Preface

This glossary was originally compiled by the MLC Technical Division in 1999. The concept arose from the considerable number of carcase and meat quality related enquiries received each year. The majority of these enquiries required a search for appropriate material followed by a response to the enquirer which led to a wealth of information being at hand, albeit in a rather fragmented fashion. It was decided to combine this information into one document which could be used to provide the information that is most often requested. This resulted in the publication of this glossary. Due to the time span since the original document was published, EBLEX and BPEX have reviewed and updated the text as appropriate.

The glossary aims to provide the livestock and meat industries, as well as students, with a comprehensive reference text of technical terms relevant to carcase and meat quality. The focus is on the cattle, sheep and pig industries and we have attempted to cover a broad range of terms relating to the complex processes involved in the production of meat and associated problems that can arise. Since this publication is based on our knowledge, any errors are ours and the definitions should not be deemed to be official definitions.

This glossary is primarily concerned with British conditions of production and is directed to those who are physically involved in meat production and processing as well as those with an academic interest. The user who simply needs to discover the meaning of technical words may use this text like any other glossary or dictionary. In addition, the reader who wishes to find out some background knowledge to a particular term will find we have often included hyperlinks to further information elsewhere in the text.

We hope you find this glossary useful. Suggestions for improvements would be welcome.

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a* See CIELAB.

abattoir a building which is licensed for the slaughter of animals and initial preparation of carcases for human consumption, also commonly called a slaughterhouse. Such buildings vary in size and sophistication depending on the species to be handled, the degree of preparation of the carcase before sale, and local government ordinance. The premises would normally contain the following facilities: accommodation for animals awaiting slaughter (called a lairage), a slaughter area (termed a slaughter hall), an area for emergency slaughter (see casually slaughter), a refrigerated area, detained meat area with adequate space for holding suspect meat (see condemnation), offal, gut and tripe area, hide and skin area, cutting room, despatch area, amenities for personnel, and a veterinary officers room. Abattoirs are becoming increasingly specialised with many newer plants catering for one species only. Following a period of contraction, the number of abattoir premises in the UK is now relatively stable. Those premises remaining are larger and therefore have a greater throughput of animals. Abattoirs are subject to licensing and compliance with EU and UK legislation. The slaughter of animals unfit for human consumption may be carried out in a knacker’s yard.

abdominal fat the fat found within the abdomen (stomach) of the animal. The abdomen is the region of the body between the thorax and the pelvis which contains the viscera. Abdominal fat often surrounds the organs of the abdomen, for example kidney fat (see KKCF, flare fat).

accelerated conditioning refers to processes that can speed up the tenderisation (ageing) of meat. Holding beef or lamb carcases at higher temperatures for a short period of time (several hours) post-mortem prior to chilling, has, in some studies, been shown to accelerate the improvement in tenderness which is thought to be due to enhanced post mortem proteolysis. See electrical stimulation, tenderisation.

acceptability see overall acceptability, meat quality, appearance, muscle colour, fat quality, eating quality.

Achilles hanging is the process of suspending the carcase from the Achilles tendon, a tendon of the distal hind leg. This method of hanging, often referred to as straight leg hanging, is more common than the more recent alternative of aitch-bone hanging.

acidification see post-mortem acidification, pH, glycolysis, lactic acid.

actin see contractile proteins.

adlibitum feeding allowing free access to food, thus allowing animals to eat as much as they wish, as distinct from restricting an animals access to feed. Such feed regimes may be imposed at any point in an animal's life. Most ruminant species (i.e. cattle and sheep) are allowed ad libitum access to a roughage source (grass, hay or silage) throughout their lives, which is often supplemented by the addition of a controlled daily ration of concentrate food, such as cereal and high protein feeds (e.g. fishmeal). In the pig, restricting the feed intake of a growing animal, particularly in the latter stages of the growth period, is an effective way of reducing fat deposition, increasing carcase leanness and improving feed utilisation, particularly in breeds with a low propensity for lean tissue growth.

adipose tissue groups of cells (adipocytes) storing and mobilising fat, which are found in particular sites of the body, known as fat depots, where they form large tissue masses (see also lipid, fatness). Examples of such fat depots are subcutaneous fat, intermuscular fat, intramuscular fat and kidney knob and channel fat (see KKCF). Adipose tissue can constitute one-fifth to one quarter of the total body mass of a live animal. Although pigs differ from cattle and sheep in the proportions of fat found in the various adipose tissue depots of the body, the relative growth rates of the depots are similar in the three species (see growth).

adrenaline a hormone circulated in the blood stream of an animal. At times when an animal is highly stimulated, for example due to fear, extra amounts of adrenaline are circulated around the body, preparing the animal for energetic action (see handling, stress, DFD). This leads to increased blood pressure and heart rate. It also increases glycolysis in muscle of the live animal which is thought to be instrumental in reducing muscle glycogen concentrations in the carcase at

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slaughter, to an extent as to limit normal post-mortem acidification. Beta-adrenergic agonists are adrenaline-like compounds.

**aerobe** an organism that grows in the presence of air. A strict aerobe can only grow in the presence of oxygen. Organisms that can grow under both aerobic and anaerobic conditions are called facultative anaerobes (see anaerobe).

**ageing (conditioning, maturation, or hanging)** the holding of carcases or primal joints at refrigerated temperatures (0 to 4 °C) to improve eating quality (particularly tenderness and flavour). The rate and degree of post mortem tenderisation (ageing) during refrigerated storage (see refrigeration) varies markedly between species and muscles. Although this commercially important improvement in meat tenderness on refrigerated storage is a well documented phenomenon, the mechanism(s) by which this process occurs is unclear. Although the break down of muscle collagen was originally thought to be fundamental to these processes, this has since been shown not to be the case. The improvement in tenderness during ageing is now thought to occur from the degradation of certain myofibrillar proteins in the muscle, which has been shown to be caused by proteolytic enzymes (proteolysis). Enzymes such as calpains and cathepsins play a fundamental role in breaking down the proteins present in meat, and are therefore thought to be responsible for tenderisation post mortem.

**AHDB (Agriculture & Horticulture Development Board)** established under the Agriculture and Horticulture Development Board Order 2008. This Order led to dissolution of the predecessor levy boards and the creation of one over-riding organisation. Six sector divisions operate under the AHDB banner, these being: EBLEX (beef and lamb in England), BPEX (pigs in England), DairyCo (milk in GB), HGCA (cereals in UK), Potato Council (potatoes in GB) and HDC (commercial horticulture in GB).

**AIMS (Association of Independent Meat Suppliers)** a trade association established in 2001 to represent small and medium sized abattoirs in the independent red meat sector in England and Wales. The scope of the Association now covers medium and small abattoirs, cutting plants, catering butchers and further processors in the red, white meat and game sectors.

**aitch-bone hanging (pelvic suspension, hip suspension)** is the process of suspending the carcase from the hip, via the hole in the aitch bone (obturator foramen of the os coxae) as opposed to suspension by the Achilles tendon. This allows the commercially more important muscles of the carcase (see joints) to be stretched and prevents these muscles from excessive shortening of the sarcomeres when rigor mortis sets in. Pelvic suspension has been shown to be a useful method of improving meat tenderness under normal chilling conditions and also to help counteract cold-shortening due to rapid chilling of the carcase after slaughter. Due to safety problems that can occur if the aitch-bone has not been properly split, an alternative method of hanging the carcase to achieve the same effect is now recommended for beef carcases. This involves hanging the carcase from the ischium. If, however, aitch bone suspension is used for beef sides then it is important to provide a secondary means of supporting the carcase to avoid it falling should the aitch bone break.

**alimentary tract** the digestive system of an animal.

**amino acids** are the building blocks of proteins that occur naturally in plant and animal tissues. Proteins are made up of combinations of up to twenty different amino acids. Eight of these amino acids must be provided in the diet (essential amino acids), the most limiting of which is methionine in ruminant species and lysine in monogastric animals such as the pig. The remaining twelve can be synthesised in the body (non-essential amino acids). The breakdown products of the amino acid tryptophan, indoles, are implicated in the generation of boar taint in pig meat. The complex reaction between amino acids and reducing sugars (carbohydrates) which occurs primarily during the cooking of meat is known as the Maillard reaction. This reaction is also known as the non-enzymatic browning reaction and is fundamental in the development of the characteristic flavours and odours of cooked meat.

**anaerobe** an organism that can grow without the presence of oxygen. Anaerobes that are poisoned by oxygen are called strict or obligate anaerobes. Organisms that can grow under both anaerobic and aerobic conditions are called facultative anaerobes (see aerobe).
androstenone the male sex hormone implicated in the generation of boar taint in pig meat. Androstenone (5-α-androst-16-en-3-one) is synthesised in the testes and secreted into the circulatory system. This compound is deposited at relatively high rates in the fat of some entire male pigs compared to either castrates or females, increasing particularly as animals mature. Androstenone is secreted as a sex pheromone in the pig’s saliva to stimulate the female pig in oestrus. A substantial proportion of humans are insensitive (anosmic) to this compound, although women are more sensitive to it than men.

animal welfare is defined, in Bailliére’s Comprehensive Veterinary Dictionary, as the avoidance of exploitation of animals by man by maintaining appropriate standards of accommodation, feeding and general care, the prevention and treatment of disease and the assurance of freedom from harassment, and unnecessary discomfort and pain. The concept of the ‘five freedoms’, as revised by the Farm Animal Welfare Council in 1993, have been used to measure animal welfare. These are: freedom from thirst, hunger and malnutrition; freedom from discomfort; freedom from pain, injury and disease; freedom to express normal behaviour; freedom from fear and distress. Increasingly, specific animal based outcome measures are being used to assess animal welfare, particularly within welfare assurance schemes.

ante-mortem before death (slaughter). In contrast to post-mortem.

antibiotics are drugs that are used to kill or inhibit fungal and bacterial infections. Certain types of antibiotic may also be used as growth promoters. Such growth promoters or growth enhancers can lead to an improved utilisation of feed by the animal and lower production of waste. The use of such drugs is strictly controlled by legislation. The time before slaughter a drug must be withdrawn from use is set down for each drug.

antioxidant a substance that in small quantities will inhibit the oxidation of other compounds e.g. vitamin E.

appearance is a major attribute of meat quality. In addition to being the main quality characteristic on which consumers base their initial purchase decision, appearance also influences the perception of eating quality attributes, namely juiciness, tenderness, flavour and aroma. The appearance of lean is made up of three main factors; colour, water-holding capacity (WHC) and firmness. Both the rate and extent of acidification of muscles after slaughter (see post mortem acidification) have a profound effect upon these main factors. The occurrence of muscles with pale, soft exudative (PSE) and dark, firm and dry (DFD) characteristics are unfavourable since both these deviations cause meat of poor appearance and are universally regarded as a major industry problem to both meat traders and meat processors. In red meats, a bright red colour of the lean is perceived by consumers as being indicative of freshness, whilst meat that has turned brown in colour is discriminated against (see muscle colour). The appearance should be of a firm (see firmness) white fat in pigs and a creamy-white fat in cattle and sheep. The degree of fatness is also an extremely important constituent of overall quality and appearance of meat. Consumer studies have shown that a meat product with a high ratio of lean to fat (of about 10:1) is most preferred.

aroma (odour) the sensory perception of attributes of substances brought about by the sensation of volatile chemicals in the nose and pharynx. Aroma is one of the major eating quality attributes of meat which is notoriously difficult to evaluate and describe. This is complicated by the difficulty in separating the organoleptic properties of taste and aroma, which together constitute flavour. Many of the flavour properties of meat are the result of odour sensations. The characteristic aromas of cooked meat only develop after heating. The meat from each species (i.e. pork, lamb, beef) has its own distinct aroma on cooking. During cooking, numerous chemical reactions occur between the many non-volatile (not easily evaporated) compounds present in cooked meat resulting in a large number of volatile compounds that contribute to the aroma of cooked meat. Important reactions involved in the formation of flavour and odour in meat include the thermal breakdown of individual muscle components, reactions between amino acids and carbohydrates (Maillard reaction), the thermal oxidation of lipids, and the interactions between these different compounds. The aroma qualities of meat are extremely subjective properties, and therefore the only reliable and consistent measure of aroma at present is achieved by sensory evaluation.

