very dry on the exposed cut surface because the naturally occurring water is tightly bound to the proteins.

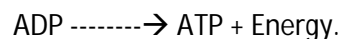
4.) Post-Mortem Heat Production and Dissipation

As a result of exsanguinations and circulatory failure heat can no longer be carried to the lungs and other surface areas for dissipation, therefore causing a rise in muscle temperature. External factors associated with the slaughter process will also influence heat dissipation such as ambient temperature in the slaughter room, the length of the slaughter and dressing operation and the temperature of the initial chill cooler will all have a considerable influence on the rate of carcass temperature decline.

5.) Rigor Mortis (Latin: "Stiffness of Death")

This is the stiffening of the muscle after death and is due to the formation of permanent cross-bridges in the muscle between the actin and myosin filaments. During the period immediately following exsanguinations muscle is quite extensible, if a force is applied to it the muscle will passively stretch and when the force is removed, then natural electricity of the muscle will return to its original length. At that time only few actomyosin is present to prevent extension by a force. The period of time during which the muscle is relatively extensible and elastic is called DELAY PHASE OF RIGOR MORTIS

The Onset Phase of rigor mortis begins when the muscle begins to lose extensibility only in ensuring relaxation which the actomyosin bond. Rigor mortis therefore is an irreversible muscle contraction



When muscle glycogen stores is depleted, ATP produced becomes insufficient to maintain the muscle in a relaxed state.

6.) Loss of Protection from Bacteria Invasion

During the conversion of muscle to meat, following exsanguinations, the antimicrobial defence system ceases to function, membrane properties are altered and the muscle becomes susceptible to bacterial invasion unchecked.

7.) Enzymatic Degradation

In the muscle cells, proteolytic enzymes called cathepsins are held in an inactive state in organelles called lysosomes. The drop in pH at the death of the animal activates these enzymes and they begin to degrade the protein structure of the muscles. In addition the muscle proteins may be subjected to denaturation due to pH drop.

Relation between Ph Decline and the Development of Rigor Mortis

Muscle with a normal pH decline curve will have on poultry meat has been shown to be due to induction of rapid onset of rigor mortis and most directly related to the rapid pH decline of the meat while carcass is still warm. Beginning immediately after death, CP falls rapidly with pH following the same pattern as ATP levels. ATP breakdown now commences and proceeds rapidly until the level becomes low. As ATP levels declines, there is rapid decrease in muscle extensibility.

Stress affected meat becomes dark, blue –red in colour.

8.) Changes in the Physical Appearance of the Muscle

In living animals muscle with sufficient oxygen supply has a bright red appearance. In post mortem muscle, as the O₂ is used, the muscle becomes dark purplish red in colour. The lower the pH the lower the water binding properties of meat.

Cold Shortening

Muscles shorten as permanent bonds form during the development of rigor mortis. Minimum shortening occurs at 14° c to 19 ° C. If the temperature of the muscles is reduced to below 10 -16 ° C while they were still in the early pre-rigor condition (pH 6.0 – 6.4), there is a tendency for shortening and thereby toughness in cooking. This phenomenon is referred to as Cold Slaughtering.

Thaw Rigor

This is the shortening that occurs upon thawing meat that was frozen in the pre –rigor state. The onset of thaw rigor occurs while the amount of ATP is relatively high (40 ° c); meat becomes less tender. In case meat is not allowed to complete its rigor months before freezing, the meat should be rapidly thawed before using, since slow thawing with accumulation of a high concentration of salts in the thawed fluid appears to accelerate thaw rigor.

Ageing Meat

in the absence of microbial spoilage the holding of unprocessed meat above freezing point (usually 2-5 ° c) for about 2- 4 weeks is known as CONDITIONING OR AGEING OR RIPENNING, this practice helps to increase tenderness and flavour.