Box 26.1 Postmortem changes to meat

In animal tissues, aerobic respiration rapidly declines when the supply of oxygenated blood is stopped at slaughter. However, muscles contain glycogen, creatine-phosphate and sugar phosphates that can continue to be used for ATP production by glycolysis. Anaerobic respiration of glycogen in muscle tissues produces lactic acid which causes the pH of the meat to fall from ≈ 7 to between 5.4 and 5.6. When the supply of ATP ceases, the muscle tissue becomes firm and inextensible, known as 'rigor mortis'. This can take place between 1 and 30 h postmortem, depending on the type of animal, the physiological condition of the muscle and the storage temperature. Lactic acid and inosine monophosphate (a breakdown product of ATP) also contribute to the flavour of the meat. The reduced pH of muscle tissues offers some protection against contaminating bacteria, but other nonmuscular organs, such as the liver and kidneys do not undergo these changes and they should be chilled quickly to prevent microbial growth. Provided that there is an adequate supply of glycogen, the rate and extent of the fall in pH depends on temperature; the lower the temperature the longer the time taken to reach the pH limit because the biochemical reactions are slowed. The reduced pH causes protein denaturation and 'drip losses'. Cooling the carcass during anaerobic respiration reduces this and produces the required texture and colour of meat. However, rapid cooling to temperatures below 12°C before anaerobic glycolysis has ceased causes permanent contraction of muscles known as 'cold shortening', which produces undesirable changes and toughening of the meat.

If animals are stressed at slaughter, their glycogen reserves are reduced and the production of lactic acid is reduced, leading to a higher pH. For example, pork that has a pH $>6.0-6.2$ produces dark, firm, dry (DFD) meat which is more susceptible to bacterial spoilage. Conversely, if the temperature is not lowered sufficiently within the first few hours postmortem, the fall in pH is too rapid, and a series of undesirable changes produce meat that is known as 'pale, soft and exudative' (PSE). This is a particular problem with pork.Soluble sarcoplasmic proteins become denatured and precipitate, to appear as white particles that reflect light and cause paleness in the meat. Changes to membrane-bound myofibrillar proteins cause damage to the cell membranes and as a result they leak intracellular contents to form drip losses and excessive softness in the meat. The shelf-life of this meat is reduced owing to enhanced microbial growth and oxidation of phospholipids (Brown and Hall, 2000). Details of these and other postmortem changes