ATP (adenosine triphosphate) a chemical compound which acts as a store and source of energy within muscle cells. ATP is involved in a large number of essential reactions within the body and is maintained at a constant level within the live animal. In living muscle, ATP synthesis takes place...
predominantly in the mitochondria and is controlled by the concentration of calcium present within the sarcoplasm, the flow of which is controlled by the sarcoplasmic reticulum. ATP is also produced by glycolysis within the cell. Following slaughter, ATP synthesis ceases within the mitochondria (mitochondria require oxygen to synthesise ATP) and therefore ATP can only be synthesised by glycolysis. Important aspects of the changes seen during rigor mortis development of the carcass following slaughter are brought about by a drop in the level of ATP within the muscles. The rate at which ATP is depleted in a muscle will depend on the species, muscle type, ante-mortem stress, chilling procedure and whether electrical stimulation takes place. The process will also be influenced by the glycogen content and pH of the muscle at slaughter.

**AUS-MEAT** an Australian company that incorporates AUS-MEAT Standards and AUS-MEAT Commercial Services. AUS-MEAT is responsible for establishing and maintaining national industry standards for meat production and processing. The AUS-MEAT language, which forms part of the AUS-MEAT Standards, provides a common language of objective descriptors to help the supply chain achieve a consistent, quality product.

**autolysis** Often referred to as “self-digestion”. Refers to the destruction of a cell by the action of its own naturally present (endogenous) enzymes, or the self-digestion of an enzyme by another molecule of the same enzyme.

**automatic-recording probes** probes which automatically record backfat or muscle depths or other physical properties of a carcass or meat cut on the slaughter line for the purpose of carcass classification or quality assessment. Measurement of tissue depths can be by insertion or by ultrasound.

**b*** See CIELAB.

**backfat** the subcutaneous fat layer located between the lean and the rind along the back (loin) of an animal, used as an index of the degree of fatness in pig carcases (see backfat thickness, pig carcass classification scheme, subcutaneous).

**backfat thickness** the depth of backfat (subcutaneous fat) including the rind, as measured from the lean at defined positions on the back. This measurement is used in pig carcass classification, as taken with an EU-approved instrument (see probe). The positions on the carcass that backfat thickness is taken are referred to as the P1, P2 and P3 positions. The backfat thickness present in the carcass can be controlled by breeding for reduced fat and nutritional manipulation such as accurately meeting, and not exceeding, the animals requirement for nutrients in the diet to maximise lean tissue growth, or employing restricted feeding in the later stages of growth. Female pigs tend to produce carcases with greater backfat thickness than entire males, and castrated male pigs produce greater backfat depths compared to either females or entire males (see sex). There are strong genotype (breed) differences in the propensity to deposit backfat. Reduction of UK backfat thickness to meet modern consumer demand has been achieved through a combination of genetic improvements and altered management practices. Commensurate with a reduction in carcase fatness, the fat is also less saturated, with higher levels of polyunsaturated fatty acids. Care needs to be taken with increasing leanness as the trend towards extremely lean pork can be associated with poor cutting, presentational and processing qualities (see cutting, fat quality and fat firmness). Additionally there is a widespread belief that lower levels of backfat thickness in pig carcases results in reduced eating qualities of the meat. Scientific evidence, however, does not strongly support such a relationship. Any influence that the level of backfat may have on pork eating quality could be indirectly brought about by concurrent changes in fat quality or the insulating effect of fat against cold shortening upon chilling and cooking abuse (see cooking procedures).

**background toughness** see collagen.

**bacon** meat from the pig which has been preserved by curing with salt, nitrite and/or nitrate.

**bacterial contamination** see contamination.

**barrow** a castrated male pig (see castrate), also referred to as a hog. Both terms are most commonly used in the USA.
beef the meat of all cattle, other than from the young calf (under 8 months of age) which is referred to as veal.

beef carcase classification the allocation of beef carcases to a category on the basis of the standard EU beef carcase classification scale. The information recorded in this scheme is carcase weight, conformation class, fat class and the category (steer, heifer, young bull, mature bull or cow) of the animal. This can be delivered by visual assessment (licensed human classifier) or automatic means (e.g. Video Image Analysis).

beef cattle animals reared solely for the purpose of beef production.

beta-adrenergic agonists adrenaline-like compounds which, when administered to animals, influence carcase composition by reducing fat and increasing lean deposition and muscularity, often termed “re-partitioning agents”. Examples of beta-adrenergic agonists include cimaterol, clenbuterol (also known as “angel dust”) and salbutamol. Their use is not permitted within the EU. A wealth of scientific literature has been published suggesting that beta-adrenergic agonists administration has several undesirable effects on meat quality. Such detrimental effects observed in cattle, sheep, pigs and chickens include, elevation of ultimate pH, associated with a darkening of muscle colour (see dark cutting meat, DFD) and a toughening of the muscle (see tenderness). Although the effects of these agents on growth is well documented, the biochemical mechanisms by which they operate within the body (in vivo) is still largely unknown. The generally accepted reduction in meat tenderness (as assessed by shear force and sensory evaluation) associated with the administration of beta-adrenergic agonists is thought to be largely caused by a reduced post-mortem proteolysis in the muscles of treated animals. This appears to be brought about by elevated levels of the calcium dependant protease endogenous inhibitor, calpastatin. This theory of reduced proteolysis occurring in such muscles is validated by the lower myofibrillar fragmentation index which has also been observed. Other muscle characteristics altered by the administration of these drugs include an increase in the strength and insolubility of collagen due to increased collagen cross-link maturity, and an increase in the proportion of white glycolytic fibres present in the muscle (see muscle fibres, fibre type).

blade tenderisation is a process to make meat more tender (see tenderness) by insertion of a set of narrow blades through the meat which disrupt the muscle structure.

bleeding see exsanguination.

blood splash a term for the appearance of numbers of small dark red areas in the muscle (particularly muscles of the hind limb and shoulders, loin and diaphragm) of carcases due to petechial haemorrhages. Blood splash may be particularly seen in animals that have been electrically stunned (see stunning). Blood splash arises when the blood vessels within muscle rupture due to over-filling with blood (termed a petechial haemorrhage). Electric stunning leads to a considerable rise in blood pressure, but it is unknown whether this actually causes the vessels to burst, or merely increases bleeding from existing haemorrhages. Reducing the interval between stunning and sticking (exsanguination), to less than 10 seconds, reduces the incidence of blood splash. Gas stunning (see CO₂ stunning) can be a useful method of reducing the incidence of blood splash in pigs and poultry.

blueprints for the production of improved consistent quality beef, lean and tender pork, and lean and tender lamb. Originally launched by the former Meat and Livestock Commission in the 1990s, the beef and lamb blueprints were updated by EBLEX in 2011. These are guidelines incorporating the best state of the art practices and novel approaches to enhance the eating quality of English beef, pork and lamb to increase consumer satisfaction of these products.

BMPA (British Meat Processors Association) a trade association in the meat and meat products sector in the British food industry. They represent businesses big and small, from smaller progressive abattoir businesses supplying local customers to large consumer brand owners.

boar un-castrated male pig (see castrate, castration, boar taint, entire, sex, wild boar).
boar taint is an abnormal odour and flavour occasionally generated during cooking of meat from pigs, particularly heavy entire male pigs. Such taints result from two naturally occurring strong smelling compounds stored in the fat. These are the male hormone androstenone, and the breakdown products of the amino acid tryptophan, namely indoles, particularly skatole (perceived as faecal odour). Both androstenone and skatole are deposited at relatively high rates in the fat of some entire male pigs compared to either castrates or females, increasing particularly as the animals mature (i.e. at heavier liveweights). Androstenone and skatole have both been implicated in lowering the flavour intensity and increasing the abnormal odour and flavour ratings of pork. However, the relative contribution of these compounds to the generation of boar taint is a contentious issue. For practical purposes, threshold concentrations of skatole and androstenone (0.25 and 1 ppm respectively), are used. Below these levels the proportion of consumers detecting boar taint is very low. It is more likely that these levels will be exceeded in pigs which are older at slaughter. In some European countries, particularly Germany and France, there is a much higher adverse reaction to the aroma generated from the meat of some entire male pigs. This is probably, at least partly, because heavier and older Continental pigs are more sexually mature at slaughter, thus their circulatory levels of sex hormones will be greater than in UK pigs. In the UK, where slaughter weights and hence ages are lower, only a small proportion of entire males have levels higher than such a threshold. This factor explains the relatively low incidence of boar taint found in the UK. Also meats tend to be cooked to higher temperatures in the UK than elsewhere in Europe (see cooking procedure). Higher end-point temperatures increase meat flavour intensity. This may mask any abnormal flavours present. Higher temperatures may also drive off the volatile compounds (androstenone and skatole) responsible for boar taint. The variable ability of populations to detect the compounds is also likely to be a factor. Generally speaking, women have been shown to be more sensitive to androstenone than men, though wide within-sex variations have also been noted.

bobby calf is calf slaughtered at a few days of age. The meat from such animals is classed as veal.

bone is the hard, rigid structural tissue that forms the skeleton of an animal. Bone comprises of collagen, which gives tensile strength, and calcium phosphate which gives bone its hardness. Some bones have a hollow cavity containing bone marrow, in which red blood cells are produced. The ratio of muscle:bone in a carcass is an indication of edible meat yield. This ratio increases with carcase weight and with fatness. While a high muscle:bone ratio is desirable, the economic consequences of increased carcase weight (and associated fatness due to the higher weight) must be carefully evaluated. Optimal slaughter weights and therefore muscle:bone ratio will depend upon the genotype of the animal, nutritional regime (see ad libitum feeding) and sex. Muscles are attached to bones by tendons.

boning is the process of removing meat from the bones of a carcase, the meat of which is then termed “boned-out”. This process is conventionally carried out after the carcase has set (completion of rigor mortis) and chilled. Boning can also be carried out prior to rigor and is then termed hot boning.

Bos indicus grouping of zebu or oriental breeds of cattle which are noted for their ability to survive in hot climates. They can be crossed with Bos taurus (European) breeds of cattle to produce breeds such as Santa gertrudis and Droughtmaster. Meat from Bos indicus breeds of cattle is less tender than meat from Bos taurus cattle. This is thought to be mainly due to the slower growth rate, leading to a reduced post-mortem proteolysis of myofibrillar proteins in Bos indicus cattle. In particular, the reduced proteolysis apparent in these breeds of cattle has been associated with higher levels of activity of the calcium activated protease inhibitor, calpastatin, following slaughter.

