Changes to meat following slaughtering

The important processes which take place in muscle meat following slaughtering (post mortem) are muscle rigidity, maturation and, if applicable, decay. Internal and external factors are important to the sequences: these factors can be influenced up to a certain degree.

In a living animal, the processes in the skeletal musculature are characterised mainly by contracting and slackening. These are caused by nervous stimuli (arbitrary reactions) and the effect of ATP (adenosine triphosphate) as an energy supplier. These are reactions which lead to physical reactions, i.e. muscle work.

Muscle rigidity

Following death, the circulation of blood and supply of oxygen to the tissues is stopped. In the meanwhile, metabolism continues in anaerobic form for some time. With the transition of metabolism into the anaerobic form, biochemical and structural changes which are mutually required take place in the muscle tissue. These result in rigor mortis — rigidity of muscles — and then to autolysis. The actomyosin complex, which comes off in living muscle as the result of slackening, is retained, since nerve stimuli are no longer given. Muscle rigidity is caused by a deficiency of ATP, and depends on internal and external conditions. This occurs more rapidly if, for example, more energy reserves (ATP and glycogen) in the living organism are consumed, for example by continuous movement or stress. The more glycogen the muscles contain at the time of slaughter (animals resting), the later the muscle rigidity occurs. The cause of the pH value is connected to this (see below).

The biochemical sequence of rigor mortis can be divided into two phases: During the preliminary phase, the flexibility and elasticity of the musculature is retained. The named properties are gradually lost the greater the reduction of the energy reserves. The muscles become harder and tougher. The temporal sequence of the muscle rigidity of different species of animal and type of muscle varies. The speed of the development of rigor mortis is thus: beef (10 to 24 hours), pork (4 to 18 hours) and chicken (2 to 4 hours). The ambient temperature is an essential factor. The lower it is, the longer the processes take. These processes do not occur in meat that is frozen before muscle rigidity sets in. Rigor mortis only sets in in this meat following defrosting (rigor upon thawing, which sometimes only occurs months later). Increased juice losses and poor water-binding capacity occur.

The effects this has on the quality of the meat can be avoided/restricted by:
- Processing the meat when it is still at slaughterhouse temperature.
- Only freezing the meat following occurrence of the muscle rigidity.
- Processing the meat immediately after removal from the freezer rooms (e.g. for use in the production of raw sausages).

Meat curing

Due to the lack of flavourings, uncured cooked meat isn’t very tasty and is relatively tough. Boiled belly of pork, which is consumed within a few hours of slaughtering, is characterised by this feature. During the curing process, the meat loses its transparency, assumes a reddish-brown shade and becomes softer. During the curing process, properties appreciated by consumer are formed: Tenderness, chewiness, flavour. New compounds are formed which influence the flavour and the scent of the meat. We are familiar with a range of such substances which contribute towards the good flavour. They include components which are also used as additives in order to improve the flavour, such as glutaminic acid, inosine acid and adenyl acid.

The reduction of the muscle rigidity is based on a different mechanism. It is enzymes which effect the curing process, including loosening of the muscle structure. Protein- and autolytic enzymes such as carboxylase and calcium-dependent proteases are of special importance here. Curing of the meat takes place mainly outside of the muscle cells. The extra-cellular connective tissue, on the other hand, is only affected several days later. Due to the lactic acid which results from glycogen, the connective tissue swells and, hence, contributes towards the tenderness of the meat. The process of the loosening of the meat structure takes place on the actomyosin. Hence, it is not the same as the slackening of muscles described above.

For cooking purposes, a three-day curing period is sufficient for beef in order to achieve a good-quality flavour. For fying purposes, however, the curing process should last at least one week. High-quality meat, e.g. for making into steaks, is left to cure for several weeks (Argentinean beef). Pork only needs a curing period of three to four days. Generally, muscle rigidity in poultry is quick, and can be ready for serving after 24 hours.

Curing in pieces following the cutting of the carcass is becoming increasingly frequent. There are several advantages to curing the meat in pieces: The smaller containers are chilled more quickly, refrigerated storage rooms and transportation means can be used more efficiently. To speed up the tenderness process, various methods are used both at home and in the restaurant as well as at industrial level. These methods include flattening, the production of steaks, chemical tenderising and marinating (all affect the connective tissue). Certain microorganisms thrive in vacuum-packed goods: these include mainly lactic acid-forming bacteria (lactobacilli). The formation of the acid extends the shelf life of the product. A disadvantage of this, however, can be the formation of a somewhat sour smell and taste.

Water-binding capacity

During the curing process, desirable sensory and structural changes occur to the meat, as do technologically significant changes. One of the most noticeable phenomena discernible following slaughtering of all animals is the change to the water-binding capacity (WBC). There is a connection between the breakdown of the ATP and the WBC. The minimum WVC coincides with the maximum rigidity. The meat has a high WBC immediately after slaughtering. It diminishes greatly within only a few hours and, in the case of beef, for example, reaches a minimum within 24 to 48 hours. It increases the longer it is stored. In order to improve the WBC, polyphosphates are added to meat destined for the production of sausages to be heated in water, for example.

pH value

The pH value in the muscle of the living animal is around 7.0 to 7.3, and decreases to between 5.3 and 6.4 post mortem. The speed and extent of the reduction in the pH value are influenced by the species of animal, the type of muscle, the ambient temperature and, in particular, by the glycogen content at the time of slaughtering. Ideally, cured meat has the following pH values: pork: between 5.6 and 6.3, beef: 5.9 (sometimes significantly higher) — a pH value of around 6.4 is considered the shelf-life limit. The course and the final pH value enable conclusions to be drawn regarding abnormalities to the meat such as the phenomena of PSE and DFD.