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Meat & Meat Products Technology

Including Poultry Products Technology



SECOND EDITION

BD Sharma

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CHAPTER

4 Some Meat Quality Parameters

Fresh meat can be referred as a product which has undergone imminent postmortem changes following slaughter but has not been subjected to any processing. However, fresh meat which has undergone freezing can be conveniently termed as raw meat. Some characteristics of fresh and raw meat need to be properly understood in order to achieve the best results in processing.

Meat Color

This is the total visual perception of meat. The hue (primary color), chroma (intensity) and the value (brightness) of meat color are based on the quantity of principal muscle pigment—myoglobin and its chemical state. It is for this reason that meat color varies with species, sex, age and even among different muscles of the same species. Myoglobin content of more active species and muscles is higher than the passive ones. Typical color of meat from various species is:

Mutton and chevon	:	Light to dark red
Pork	:	Greyish pink
Poultry	:	Grey white to dull red
Buffalo meat and beef	:	Cherry red

Myoglobin constitutes about 80–90% of the total meat pigments. The role of hemoglobin in meat color is negligible in a properly bled muscle. Catalase and cytochrome enzymes are of little consequence as far as meat color is concerned. Myoglobin molecule has a protein portion (globin) and a heme (iron containing) ring. It is one-fourth in size as compared to structurally similar hemoglobin molecule. In intact meat, iron in the heme ring of myoglobin exists in the reduced form. Upon cutting, grinding or exposure to air, myoglobin is oxygenated to form oxymyoglobin within 30–45 minutes. Oxymyoglobin has a bright red color (bloom) which is very much desired by the consumers.

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However, this pigment is comparatively unstable. In conditions of less oxygen, partial vacuum or semipermeable package, myoglobin as well as oxymyoglobin is oxidised to brown colored metmyoglobin. At the time of meat purchase, brown color is usually associated, by the consumers with meat that has been stored for long although it is not always true. In order to prevent the formation of brown color, fresh meat is often packed in films with very good gas (oxygen) transmission rate.

Water Holding Capacity

Water constitutes about 76% of fresh meat. It is a universal solvent and takes part in a large number of biological reactions. In muscles, water molecules carry positive and negative charges. The location of these molecules allows water to exist in three different forms— free water, immobilised water and bound water. The water molecules held by capillary forces on the surface make up free water which can be removed by application of even minor physical force. The middle layer of water molecules remain in contact with proteins and make up immobilised water, a large part of which can be removed by application of severe physical conditions. However, 4–5% of water molecules are so tightly bound to the charged hydrophilic groups on the muscle proteins that they do not allow this bound water to escape by application of any physical force.

The capacity of meat to retain its water during the application of physical forces is known as water holding capacity (WHC). This property of meat has a special significance because it contributes to the juiciness of cooked meat besides influencing the texture and color. Fresh meat with a good water holding capacity is less prone to shrinkage during storage. WHC of meat is very important in processing where meat is subjected to physical forces such as cutting, grinding, filling, pressing, heating etc.

Marbling

It refers to the intramuscular fat which can be visibly detected when the muscle surface is cut. The solidification of this fat during chilling contributes to the firmness of meat. Marbling prominently figures in the USDA quality grades for meat because of its merchandising value. During handling of chilled meat, some special retail cuts like chops and steaks retain their uniform thickness and typical shape due to marbling. Besides, marbling also enables meat to bear the impact of

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comparatively high cooking temperature. During thermal processing, moderately marbled meat yields a juicy and flavorful product whereas too little marbling yields a dry and flavorless product. Excess marbling neither enhances the eating satisfaction nor desired in a fat conscious society.

Quantum of Connective Tissue

The amount of connective tissue in meat has a direct bearing on its textural characteristics. During animals lifetime, more active muscles tend to deposit more connective tissue to gain strength. This factor accounts for the coarse texture of biceps femoris and tenderness of loin eye muscle postmortem. The quantum of connective tissue per unit muscle does not increase with age and is not responsible for tough meat of older animals. In fact, it is the increase in muscle fibre diameter and consequent increase in muscle fibre bundles which account for the coarse texture of such meat.

Most meat cutting practices are based on separation of coarse textured meat from the tender meat, so as to facilitate the right kind of cooking procedure and derive maximum palatability pleasure.

Firmness

The firmness of meat is a good quality parameter which plays an important role in carcass setting, fabrication, aging, processing, slicing and product display. During carcass chilling, the firmness increases due to loss of extensibility associated with the completion of rigor mortis. Fresh meat having a high water holding capacity shows good firmness and tight structure. It can be objectively measured by shear force apparatus or penetrometer. Meat with a good degree of firmness yields a comparatively better quality processed meat products.

Meat Storage Conditions

Cold shortening: When prerigor meat is fast chilled below 15°C, there is shortening of muscles. This shortening or contraction is more at 0°C and still more at -2°C. However, it is minimum at 14-21°C. At 40% shortening, which is quite common, meat becomes very tough and large quantity of meat juices are exuded. However, in case cold shortening exceeds more than 40%, Z-lines are disrupted and meat becomes soft and tender. Otherwise also, cold shortening is a reversible phenomena and is resolved when glycogen content of muscle is exhausted. In the meat plant, cold shortening can be

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avoided by keeping the meat above 14°C for sufficient time to pass the rigor stage.

Thaw rigor: When prerigor meat is frozen, a severe type of rigor mortis ensues during thawing. The shortening so produced may be 60 to 80% of the original length of the unrestrained muscle. Although shortening is less in a muscle attached to skeleton, the condition results in a tough meat and heavy drip losses.

Antemortem Factors Affecting Meat Quality

Various stress factors such as extremes of environmental temperature, overcrowding, preslaughter transportation, struggle during immobilisation and bleeding etc. have ultimate bearing on the quality of meat. Exposure to low temperature may cause shivering which results in reduction in muscle glycogen level. During any environmental stress, susceptible pigs, show porcine stress syndrome which is characterised by muscle tremors, anxious behavior and reddening of skin. In such animals antemortem temperature rise, lactic acid build up and ATP depletion are the general features and postmortem changes are rapid. So conversion from muscle to meat is also fast due to a sharp fall in pH and muscle denaturation. Ultimately, meat becomes pale in color, soft in texture and exudative or moist during chilling itself. Stress resistant animals are able to withstand exercise, fasting, fatigue, fight etc. but at the expense of their glycogen reserves. Slow and limited glycolysis often result in high ultimate pH and excellent water binding capacity. So meat appears dark, firm and dry.

Preslaughter handling such as long distance transportation and overcrowding in trucks is also stressful to the animals. This treatment causes shrinkage of muscular tissue and comparatively low dressing percentage. So holding of such animals for resting and feeding can be helpful in restoring their depleted glycogen level. However, basic principle of feed withdrawal and adequate water supply for 24 hr before slaughter has to be followed for ease of evisceration and to reduce microbial contamination of carcass from intestinal contents.

Like other livestock products, meat is also quite prone to the absorption of off-odors from the surrounding environment. Hence, meat should not be stored in the presence of other strong smelling substances.

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- MSc (Food Technology)
- BTech (Food Technology)
- MVSc (Livestock Products Technology)

It will serve as a useful handbook for meat industry personnel especially:

- Meat Plant Managers and Supervisors
- Meat Processing Technicians.

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