Bos taurus grouping of the common domestic cattle breeds of Britain and Europe. These breeds are further divided into 2 main groups: beef breeds are cattle bred specifically for the economic
production of meat, for example the Hereford or the Aberdeen Angus (see beef cattle); dairy breeds of cattle, are specifically bred for the production of milk, such as the Friesian and Holstein breeds (see dairy cattle). Cattle producers in semitropical and tropical climates utilise Bos taurus breeds of cattle in crossbreeding programmes with Bos indicus cattle. Such matings take advantage of hybrid vigour, providing additional advantages for heat and disease resistance, which results in improved growth rates and meat quality characteristics in comparison to the native Bos indicus breeds.

botulinum (botulism) is a rare and often fatal form of food poisoning caused by the anaerobic (not requiring oxygen) spore forming bacteria, Clostridium botulinum (see microbiology). The organism grows in the food and produces a powerful toxin, the ingestion of which causes the disease. Most botulism outbreaks are caused by home-preserved foods.

bovine the Latin term pertaining to, or characteristic of, the ox or cattle.

boxed beef normally vacuum packaged boned-out beef primal joints sold in boxed form (see boning).

BPEX representing pig levy payers in England. BPEX is focused on enhancing the competitiveness, efficiency and profitability for English pig levy payers and driving demand for English pork and pig meat products in Britain and globally. BPEX is a division of the Agriculture and Horticulture Development Board. BPEX and EBLEX (for beef and lamb) replaced the former Meat and Livestock Commission, (MLC).

brine a salt solution used in the curing of meat which is normally based upon sodium chloride and sodium nitrite (with or without sodium or potassium nitrate), however other ingredients are also included depending on the curing process.

browning (i) the term often given to the changes seen in the colour of raw meat as a result of exposure to oxygen.
(ii) the change in colour seen in meat as it is cooked, partly caused by the Maillard reaction. See muscle colour, myoglobin, discoloration, haem, oxidation.

bruising is the discoloration and actual haemorrhage at the site of an injury, and can seriously reduce the value of a carcase. Bruising causes damage to the muscle and triggers the release of enzymes into the blood stream. As a result, in the first 12 hours after injury the bruise is bright red, at 24 hours it is dark red and at 24 to 36 hours it loses its firm consistency and becomes watery with an orange-red colour. Bruising can result in a less acceptable appearance of the carcase and incur price penalties. Bruised meat may be trimmed which leads to a reduced carcase weight. Careful handling of the animals at loading, during transportation and in lairage will reduce the incidence of bruising.

bull uncastrated male cattle (see castrate), often referred to as an entire.

bull beef the meat from young entire male cattle, reared purposely for the production of meat. The meat produced from entire male cattle is leaner than that from castrated cattle and the animals also grow faster with better feed conversion efficiencies (see sex). However, a major disadvantage with keeping bulls entire as they mature, is an increase in aggressive behaviour, which can lead to management problems and predispose the animals to developing DFD meat at slaughter. As bulls mature there is also a negative affect on meat tenderness, with an increase in prevalence of tougher meat.

bullock castrated male bovine, often referred to as a steer.

bung refers to the caecum, that part of the large intestine closest to the small intestine. Traditionally pig bungs would be used for casings.

by-products non-carcase parts of the animal, both edible (e.g. liver) and inedible (e.g. gut contents).

calci um (Ca\(^{2+}\)) is the most abundant mineral in the body and in combination with phosphorous (as calcium phosphate), forms bone and teeth. Calcium is extremely important in muscle contraction.
In living muscle the calcium is normally only freely available throughout the muscle cell during its contraction. After a muscular contraction the calcium is rapidly pumped back into specialised stores in the cell known as the sarcoplasmic reticulum. This process is energy dependent and consumes ATP. Following death however, the energy supply becomes exhausted and the free calcium concentration of muscle cells increases dramatically during the onset of rigor mortis. Calcium accumulation in post-mortem muscles is thought to be responsible for stimulating the action of calcium dependant proteases, which are subsequently responsible for post mortem proteolysis derived improvements in tenderness. Infusion of a carcase or meat piece with calcium chloride has been shown to accelerate ageing and tenderisation, although the flavour may be undesirable.

calcium activated protease (calpain) see proteolytic enzyme.

calf young cattle from birth to weaning. A female calf is referred to as a heifer calf, and a male calf a bull calf. The meat obtained from calves slaughtered at less than 8 months of age is termed veal. A calf slaughtered at only a few days of age is termed a bobby calf.

calliper a device used to accurately measure fat and muscle depths on the cut surface of the carcase.

calpain see proteolytic enzyme.

calpastatin The specific inhibitor of the calpain proteolytic enzyme system. See post mortem proteolysis, proteolytic enzyme.

canning of meat is a means of long term preservation by the use of heat to sterilise (destroy all micro-organisms and their spores). The meat is hermetically sealed into the can and subjected to heat. For the process of canning, meat is classified as a high pH food. This means that it is possible for Clostridium botulinum to survive as spores unless the heat treatment is sufficiently severe. It is therefore very important to ensure good control of the heating process. This extensive heat treatment substantially alters the nature of the raw product so that, in effect, a new product is formed. Although canning is a well-accepted process, meat, poultry and fish products tend to develop a “canned meat flavour.”

cap the blind end of the caecum or large intestine from which casings can be made.

carbohydrate an organic compound containing carbon, hydrogen and oxygen. They have an important function in muscle and have numerous roles. Typical examples include sugars, starches and cellulose’s.

carcase (carcass) the body of an animal killed for meat. The term usually applies following the removal of various parts from the dead body (dressing). There are specific definitions of carcases of beef, sheep and pigs within the European Union which specify the inclusion or exclusion of various organs and body parts (see dressing, dressing specification).

carcase classification the placing of carcases into categories, whether as part of an EU scheme or otherwise, designed to indicate their commercial value. Normally the classes are related to the lean meat content, retail yield or quality attributes of the meat. See pig carcass classification scheme, sheep carcass classification scheme or beef carcass classification scheme, grading.

carcase composition refers to the proportion of the various tissues (fat, lean, bone etc.) in the carcase, or to the amount of chemical constituents contained in the carcase. Tissue proportions can be determined by dissection and the chemical composition of those tissues can be determined by analysis.

carcase conformation see conformation, conformation class.

carcase length is an important determinant of the size of particular joints. This is particularly significant in pigs, as the longer the carcase, the longer the Longissimus dorsi (loin) muscle, which will yield more (although usually smaller in area of cross section) rashers of bacon or pork chops.
**carcase weight (hot/cold)**  the weight (kg) of the body of an animal, dressed (see dressing) according to a defined specification (see dressing specification), at the end of the slaughter line (within 45 minutes of slaughter for pigs and within one hour of slaughter for cattle and sheep) is termed hot carcase weight. Carcase weight can also refer to the weight of the carcase following chilling (thus cold carcase weight). The carcase weight of an animal when expressed as a proportion of the animal’s liveweight is termed the killing out percentage. A hot carcase weight rebate can be used to allow estimation of cold weight from the hot weight of a carcase. Different rebates apply for different intervals between slaughter and weighing due to the loss of weight through evaporation during this period.

**carcase yield**  see killing out percentage.

**carotenoids**  are a group of red, orange or yellow pigmented lipids (e.g. carotene), found in vegetables and also in animal fat and muscle tissues, which are nutritionally important as precursors for vitamin A. Some retailers and consumers perceive yellow fat to be an undesirable attribute. Yellow fat particularly as seen in beef carcases, is predominantly caused by the natural storage of carotenoids. The prejudice against yellow fat is purely aesthetic since yellow fat, by virtue of its carotenoids, has higher nutritive value.

**cartilage**  supporting connective tissue consisting of mainly collagen. Cartilage present in meat is often termed gristle.

**casings**  refers to the outer layer of meat products such as sausages, i.e. the ‘skin’ of a sausage. These can be made from a range of materials of which there are a number of types: (i) traditionally sausages are contained in natural casings produced from the intestines of cattle, sheep and pigs (see runners, chitterlings, bung, maws, middles). These are prepared by processing the intestines in a number of steps. Initially there are a number of washes, with the gut contents, intestinal mucosa and fat being removed by the action of rollers. The gut is then cured with dry salt for a minimum of 30 days. The salt is then washed out and the casing graded for diameter and length. The casings are then re-salted for storage and transport. Prior to use the casing would be washed by the meat product manufacturer to remove the salt and restore pliability. Similar processes are used to produce casings from other parts of the viscera, for example casings for haggis from sheep stomach. (ii) reformed collagen casings are prepared from collagen extracted from the hides, usually of cattle. The inner, corium, layer of the hide is rich in collagen and is separated from the outer grain layer (leather) before being processed and formed into a tubular casing. (iii) cellulose casing produced from cotton. (iv) plastic casings which are used for larger diameter products such as sliceable sausages which are peeled before consumption, particularly continental charcuterie products.

**castrate**  a male animal that has been castrated (see castration). A castrated male pig is often referred to as a barrow or a hog (particularly in the USA). Castrated male cattle are called steers or bullocks, and a castrated male sheep is called a wether. See sex.

**castration**  the act of removing, or rendering dysfunctional, the testes of a young male animal, thus making the animal incapable of reproduction and, in many cases, modifying the animal’s behaviour (see sex). Both surgical and “bloodless” physical methods of castration are legal in the UK, but strict age limits are defined. Immunological methods of achieving castration are also available. The practice of castrating male pigs has practically ceased in the UK on the grounds of economics and animal welfare. The castration of beef and sheep animals is in decline but is still extensively carried out justified by advantages to be gained in animal management. Current welfare legislation along with accompanying codes of practice state the procedure for castration of cattle, sheep and pigs in terms of timing, method and veterinary personnel and medicine use.

**casualty animal (casualty slaughter)**  an animal slaughtered prematurely for meat as a result of an accident, injury or wound. This is also known as emergency slaughter. Strict regulations are in force to limit unnecessary suffering of animals that are injured with regard to their fitness to travel to the abattoir and be subjected to the slaughter process. Emergency slaughter of animals with unspecified illness can be a source of risk to human health, therefore strict veterinary inspections of the animal prior to slaughter and of the carcase are made before deeming such meat fit for human consumption.
cathepsin  see proteolytic enzyme.

cattle  bovine animals. Domestic cattle are all members of the Bos genus of which there are two major species; Bos taurus which refers to European or British breeds of cattle; and Bos indicus, the Zebu or oriental domestic cattle. A general term for cattle is ox. Cattle used within the UK tend to be either specialist beef cattle or dairy cattle breeds but some breed societies promote their breed as “dual purpose”.

caul fat  see omental fat.

cereal beef  young cattle ready for slaughter at approximately 10 to 12 months of age, commonly referred to as “barley beef”. These cattle are fed a predominantly cereal diet (e.g. cereals plus a protein supplement and some forage, e.g. straw) and are generally housed indoors throughout their lives. The cattle used for cereal beef production tend to be bull calves surplus from the dairy herd (see dairy beef), although continental crosses are also used in this system.

chemical contamination  see contamination.

chilled food chain  the sequence of operations after slaughter under controlled temperature conditions. This includes chilling after slaughter (primary chilling), chilled storage, distribution and retailing, through to domestic consumption.

chilling  is the reduction in temperature of a carcase. It is used to restrict the growth of pathogens and spoilage micro-organisms in meat (see microbiology) and hence reduce deterioration and improve food safety. The chilling process generally involves placing carcases in conditions of 0 to 5 °C within one hour of slaughter (post-mortem). Conventional chilling typically involves holding the carcases at an air temperature of 0 to 5 °C until the muscle temperature is below 7 °C throughout. Rapid chilling involves subjecting the carcase to sub-zero temperatures (perhaps as low as -30 °C) and high air velocity for a short period of time (typically 30 to 90 minutes). Rapid chilling is carried out to reduce evaporative weight loss (see water holding capacity, drip loss) from the carcase and can also improve some aspects of carcase quality (see PSE). There may also be benefits in saving energy and chiller space requirements. However, rapid chilling can also lead to cold shortening, and unless chilling follows electrical stimulation or pelvic suspension a reduction in meat tenderness may occur. The rate of muscle cooling within the carcase post-mortem is not uniform, even within the same muscle. The centre of a muscle can take considerably longer to cool than the outside edge of a muscle. The position of the muscle within the body will also determine how quickly and to what degree chilling will take place. The rate of cooling of the carcase is markedly affected by the size and fatness of the carcase, and the chilling process (particularly the temperature and rate of air movement past the carcase). A high subcutaneous fat (backfat) cover on the carcase can act as an insulator, reducing cooling rate and helping to prevent cold shortening.

chitterlings  refers to the large intestine (middles) of pigs from which casings can be prepared.

chop  a cut of meat containing bone taken by transverse slicing across the loin of an animal. The chop predominantly comprises longissimus dorsi muscle. Carcase length influences the number of chops of a given thickness that can be taken from a loin. Occasionally chops may be marketed as boneless chops (e.g. boneless pork chops); however, the more recognised terminology for these would be loin steaks.

CIELAB  is a system for describing the colour of anything using a 3 dimensional colour space. CIE stands for Commission Internationale de l’Eclairage (International Commission on Illumination) and L*a*b* are the co-ordinates used to describe the colour in the space. The CIE system also specifies the use of a standard light source, exact conditions for the observation and “standard observer” tables relating the objective measurements to human observation. The system can be used to evaluate muscle colour. Portable instruments for the measurement of colour in this way are available. The three co-ordinates of the measurement are lightness (L*), a red- green axis (a*) and a yellow-blue axis (b*).
classification  see carcase classification, beef carcase classification scheme, pig carcase classification scheme and sheep carcase classification scheme.

clean cattle  heifers, young bulls or steers, as distinct from cull cows or mature bulls. Also known as prime cattle.

clean sheep  female ovines that have not lambed or reached a state of pregnancy, and male ovines that do not possess “ram characteristics”.

clean pig  gilts, young boars and castrates, as distinct from cull sows or mature boars.

Clostridium  is a genus of Gram-positive bacteria. They are rod shaped obligate anaerobes. Clostridium consists of around 100 species that include common free-living bacteria as well as important pathogens. Whilst there are several species responsible for causing disease in humans, Clostridium botulinum is of most relevance in meat, particularly canned or pre-cooked and convenience meats. Additionally Clostridium estertheticum is of significant importance with regard to meat as these Clostridia are able to grow at chilled temperatures and lead to meat spoilage.

CO₂ stunning (carbon dioxide anaesthesia)  a method used to render an animal unconscious for slaughter. CO₂ gas (at least 80% CO₂) can be an effective alternative to electrical stunning (see stunning). CO₂ stunning can be a useful method of reducing or preventing blood splash. Sometimes referred to as controlled atmosphere stunning (CAS). UK legislation states that pigs are required to remain in the gas mixture until death, thus in the UK it is referred to as a killing method rather than a stunning method. In poultry an anoxic gas mixture can be used as an alternative to using CO₂.

cod fat  the fat in the area of the scrotum.

cold shortening  occurs when muscles are cooled rapidly after slaughter while still in a pre-rigor condition (see rigor-mortis). This causes the sarcomeres (the contractile units of myofibrils) within the muscle to shorten, which results in a very appreciable reduction in the tenderness of meat. The basic underlying cause of cold shortening appears to be related to a premature, cold induced, rise in calcium within the muscle cell. This increase in calcium availability occurs at a time when the muscle may still contain appreciable energy reserves capable of fuelling the contraction of the muscle. The muscle will then go into rigor in a contracted state leading to the toughness. Several methods have been developed to overcome the problem of cold shortening. These include considerate chilling, electrical stimulation to accelerate the development of rigor-mortis of the carcase and pelvic suspension to place the hind quarter muscles under tension and prevent them from shortening. Faster chilling and hence cold shortening has been demonstrated to occur in extremely lean carcases, thus it has been suggested that subcutaneous fat (backfat) may assist in insulating the muscles from rapid chilling. The muscle fibre type has been shown to be an important determinant of susceptibility to cold shortening. With those muscles or species containing predominantly white fibres showing more resistance to cold shortening than those with predominantly red fibres. This is largely because white muscle fibres enter rigor-mortis more rapidly than red muscle fibres.

cold carcase weight  see carcase weight.

collagen  is the chemical which forms the bulk of the connective tissue within meat. The collagen component of muscle is fundamental in determining the structure of meat and is a major determinant of the eating quality, particularly tenderness of meat. It has been widely recognised that the amount and maturity (degree of cross-linking of molecules) of collagen play an important role in the determination meat tenderness. It is well accepted that as animals mature their meat becomes tougher and this has been most directly related to the progressive maturation of muscle collagen. Although there is little variation in the collagen concentration of skeletal muscle with growth and animal age, it has been shown that as animals reach maturity, less collagen turnover takes place, providing existing muscle collagen time to progressively cross-link. This cross-linking results in increased strength of the collagen and decreased solubility during cooking. Slaughtering animals after a period of rapid growth is generally considered to produce meat which is more tender. One of the possible reasons for this is that rapidly growing animals will have greater
collagen synthesis. The newly synthesised collagen will dilute the older, existing collagen. A considerable amount of research over many years has shown that very little degradation (proteolysis) of collagen occurs during meat ageing. Therefore it has been concluded that although collagen is known to play an important role in tenderness, proteolysis of collagen is not thought to be important in tenderisation post mortem. For this reason, the collagen concentration in combination with the heat stability and the degree of collagen cross-linking of the muscle is often referred to as “background toughness”. The age of the animal at slaughter and the particular cut of meat will determine greatly the background toughness of meat. During cooking of meat the collagen is denatured and either shrinks (see collagen shrinkage) or forms soluble gelatin (soft in texture). It is the degree of collagen cross-linking that will determine its solubility, and therefore the extent of shrinkage and the tension generated on shrinkage (background toughness). The variations in tenderness found between different muscles of the carcase are largely thought to be due to the amount of background toughness arising from connective tissue content. This difference between muscles is probably related to their functional role within the body.

collagen crosslinks  see collagen.

collagen shrinkage  occurs during cooking across a broad range of temperatures (approximately 40-80°C). From about 40-50°C the collagen surrounding the individual muscle fibres (endomysial collagen) shrinks but this does not produce significant toughening. From about 65-80°C the thicker collagen surrounding the bundles of muscle fibres shrinks (perimysial collagen). As the temperature increases this shrinkage progresses and the meat expels water becoming tougher and drier. However, at temperatures over 70°C and in the presence of water, collagen is dissolved, forming gelatin. This process is rather slow and this is why cuts of meat with a high collagen content require long slow cooking in order to become tender. It is the degree of collagen crosslinking that will determine collagen solubility, the extent of shrinkage and the tension generated on shrinkage.

colour  see muscle colour, fat quality.

computed tomography (CT)  a radiographic technique that produces detailed images of body cross-sections or 3-D images. This technique can be used on live sheep and pigs to measure body composition and help identify outstanding animals within the breed, which is particularly important in breeding improvement programmes. Used on carcases or primal joints, the technique can accurately measure lean meat percentage of beef, pork or lamb.

condemnation (condemned meat)  meat deemed to be unsafe for human consumption, as identified and rejected by veterinary surgeons or meat inspectors at the abattoir (see meat inspection). If specific abnormalities are found which indicate that the carcase, or part of it, is unfit for human consumption it, or in certain cases the relevant part, is condemned. Once a carcase or part of it is condemned, it must be kept separate from meat intended for human consumption, in a room designated solely for this purpose within the abattoir. Strict regulations are enforced to ensure condemned carcases are disposed of in a safe manner.

conditioning  see ageing and accelerated conditioning.

conductivity  is the capacity for conduction (i.e. conveyance of energy). The conductivity of muscle can be used to identify PSE in pork carcases. Electrical capacity declines in muscle post-mortem and the rate of decline is faster in PSE pork relative to normal pork. Although commercial probes to measure conductivity have been tested, they have been associated with high degrees of error and have not therefore been taken up by the UK industry.

conformation  the overall thickness of muscle and fat in relation to the size of an animal’s skeleton, i.e. the “shape” of the carcase profile and degree of muscularity. This attribute is judged either in the live animal or in the carcase (see conformation class) and is a major component of the EU beef carcase classification scheme and the MLCSL method of sheep carcase classification employed in the UK. In the case of beef carcases, conformation is one of the determinants of retail yield. As conformation improves the lean to bone ratio also improves and hence the carcase contains less waste. A similar picture is seen in pig carcases. Better conformation in sheep carcases, however, can result from more fat between the muscles (intermuscular fat) rather than more muscle and,
conformation class is the score (see subjective score) given for the conformation of a carcase used in EU methods of beef carcase classification and GB sheep carcase classification. There are five main classes used: E, U, R, O and P. E relates to a carcase of excellent conformation and a carcase of P conformation is at the other extreme. Two systems of conformation scoring operate for beef in GB. In the most widely used system, U, O and P are divided into an upper (+) and lower (-) band for the classification of beef carcasses. The second system, referred to as the 15 point scale, divides each of the classes (E, U, R, O, P) in to a high (+), medium (mid) or low (-) sub division. Unlike beef, there are no sub-divisions of lamb carcase conformations. In some countries an optional S grade is used for superior conformation animals.

connective tissue the components of animal tissues responsible for structural integrity. In meat it is mainly present as collagen and to a lesser extent elastin. The connective tissue component of muscle is fundamental in determining the structure of meat and is a major determinant of the eating quality, particularly tenderness of meat.

consumer panel used in the sensory evaluation of meat. The panel can consist of anything between 20 and several hundred members that are chosen at random, and should be representative of the population as a whole. The objective of this type of evaluation is to determine the likely acceptability of a product in the market place, using the assessment of hedonic data such as overall liking, acceptability and preference, although some panels do ask consumers to score individual traits. They can be carried out either in a controlled environment, cooking and presenting the samples in a unified manner, or can be carried out within each panel member’s home.

contamination bacterial or chemical contamination of the carcase can be a serious cause of deterioration and spoilage of meat during storage (see microbiology). Although chemical contamination can take place prior to slaughter, it is generally accepted that muscle is sterile in a healthy living animal, thus it is only when the animal is killed and the carcase handled, will the external surfaces of muscles be exposed to contamination by bacteria. Bacterial growth on meat can be strongly influenced by the pH of the muscle. Hence, DFD muscle, being of a higher ultimate pH tends to be more susceptible to bacterial spoilage than normal muscle. Contamination can be minimised by good slaughter hygiene and chilling (see HACCP).

contractile protein the major constituents of muscle fibres which generate force by contraction. The contractile proteins are predominantly actin and myosin.

controlled atmospheric packaging (CAP) is the process of packing food products in a mixture of gases, the proportions of which are maintained by some mechanism such as oxygen scavengers. It is rarely used for meat and is often confused with modified atmosphere packaging.

cooked meat refers to meat that has been rendered suitable for consumption by a suitable heating process.

cooking loss is the reduction in weight of meat during the cooking process. Such losses consist of moisture and lipids from both the lean and fat tissues during cooking. This loss of weight has been shown to consist of mainly water (see water content), but a substantial loss of lipid can also occur. The degree of cooking loss will depend greatly on the cooking procedure employed. The thickness of the cut of meat will also affect cooking loss as will the removal of subcutaneous fat from the outside of the joint. The ability of meat to retain its water content during cooking is strongly dependent upon the myofibrillar structure of the muscle (see myofibril). Various processes occur within the muscle during cooking which lead to cooking loss. At 30-50°C the myofibrillar proteins start to denature leading to a loss of water holding capacity. Around 55°C protein denaturation leads to shrinkage of the myofibrillar lattice and at 60-63°C collagen shrinkage occurs. This shrinkage squeezes the muscle fibres, resulting in fluid loss from the meat. At approximately 65°C most of the water contained in the raw meat has been lost. The majority of biochemical factors predisposing carcases to excessive drip loss, such as PSE, will also cause increased losses on cooking (see post-mortem glycolysis, water holding capacity). Such losses are both unsightly (see appearance) and seen by the consumer as wasteful. Eating
quality characteristics, particularly juiciness, tend to be negatively correlated with cooking losses and cooking temperatures/duration.

Cooking procedures (methods) can have a dramatic effect on the final appearance and eating quality of meat, as well as its nutritional value (see nutritional composition). The majority of meat is heated in some way prior to consumption; however, the method used to cook meat can vary greatly. The aspects of cooking methodology that are particularly crucial are final endpoint temperature, the time the meat spends at higher temperatures and the presence of moisture or fat. When meat is heated, a number of biochemical changes occur within the muscle structure that affect its colour. The changes in colour on cooking are primarily brought about by the red myoglobin and oxymyoglobin pigments present in the muscle converting to metmyoglobin, which is brown in colour. This reaction takes place at around 60-70°C. The Maillard reaction is also fundamental in determining surface colour changes during cooking as well as the formation of flavour compounds. Cooking methodology will greatly effect the ability of the meat to maintain its water content (water holding capacity, cooking loss). It has been demonstrated that heating meat for a long period of time at lower temperatures can have the same effect on water retention as does heating at higher temperatures for short periods of time. As internal temperatures of meat increase, cooking losses increase and the meat becomes less juicy. Cooking procedures can have considerable effects on the juiciness of meat. In general, those cooking procedures that result in the greatest retention of fluids will yield the juiciest meat. Tenderness is influenced by cooking due to the shrinking of connective tissue (see collagen shrinkage) and structural changes to the myofibrillar proteins, which increase over the temperature range of 60-75°C. The structure of the muscle is also affected during cooking by a decrease in the length of the sarcomeres which results in a considerable shortening of the muscle. Raw meat is noted to have very little flavour with only a blood-like taste. The characteristic flavours and aromas of cooked meat only develop after heating. It is of little surprise therefore, that flavour and aromas can also be strongly influenced by the method of cooking. How the meat is prepared prior to cooking can also effect its subsequent eating (see tenderisation). The removal of the subcutaneous fat (backfat or rind in pigs) from the outside of the cut, may increase the loss of moisture from the lean during cooking (see cooking loss), which has been shown to reduce juiciness of the meat.

cow a female bovine animal which has produced a calf. Prior to producing a calf, female animals are referred to as heifers.

Creatine phosphokinase (CPK) is an enzyme which breaks down the high energy compound creatine phosphate within the muscle cell. Although the cell uses ATP as its primary source of energy to drive reactions, creatine phosphate is also used, which is dependant on CPK. Circulatory levels of creatine phosphokinase in the live pig, can be used as an indicator of the porcine stress syndrome (PSS), thus indicative of the susceptibility of a pig to develop PSE meat after slaughter.

cull breeding animals of any species slaughtered at the end of their productive lives. The term most commonly refers to dairy cattle or suckler cows, sows and ewes. The meat from these animals tends to be tough (see tenderness) with a large amount of insoluble connective tissue present (see collagen). The meat from cull animals possess different, often stronger flavour characteristics from younger animals.

curing (cured meat) a method of preserving and thus extending the shelf life of meat (particularly cured pigmeat products e.g. bacon and ham) which includes treating with a solution of salt and nitrite or nitrate (brine). The inclusion of salt serves to inhibit growth of pathogenic organisms, while allowing salt-tolerant bacteria to develop, which are beneficial to the process. During this process the salt dehydrates the meat and the nitrate is converted to nitrite which releases nitrous oxide. This converts the muscle colour pigment, myoglobin, to nitrosomyoglobin which causes the meat to have an attractive red/pink colour. The process of cooking then denatures the nitrosomyoglobin resulting in the characteristic colour. The Wiltshire cure process is a traditional English method of curing bacon.

cut (i) see jointing
(ii) a term used to refer to a specific joint after a carcase is butchered.

Cutting see jointing.
dairy beef  
beef produced as a by-product of the dairy industry from calves of dairy cattle. The calves produced from dairy cattle, which are predominantly Friesian/Holstein crosses, tend to produce lean carcases with poor conformation in comparison to beef breeds. Bull calves from the dairy herd are the predominant type used for cereal beef production systems, due to their ability to produce good feed efficiency on such systems. The crossing of dairy Holstein/Friesian cows with a beef breed bull can improve the conformation of their offspring.

dairy cattle  
cattle of a breed specifically bred and kept for milk production. In the UK the Holstein and Friesian breeds are the most widely used dairy cattle.

dam  
female parent of an animal.

dark cutting beef  
see DFD.

DEFRA (Department for Environment, Food and Rural Affairs)  
a UK government department making policy and legislation and working with others to deliver policies in sustainable development and the green economy, food, farming and fisheries, animal health and welfare, environmental protection and pollution control and rural communities and issues. DEFRA only work directly in England although they work closely with the devolved administrations in Wales, Scotland and Northern Ireland.

de-hairing  
the removal of hairs from a pig carcase. In the UK, pig carcases are rarely skinned (see skin, rind) following the slaughter of an animal. The carcase is normally scalded by plunging in a vat of water held at about 60°C for about 5 minutes so as to soften the skin and bristles (hairs). Following scalding, the bristles and superficial layers of skin are removed, either by the use of a machine with soft flails that beat the carcase (known as a de-hairer) or manually by scraping with a sharp knife. The carcase may then be singed (burning off the remaining hairs). In traditional bacon pig production the singeing may be severe and followed by scraping/polishing of the carcase. The carcases of some dark haired breeds of pig such as the Duroc, often have deep seated hairs which may be difficult to remove completely.

de-hiding  
the process of removing the skin (hide) of cattle as carried out following slaughter in an abattoir. The hide is separated from the carcase normally mechanically, using either a hide flayer, which is a hand-held vibrating instrument, or a hide puller which pulls away the hide. A carcase with a skin that does not easily lift from the subcutaneous tissue is said to be “hidebound”. This particularly occurs in extremely lean animals due to an absence of fatty tissue beneath the skin. See pelting, de-hairing.

dead weight  
the weight of the carcase after dressing. Also referred to as dressed weight (see also cold/hot carcase weight).

deep seated hair  
the hairs remaining in the skin (rind) of a pig carcase following the process of de-hairing. Deep seated hair is a particular problem in dark haired breeds of pig such as the Duroc. Also known as deep rooted hair.

DFD (dark, firm and dry muscle)  
is a muscle condition defect seen in beef carcases, (particularly in young bulls, cull cows and veal) when it is termed dark cutting beef, and less frequently in pig carcases. The condition is rarely seen in sheep carcases. In muscles that develop DFD, increased circulatory levels of adrenaline cause the muscle glycogen to be depleted prior to slaughter. This results in less substrate available for post mortem glycolysis, in turn this restricts the amount of lactic acid formed in the muscle post-mortem and thus the ultimate pH, (pHu), of the muscle will be higher than normal. An indication of the occurrence of DFD in a carcase is an ultimate pH of above 6.0. In addition to the apparent abnormal colour found in DFD meat, it also has reduced keeping qualities and is prone to microbial (bacterial) spoilage. Both of these traits are because of its higher pHu. Fluid retention is very high in DFD meat, so that in many ways DFD may be regarded as the opposite to PSE. However, factors that increase PSE do not always decrease DFD and vice versa. Poor pre-slaughter handling (prolonged stress) and prolonged periods of fasting prior to slaughter (see lairage) are predisposing factors for the development of DFD. Both visual and palatability evaluations have shown DFD pigmeat to be preferable to PSE meat, with normal (not PSE or DFD) meat preferred overall.
discoloration of meat results from those factors that cause a change in the state of the iron within the haem of myoglobin. Variation in muscle colour of meat depends upon the chemical state of myoglobin related to oxygen availability (see oxidation). Discoloration is most likely to occur when reduced post-mortem acidification leads to a high ultimate pH. Conditions such as glazed bacon and browning of lean during retail display are examples of discoloration. Meat showing discoloration is often prone to subsequent development of microbial spoilage (see microbiology, contamination). Microbial contamination may also be a cause of the discoloration seen in meat. Controlled atmospheric packaging can assist in reducing the discoloration of meat before consumption by prolonging the persistence of the red oxy-form of myoglobin, thus extending retail shelf life. Bruising of the carcase can be a cause of discoloration. The colour and appearance of meat is a very influential factor affecting consumer acceptance. See also greening.

dissection the physical separation of the various tissues of the carcase. This is often carried out when it is necessary to accurately assess the proportions of lean, fat, bone and other tissue of the carcases evaluated. This can be done in two ways. Firstly a full-side dissection can be performed on all the carcases in the experiment, which is both time consuming and expensive. Alternatively, sample joint dissection can be used. This method uses a combination of the accurate and expensive full dissection on a percentage of the carcases, with a less accurate but cheaper sample joint dissection on the rest. Used with the correct methods of statistical analysis this method has been shown to be an accurate and consistent method of predicting the proportion of lean meat in carcases, which is cheaper and more convenient than fully dissecting them. An alternative non-destructive method is to use computed tomography to calculate the proportions of lean, fat and bone. Research shows this method has a high correlation to results seen in full dissection.

double muscling is an inherited trait seen in certain breeds of cattle (e.g. Belgian Blue) that results in the deposition of increased muscle tissue, particularly in muscles of the upper hind limb. Although double muscled cattle have a normal number of muscles, they have more muscle fibres in each muscle with an increased percentage of fast-twitch glycolytic fibre types present. Carcases from such animals attract premium prices at slaughter due to their high lean meat content and high muscle:bone ratio. However, such animals kept for breeding can have fertility and calving problems. This condition is also referred to as culard or doppelender development. Trials evaluating meat quality attributes in double muscle breeds compared to breeds with normal conformation have been inconclusive.

dressed weight the weight of the carcase following the process of dressing.

dressing the process of removing various parts of the body of an animal following slaughter. Following this process, the body of the animal is generally referred to as a carcase, the weight of which is termed as the dressed weight or carcase weight, and when compared to the initial liveweight of the animal, is referred to as the killing out percentage. See offal.

dressing specification sets out the particular parts of the body that are removed from the carcase and level of fat trim during dressing. In the UK there are 3 approved specifications for beef: Standard Specification, EC Reference Specification and UK Specification. A plant can choose which of these specification's they dress to. For lamb the UK has two recognised specifications: MLC Standard Conditions and MLC Standard Conditions, Tail Off. There is no legislation governing sheep dressing specifications and sheep plants can choose either of these specifications or adopt their own company specification. In pigs there are four recognised specifications. These include: the removal of the Tongue (Tng), Flare Fat, Kidney and Diaphragm (FFKD) and is referred to as 'Tng out and FFKD out'. Alternatively these can be retained, referred to as 'Tng in and FFKD in', or it can be either tongue in and FFKD out or tongue out and FFKD in.

drip loss (i) the discharge of exudate (mainly water) from the carcase (see exudation). Factors predisposing a carcase to poor water holding capacity result in high levels of drip from the carcase. Drip loss is an important determinant for both carcase yield and meat quality. The method of chilling a carcase can strongly affect drip loss with faster chilling reducing drip loss. (ii) the loss of fluid from retail cuts whilst on display. This parameter can be evaluated by storing a cut of meat at a fixed temperature for a standard time (e.g. 4°C for 48 hours), suspended in a plastic bag. The amount of drip collected over this time is then weighed and expressed as a percentage of the original muscle weight. This evaluation is most often carried out on the loin (see Longissimus dorsi, eye muscle).
(iii) the loss of fluid from meat on thawing following freezing. Such losses are dependant upon the damage to muscle caused by the formation and growth of ice crystals. Rapid (blast) freezing produces small intracellular crystals, whereas slow freezing produces large extracellular crystals. The latter produce greater amounts of drip on thawing due to cellular rupture and damage.

dry ageing a method of ageing whereby the carcase, side or cut is left exposed to the air in a chill room for a required period of time. This can lead to high evaporative losses and a reduced lean meat percentage; however it can also promote a stronger meat flavour, which some consumers find desirable.

E. coli (Escherichia coli) a species of bacteria found in the intestines of animals. Pathogenic strains can cause urinary and digestive infections in humans. The most significant of these to human health are the enterohaemorrhagic E. coli (EHEC), in particular E. coli O157:H7, which cause haemorrhagic diarrhoea. These are also known as verotoxigenic E. coli (VTEC) because of their production of a compound toxic to vero (green monkey kidney) cells in culture. E. coli infections of meat are only likely if poor handling of the carcase, particularly the guts or hide, is carried out during slaughter. Care should always be taken to prevent the gut contents or hide of a slaughtered animal coming into contact with the meat of a carcase during the dressing process. Rapid chilling of the carcase will also limit the growth of such micro-organisms. See microbiology.

eating quality of meat refers to the organoleptic factors influencing consumer acceptance and enjoyment of the product. The main eating quality attributes of meat are tenderness, juiciness, flavour and aroma. It is extremely difficult to segregate each of these factors, as many of the attributes of meat eating quality are interrelated, and what may affect one attribute is quite likely to affect another. Eating quality of meat can be subjectively assessed using sensory evaluation panels. However, such subjective methods are complicated, expensive and time consuming. Therefore efforts have been made to develop reliable objective tests to evaluate eating quality in meat, although to date such objective assessments have been mainly limited to the assessment of tenderness (see shear force). At present objective methods for evaluating meat flavour and aroma are rarely used because they do not correlate well with subjective human evaluation. See meat quality. As yet therefore, the prediction of the ultimate eating quality of meat cannot be determined from objective measurements, although subjective measurements may be used as a predictor of eating quality (e.g. level of marbling). The eating quality of meat can be affected by a wide range of factors including cooking procedures, age of the animal, ageing of the meat, post-mortem glycolysis and proteolysis, chilling, fatness level, and fat quality.

EBLEX is the organisation for beef and lamb levy payers in England. EBLEX is part of the AHDB and is funded through a statutory levy paid by producers and processors on all beef and sheep animals slaughtered in, or live animals exported from, England. EBLEX exists to enhance the profitability and sustainability of the English beef and lamb sector through increasing efficiency and adding value. EBLEX is a division of the Agriculture and Horticulture Development Board (AHDB). EBLEX and BPEX (for pigs) replaced the former Meat and Livestock Commission, (MLC).

EEL reflectometer is an instrument for assessing meat colour. The name derives from the original manufacturers, Evans Electroelenium Ltd, and the equipment was originally developed as a smoke stain meter. It works by measuring the degree of reflectance off the cut surface of the meat. A higher reading indicates paler meat.

eighteen-month beef production system for beef from animals slaughtered at 16-20 months of age. Calves born in the spring will have a period at grass followed by a housed period through the winter and will then be finished off grass with supplementary concentrates as required the following autumn. Conversely, animals born in the autumn will be housed before being turned out at spring and have the summer at grass before being finished indoors off forage and concentrates the following winter.

electrical stunning see stunning.

electrical stimulation a method of improving the tenderness of meat by the application of an electric current to the carcase following slaughter. This method can be used to reduce or even replace expensive ageing of meat. Electrical stimulation has also been shown to improve muscle colour, enhance marbling scores, prevent the development of heat ring and to enhance the flavour of meat. The action appears to be predominantly due to the acceleration of depletion of ATP (muscle
energy) and hence a more rapid lowering of pH, and hastening of the onset of rigor mortis in the carcase following slaughter. When muscle cells cool below 10°C, the pump used to remove calcium from the cytoplasm to the sarcoplasmic reticulum does not work as efficiently. If ATP is still available within the cell, a contraction could be stimulated but the pump would be unable to remove the calcium to achieve a relaxation in the muscle therefore electrical stimulation of the carcase can also be used to overcome the problem of cold shortening. The release of calcium stimulates early ageing (see proteolysis, proteolytic enzymes). Additionally it is believed that the mechanical disruption of the muscle fibres also influences the tenderness of electrically stimulated meat. It should be noted that safety implications must be taken into account when electrical stimulation is applied. Application can either be low voltage, carried out immediately post sticking which can decrease the risk of cold shortening, or high voltage, carried out post dressing which helps improve tenderness.

**endogenous** produced within or caused by factors within the animal's body.

**entire** a male animal that has not been castrated (see castrate) and therefore retains the testicles in the scrotum and is capable of reproduction. An “entire male” pig is usually a young male reared specifically for meat production but the term boar can also be used. An entire sheep is referred to as a ram, and entire cattle are referred to as bulls.

**enzyme** refers to any soluble protein that acts as a catalyst, increasing the rate at which a chemical reaction occurs in the body. Animals can contain up to 10,000 different enzymes. See proteolytic enzyme, papain, creatine phosphokinase, phospholipases.

**evaporative weight loss** a loss of water from the meat, particularly during the chilling process, through its conversion to a gaseous form (as opposed to liquid drip). Evaporative weight loss can be reduced by rapid chilling. The moisture loss during chilling has been shown to be greater with high air speeds and low air humidity. The rate of evaporation from different parts of a carcase can vary considerably and will also be influenced by the size, hence surface area, of the carcase. See water content, water holding capacity.

**evisceration** the removal of the viscera (internal organs) from the carcase, as carried out on the slaughterline at an abattoir as part of the dressing procedure.

**ewe** female sheep which has lambed or reached a stage of pregnancy which will depreciate the carcase value.

**expressible juice** the release of juice from unheated meat during the application of external forces such as pressing. See water holding capacity, drip loss, thaw loss.

**exsanguination** the technique used to drain the blood from the carcase of an animal at slaughter. Also known as sticking or bleeding. In the UK, immediately following stunning, the animal is bled by severing the major blood vessels. Sticking can be carried out at the neck or the chest (often referred to as a thoracic stick). Pigs must be bled via a chest (or thoracic) stick. For beef and sheep either a neck or chest stick can be used. Sticking must be carried out by a trained person, ensuring that at least one of the carotid arteries (or the vessels from which they arise) is severed. If electrical stunning is used prior to exsanguination, it is important to minimise the time between the two operations so as to reduce the occurrence of blood splash. Some methods of ritual slaughter practised within the UK (see religious slaughter) use exsanguination only, without stunning, for certain animal species.

**exudate** the fluid lost from meat also known as weep or drip. The amount of exudate from meat is particularly increased in conditions such as PSE (see water holding capacity, drip loss, thaw loss, cooking loss). It can also refer to the appearance of fluid and precipitated protein (which usually appears white) on the surface of meat, particularly bacon, during cooking.

**eye muscle** this is the common term for the Longissimus dorsi, the main muscle running the length of the loin. The transverse cut of meat containing the eye muscle is often referred to as a chop. Eye muscle area and eye muscle depth can be used as an objective measurement of meat yield in a carcase. Linear and area measurements of the cross section of the eye muscle are normally made at the point where the carcase is cut at right angles to the backbone, at the level of the
posterior edge of the head of the last complete rib. The length of the loin in a carcase is strongly influenced by **carcase length**. The quality assessments of **pH** and muscle **temperature** are often taken from the eye muscle and it is the muscle most commonly used for assessment of eating quality.

**fat**

(i) the adipose (fatty) tissue found in the body. The visible adipose tissue in prepared meat is known as visual fat. (ii) a substance which is insoluble in water but soluble in organic solvents such as ether (also termed **lipid**). The amount of fat determined by laboratory analysis using one of these solvents is known as chemical fat. The amount and the **appearance** of the fat between individual muscles (**intramuscular fat**), within muscles (**intramuscular fat**) and surrounding (**subcutaneous**) the **lean tissue** of a carcase, is an important determinant of attractiveness to the modern day consumer (see **appearance**). In chemical terms, the fats present in meat are essentially glycerides with a smaller proportion of phospholipids (which are important constituents of cell walls). The physical characteristics of each fat are determined by its fatty acid composition. See adipose tissue, backfat, intramuscular fat, fatness, fatty acid, growth.

**fat class** a **subjective score** given for the degree of fat cover of a carcase, used in beef carcase classification and sheep carcase classification. There are five main classes (1 to 5) according to fat cover in the classification schemes currently used. The beef carcase classification classes are based on the EU scale but with classes 4 and 5 being divided into low (L) and high (H). In sheep carcase classification classes 3 and 4 are divided into low and high. In beef, as with conformation class, the 15 point scale can be used. This scale divides each of the fat classes (1,2,3,4,5) into a high (+), medium (mid) or low (-) sub division.

**fat colour** see fat quality.

**fat firmness** see firmness.

**fat quality** desirable fat has been described as fat which is firm but not too hard and of a white colour in pigs and creamy-white colour in cattle and sheep. Fat in pigs is inherently of a white colour, and therefore fat colour in pigs is not noted to be of a major quality problem. In ruminant species, particularly cattle, a condition known as **yellow fat** can be a problem. Fat quality is also determined by optimum fat firmness and melting point, with relatively firm fat being desirable in pork and beef, and the fat of some lambs being considered of too high a melting point (too firm). There is substantial evidence to suggest that, in pigs, fat firmness is a function of fat thickness. As fat thickness (see backfat) is reduced so firmness declines along with the cohesiveness of fat tissues, leading to increased tissue separation in very lean animals. The fatty tissue in lean pig carcases has been shown to be less developed than in fatter carcases, containing higher concentrations of water (see water content) and connective tissue and less lipid. The lipid present also tends to be less saturated (see fatty acid), with a higher concentration of linoleic acid causing the tissue to feel softer. Extreme changes of this sort are undesirable since meat with soft fat can be unsightly, difficult to cut (see jointing) and tend towards more rapid development of oxidative rancidity during storage (see lipid oxidation).

**fatness** the amount of fat present relative to lean is an extremely important constituent of the **appearance** of meat. There is a widespread belief that a certain amount of external and intramuscular fat in the carcase is essential to ensure optimum eating quality of meat. Scientific evidence however, has shown only a weak relationship and demonstrated that any influence that carcase fatness may have on the eating quality of meat, is likely to be indirectly brought about by concurrent changes in fat quality or as an insulator against cold shortening and cooking abuse. Meat cuts with a high ratio of lean to fat (estimated to be around 10:1) are most preferred by consumers in the UK. Pigs differ from cattle and sheep in the proportions of body fat found in the various dissectable fat depots. Despite these differences in fat partition, the relative growth rates of the depots are similar in the three species. See growth, adipose tissue, fat, lipid.

**fatstock** animals that have been purposely reared and finished (or fattened) for meat production, in direct contrast to breeding stock.

**fattener** See finish.
fatty acids are organic acids which occur in fat. The distinctive feature and major compositional characteristic of each fat is determined by its fatty acid composition. Fatty acids can be either saturated (all carbon to carbon bonds within the molecule are single) or unsaturated (one or more carbon to carbon bonds are double bonds) and this is a major determinant of the melting point (which determines the firmness of the tissue at a particular temperature) of the fat. The greater the saturation, the higher the melting point. Fatty acid composition of the fat can vary with the position within the body, the diet of the animal, its weight or fatness, age, sex, and genotype. In pigs and other monogastric animals, the fatty acid composition of the fat tissue (particularly of the subcutaneous fat) can be readily manipulated by modifying the proportions of dietary fatty acids, which are absorbed intact from the small intestine and incorporated directly into fat tissue. In ruminants the impact of dietary fats on the fatty acid composition of the body is reduced by the effect of microbes in the rumen. Fatty acids can be protected from this effect by the natural protection of a seed coat (for example in feeding whole flax seed) or can be achieved by chemical treatment of one or more of the dietary components.

feed conversion ratio (FCR) is the number of kilograms of feed required to produce 1 kg of liveweight gain. Also known as feed conversion efficiency (FCE).

fibres (fibre type) see muscle fibres.

finish to rear an animal to a suitable weight and condition for slaughter. An animal is referred to as "finished", based on subjective assessments of conformation and subcutaneous fat deposition. An animal in the later stages of the growing period (finishing period) is often referred to as a finisher. Outdated equivalent terms are fatten/fattened/fattener.

firmness (carcase/fat firmness) at low levels of fat in the carcase (particularly in lean pig carcases), fat and muscle tissue do not adhere together so strongly (see tissue separation) and the carcase lacks firmness and is said to be "floppy". Such carcases also tend to show an increase in muscle wetness (see water content). These factors make cutting (see jointing) or slicing more difficult and the meat unattractive to the consumer (see appearance). Fat from such lean carcases tends to be softer than that of fatter carcases. This is largely due to a higher proportion of unsaturated fat (see fatty acid) or higher water content of the fatty tissue. The firmness of carcase fat can be evaluated subjectively (see subjective scoring) or objectively using instruments such as a penetrometer.

flank two parts of the beef carcase are referred to as flank. The thick flank, or top rump (being immediately adjacent to the rump), is the front portion of the hind leg including the patella but no other bones. The thin flank is broadly equivalent to the belly and includes the ventral portion of the last four ribs.

flare the retroperitoneal and perinephric (or perirenal) fat of pigs. Known as the kidney knob and channel fat, (KCFl) in ruminants, this layer of fat surrounds the kidneys.

flavour is one of the eating quality attributes of meat. It is the combined result of the senses of taste and smell (aroma) and is notoriously difficult to evaluate. Each species has its own characteristic flavour (i.e. beef, pork and lamb flavours) and this will vary within a species depending upon many production, processing and cooking practices. Raw meat is noted to have very little flavour with only a blood-like taste (slightly salty, slightly sweet and slightly sour). The characteristic flavours of cooked meat only develop after heating. During cooking, numerous chemical reactions occur between the many non-volatile (not easily evaporated) compounds present in meat, resulting in the formation of numerous volatile compounds. In the order of 1000 different compounds have been identified as contributing to meat flavour. Important reactions involved in the formation of flavour and odour in meat include the thermal breakdown of individual muscle components, reactions between amino acids and carbohydrates (Maillard reaction), the thermal oxidation of lipids, and the interactions between these different compounds. In meat that is stored after cooking, lipid oxidation is very rapid and is accompanied by a deterioration in flavour and increase in abnormal odours. This phenomenon is often termed "warmed-over flavour". Lipid oxidation (particularly of phospholipids) also contributes to desirable meat flavour. Flavour of meat can be influenced by the diet of the animal, the ultimate pH (pHu) of the muscle, the method of storage of the meat and the method of cooking. In addition to abnormal flavours associated with lipid oxidation, a potential flavour problem in pork, is that of boar taint. Flavour of meat is an extremely
subjective property and therefore the only reliable assessment of flavour is achieved by sensory evaluation.

**Food Standards Agency (FSA)** is an independent government department responsible for food safety and hygiene across the UK. The aim is to safeguard public health and animal welfare through fair, consistent and effective enforcement of hygiene, inspection and welfare regulations. In April 2010, the FSA Operations Group was formed following the dissolution of the Meat Hygiene Service, (MHS), whose main functions were: enforcement of hygiene rules in licensed fresh meat premises, meat inspection and health marking in licensed fresh meat premises; enforcement of animal welfare legislation in licensed slaughterhouses; enforcement of hygiene controls in certain minced meat and meat products plants; enforcement of Specified Risk Material and other animal by-products, and to provide export certification when required by the importing country or by EU rules.

**free-range** very loosely used to describe a wide range of systems of keeping animals in “unconfined” groups (i.e. not within the confines of a small space). The allocation of a free range label to a product can often bring a price premium. For example: free range pigs are born outside in fields and they remain outside until they are sent for slaughter. They are provided with food, water and shelter and are free to roam within defined boundaries. Generous space allowances are defined with minimum requirements dependent on soil conditions and rotation practices. Free range breeding sows are kept outside in fields for their productive life and are provided with food, water and shelter with generous minimum space allowances.

**freezer burn** is the name given to the whitish or amber coloured patches seen on the surface of frozen meats. These discoloured patches are caused by the formation and subsequent evaporation of ice crystals on the surface of the carcase (sublimation).

**freezing** the process of reducing the temperature of meat to a level at which most of the water within it is converted into ice for the purpose of reducing bacterial growth (see microbiology) and biochemical deterioration during extended storage. UK recommendations state that this temperature should be -12°C or lower. The actual process of freezing meat causes little change in nutritional value, with the exception of a small reduction in some vitamins during freezing and upon thawing.

**fresh meat** is that which is unprocessed (i.e. in its original state). The fresh state is defined as that of a short shelf life perishable unprocessed food prior to perceptible evidence of physical, chemical or microbiological change by the Institute of Food Science and Technology.

**game** birds or animals hunted and killed for sport as defined in the Game Act 1851 and subsequent legislation. Includes deer (venison) and wild boar, and birds such as pheasants, quail, partridge and grouse. Licences are required to kill or deal in some game species. Traditionally game is hung (aged) for relatively long periods prior to consumption. This ageing contributes to the tenderness and strong flavours associated with game.

**gelatin** a jelly like substance resulting from the solubilisation of collagen upon cooking.

**gene** the basic unit of inheritance consisting of lengths of DNA which control the hereditary characteristics (e.g. skin colour, growth rate potential) of organisms from one generation to another. Genes are carried on chromosomes within the cell nucleus. The inheritance of individual characteristics (traits) of an animal can either be controlled by one gene (single gene traits) such as susceptibility to halothane gas in pigs (see halothane gene) or influenced by several different genes (multigenic) e.g. growth rate. Genes with particular relevance to meat quality include the halothane, RN- gene and those associated with double muscling.

**genotype** this can mean the entire array of genes of an individual or the genetic constitution of an individual with respect to a limited set of genes of interest. More loosely it is used to describe a group of animals of similar genetic make-up such as a breed or breeding company population.

**gilt** young female pig. The term is most often applied until the production of the animal's first litter, although it is also used until the first litter is weaned. A “maiden” gilt is a sexually mature female pig that has not yet been mated. A rarely used system of production which involves the slaughter of a gilt after she has produced only one litter of piglets is termed a “once bred gilt” system. Once
bred gilts have been shown to produce meat of a similar quality (though occasionally of reduced tenderness) to conventional slaughtered pigs.

gimmer young female sheep, between one and two years of age, that has not born a lamb.

glazzy bacon a condition seen in bacon where the surface appears to have a coloured sheen. It has been associated with bacterial growth on the surface of bacon produced from pigment of a high ultimate pH (DFD). See muscle colour, microbial spoilage. Another cause of glazzy bacon has been attributed to the different refractive indices of water and fat at the surface. Fat can form emulsions in the water at surface, causing light to scatter rather than be reflected which in turn gives rise to the coloured sheen.

glycogen a carbohydrate used in animals as an energy store in liver and muscle. Glycogen is occasionally referred to as animal starch and is a highly branched polymer of glucose. The content of glycogen in skeletal muscle can range from 0.3 to 1% depending on genotype, muscle fibre type, nutritional status, and muscle activity. Glycogen concentration of the muscle increases after the animal has fed and can be broken down rapidly in response to stress. Following slaughter, the glycogen is broken down to produce energy (ATP). Due to the absence of oxygen this results in the formation of lactic acid and a lowering of muscle pH to achieve ultimate pH (see glycolysis). The content of glycogen in the muscle at the point of slaughter is the major factor controlling the extent to which glycolysis takes place. If insufficient glycogen is present (e.g. following prolonged feed withdrawal), less lactic acid is produced and ultimate pH is high, DFD may result.

glycolysis (i) in the field of meat science and technology (and throughout this document), the term glycolysis refers to the anaerobic metabolic process converting glucose from glycogen to lactic acid, resulting in the formation of energy in the form of ATP (also called anaerobic glycolysis). Following slaughter, muscle quickly becomes anaerobic and glycolysis is increased as a means of synthesising ATP. This produces increasing levels of lactic acid during the early stages post-mortem. This results in a drop in muscle pH from approximately 7.3 in the live animal to approximately 5.5 following rigor. Thus, the measurement of pH is often used as an indicator of the rate and extent of post-mortem glycolysis occurring in the carcase. Glycolysis is more rapid in the muscles of pigs (ultimate pH being achieved 3 to 5 hours after slaughter) than sheep or cattle (up to 24 hours), with significant breed differences within species. The rate of glycolysis in the live animal is affected by circulatory levels of the hormone adrenaline. Adrenaline concentration in the bloodstream is raised at times of stress, such as prior to slaughter. Stress immediately prior to slaughter therefore results in an acceleration of glycolysis and hence the development of rigor. Whereas longer term pre-slaughter stress is instrumental in reducing muscle glycogen concentrations in the carcase at slaughter to an extent as to limit normal post-mortem acidification, hence a raised ultimate pH is observed, which promotes the development of DFD meat. The meat quality condition known as PSE results from an extremely rapid post-mortem glycolysis that drops the pH while muscle temperature is still high. PSE is a particular problem in pig muscle, where the pH decline in PSE carcases may be twice as fast as normal muscle, and in extreme circumstances, the ultimate pH may actually be reached within as little as 15 minutes post-mortem.
(ii) glycolysis also refers to the sequence of chemical reactions that results in the production of pyruvic acid from glucose which occurs in both the presence and absence of oxygen. It is from pyruvic acid that lactic acid is formed in anaerobic glycolysis.

goad (electric goad) an instrumental "prod" often capable of delivering a small electric current used to make an animal move forward. The use of such instruments is strongly discouraged on the grounds of poor animal welfare leading to high levels of stress in the animal. Careful, quiet handling of animals is recommended for loading, transport, unloading, lairage and slaughter of animals to maximise animal welfare and safety, and to optimise meat quality.

GR the total tissue thickness over the 12th rib taken at a distance of 110mm (11cm) from the midline. The GR measurement, ascertained using a probe or a GR knife, is used to define fatness in lamb carcase grading in Australia and New Zealand.

grading the categorisation of a carcase according to quality standards. Individual abattoirs may operate their own grading systems depending on their requirements. This will, in the UK, normally make use of the information supplied by classification. Grading attempts to assess some quality
attribute against what the market demands. In contrast, classification simply allocates carcasses to clearly defined classes without attaching a quality judgement.

**grass silage beef**  
beef produced from cattle (often bulls of dairy breeds) fed indoors on a diet of silage and cereals for slaughter at 13-17 months of age.

**greaves**  
during rendering, raw by-products are cooked resulting in a fatty product called greaves. This product has recognisable parts of the animal (such as pieces of bone) and when squeezed in the hand, tallow oozes out. Mechanical separation results in tallow and greaves with a lower fat content. This remaining greaves is then milled and dried resulting in meat and bonemeal.

**greening**  
is a discoloration of cured meats, caused by an excess of nitrite (see curing). Microbial contamination of meat can also lead to this greening effect (see microbiology) particularly in high pH (above pH 6) carcases. See glazy bacon.

**gristle**  
see cartilage.

**growth**  
is the progressive increase in size or number of cells of living things and is the basis of meat animal production. The relative patterns of growth of animal tissues (bone, muscle, fat) are similar in the three species. In each species, bone is an early developing tissue (grows most quickly when the animal is young), muscle intermediate, and fat late developing. Subcutaneous and omental fat grow more rapidly than intramuscular and mesenteric fat, with mesenteric fat being particularly slow growing. Intramuscular fat is a late-developing adipose tissue. Changes in the relative proportions of lipid, water (see water content) and connective tissue occur during growth which have important effects on fat quality. Sex, feeding regime (see ad libitum feeding) and genotype can all influence growth, tissue distribution and fat partitioning. The rate of growth of the animal, particularly of lean tissue, can influence subsequent eating quality of the meat, particularly tenderness (see collagen, post-mortem proteolysis, ad libitum feeding).

**growth promoters**  
chemical substances which when administered to an animal lead to increased growth rate and feed conversion efficiency, they can also result in a beneficial reduction of carcase fatness. Growth promoters may be administered in the form of implants (e.g. steroid hormones, somatotrophin) which has not been legally permissible in the EU since January 1988, or added to the feed. Beta-adrenergic agonists such as clenbuterol are often incorrectly termed as growth promoters when in fact, because of their abilities to “repartition” food nutrients away from fat tissue development and into lean tissue development, their correct description is re-partitioning agents. Such agents are also not currently legal in the EU.

**gut**  
a term used to refer to the alimentary tract (stomach and intestines) of an animal (see gutfill).

**gutfill**  
refers to the food, digesta and faeces as contained in the animal’s gut. The amount of gutfill is extremely variable, greatly influencing the animal’s total body weight particularly in ruminant species. The proportion of gutfill to overall body weight will depend on the species, age of the animal (i.e. being greater in ruminants and young animals), degree of fatness and the time of the last feed (see lairage). Gutfill is a major contributor to the variation found in killing out percentage.

**HACCP**  
(Hazard Analysis and Critical Control Point) a systematic, preventative approach to food safety, (see Microbiology).

**haem**  
the chemical group within haemoglobin and myoglobin (and in other compounds elsewhere in the body) that contains iron. A greater haem concentration in the muscle will cause meat to look redder or darker and is likely to be an indication of more red oxidative fibres in the muscle (see muscle fibres) which is characteristic of red meats. Low haem concentrations produce pale muscles which predominate white meats. Haem pigments will increase with the age of the animal and also, it has been suggested, due to exercise.

**haemoglobin (Hb)**  
an iron containing pigment in blood. Haemoglobin is responsible for transporting oxygen around the body. Oxygenated haemoglobin is bright red in colour and haemoglobin that is unbound to oxygen (deoxyhaemoglobin) is darker. Thus arterial blood which is about 97% saturated with oxygen, is bright red, whereas venous (returning to the heart from the muscle and
other tissues) blood is much darker. After exsanguination of the animal at slaughter meat contains relatively little residual haemoglobin. See haem.

**Halal slaughter**  Muslim method of religious slaughter with much in common with Jewish slaughter. The religious requirement is that only healthy and uninjured animals can be slaughtered for consumption. Stunna prior to slaughter is acceptable to some but not to other Muslim officials (it is considered injurious by some), and therefore is not carried out in all cases. Death is achieved by drawing a very sharp knife across the throat thus cutting both carotid arteries and both jugular veins with one stroke.

**halothane gene**  a gene present in some pigs which may make them susceptible to the porcine stress syndrome (PSS), a condition also known as malignant hyperthermia. The Halothane gene is actually a single recessive mutation of a gene coding for a protein involved in controlling the flow of calcium within cells. Therefore, for individuals to show the symptoms of PSS, the mutated form of the gene must be inherited from both parents. This gene is now also known as the ryanodine receptor gene. Halothane is a colourless heavy gas, used to produce general anaesthesia in animals and humans. This gas has also been used to identify pigs susceptible to PSS. On exposure to halothane, stress susceptible pigs will show muscle rigidity, an accelerated muscle metabolism with an uncontrolled intense production of heat. Prolonged exposure will result in death of the animal from hyperthermia. Stress resistant animals show a normal reaction to halothane anaesthesia and their muscles remain relaxed. Depending on their reaction to halothane anaesthesia, pigs are classified as halothane-positive (H+) or halothane-negative (H-). However, this test will only identify animals that have inherited the halothane gene from both parents and therefore show PSS symptoms. The halothane test does not show up animals that have only one copy of the gene (carriers). Such carriers may account for a large proportion of the animal’s herd when only a few pigs may be shown to be halothane positive. Halothane-sensitive pigs tend to yield more lean meat (up to a 5% increase) and produce carcases of improved conformation, compared with halothane-resistant pigs. However, the meat quality (rate of pH decline, colour, water holding capacity) in H+ pigs tends to be inferior, and PSE frequency higher. These animals also tend to be very excitable and frequently suffer stress related problems (which can be fatal, particularly during transport). The degree to which pigs of any halothane status produce inferior quality meat, and particularly develop PSE, will depend very much upon the type of handling and amount of stress the animals are exposed to prior to slaughter. The incidence of the halothane-positive reaction differs widely between countries and particularly between breeds. The stress susceptibility in some breeds is extremely low, such as the Duroc, whereas in others, which tend to be the heavy muscled breeds such as the Landrace types and Pietrain, is very high. The precise nature of the genetic mutation responsible for the halothane reaction has been identified and isolated, and a commercial DNA test has been developed to identify carriers of the mutated form of the gene. Terminal sire lines of pig are available, which are guaranteed free from the halothane gene. An alternative notation for halothane gene status is NN, Nn, and nn where these denote halothane free, halothane negative carrier animals and halothane positive animals respectively.

**ham**  (i) the joint or cut of pork that constitutes the upper hind leg (ii) cured pork from the upper hind leg (see curing).

**Hampshire type meat**  a term given to pig meat which tends to be pale and somewhat wet, although less exudative than typical PSE meat. This characteristic is thought to be caused by the presence of a gene called the RN- gene which is associated with certain strains of the Hampshire breed of pig.

**handling**  refers to the treatment of animals when they are moved by humans. The way meat animals are handled between the farm and the abattoir, and within the abattoir itself, has very important implications for both animal welfare and meat quality. During these times, animals are inevitably subjected to unaccustomed social, environmental and physical stresses (see stress, PSE and DFD). In the interests of animal welfare and meat quality it is critical that animals are loaded and transported quietly and calmly to the abattoir. Careful handling can also reduce bruising and skin damage (see rindsde damage).

**hanging**  see ageing, aitch bone suspension.

**heat-ring**  a two-toned appearance with a dark ring most commonly seen in the eye muscle. The cause is generally thought to be inappropriate chilling.
heifer  young female  bovine  that has not produced a  calf.

hide  the  skin  of  cattle  as removed at  abattoir.  See  warble fly, de-hiding.

hide puller  is a piece of equipment for the  de-hiding  of animals after slaughter. These operate by attachment to the hide and then mechanically pulling away from the animal, usually at the same time as rolling the hide to avoid contamination of the skinned carcase. Different types of hide puller include up and down pullers and shoulder pullers for sheep.

hip suspension  see  aitch-bone suspension.

heme  American spelling of  haem

hogg or hogget  (i) young  sheep  (either male or female) slaughtered before any permanent incisor teeth have erupted. Hogget's are more correctly termed old season  lambs.
(ii) a live sheep between the time of weaning and its first shearing.

hot boning (hot de-boning)  the separation of the  bones  from the  meat  in a  carcase  as carried out immediately following  slaughter,  before the carcase has been chilled and the meat time to set (rigor mortis). Hot de-boning of individual muscles removes them from the restraint of attachment to the skeleton and will allow them to shorten if chilled too rapidly (see cold shortening) which causes the meat following cooking to be of a reduced  tenderness  compared to conventionally (cold) deboned meat (see boning). Hot boning has been combined with  electrical stimulation  of the carcase to accelerate the onset of rigor mortis. See  hot processing.

hot conditioning  very slow chilling of the carcase by holding at air temperatures above conventional chiller temperatures for a period of time before lowering of the carcase temperature to normal refrigeration temperatures. This may enhance the rate of  post-mortem proteolysis.

hot processing (pre-rigor processing)  is the term given to the processes of  boning  of a  carcase  and the manufacture of meat products immediately following  slaughter,  before the carcase has had time to cool and the meat to set (rigor mortis). There are several economic advantages of hot processing prior to carcase  chilling; increased economic efficiency, reduced chiller requirements and energy costs of chilling, superior  water holding capacity  and processing properties, as compared to conventionally chilled post-rigor meat. To exploit these benefits processing must be conducted immediately after slaughter, particularly when  post-mortem glycolysis  is fast (especially important in  pig  muscles). There can however be disadvantages in meat  tenderness  with this type of processing (see cold shortening).

hot shortening (rigor shortening)  is the contraction (shortening) of  muscles  seen when muscle goes into  rigor mortis  at temperatures above 20 °C. There is little remaining energy in the muscle at this stage to fuel the contraction and therefore it is generally weak. Muscle will attempt to shorten if it goes into rigor below about 10 °C (cold shortening) or above 20 °C (hot shortening) possibly giving rise to decreased  sarcomere lengths. Shortening is likely to be greater if the muscle is not under the normal restraint of attachment to the skeleton or the position of the muscle in relation to the skeleton is abnormal (see aitch-bone hanging). Hot shortening generally produces low to moderate shortening and reductions in meat  tenderness,  in comparison to cold shortening. The toughening effect of this shortening may be counteracted by enhanced  post-mortem proteolysis  at these temperatures.

hot weight  see  carcase weight.

hyperspectral imaging  collects and processes information from across a portion of the electromagnetic spectrum. In comparison to the human eye which sees visible light in three bands (red, green and blue), spectral imaging divides the spectrum into many more bands and across a wider range of wavelengths. It has the potential to provide a useful technique in assessing  meat.
composition, particularly differentiating intramuscular fat (marbling fat) from lean meat, which in turn can help in the assessment of eating quality.

**IMF** see intramuscular fat.

**in vitro** literally "in glass" such as a test tube, used to indicate an observation of a biological process made to occur experimentally outside the body of an animal as distinct from **in vivo**.

**in vivo** literally “in a living thing”, used to indicate an observation of or experiment on a biological process occurring in a living animal. Observations made on intact tissue, such as muscle, of a carcase prior to rigor mortis fall into a grey area. At this stage the animal is dead but in biochemical terms its tissue is alive.

**in-calf** used to describe a cow or heifer when pregnant.

**in-lamb** used to describe a pregnant ewe.

**in-pig** used to describe a pregnant sow.

**indoles** are breakdown products of the amino acid tryptophan, which are implicated in the generation of boar taint in pig meat. The major indole thought to be involved in boar taint is skatole. This compound is deposited at relatively high rates in the tissue of entire male pigs compared to either castrates or females.

**infusion** is the introduction of a solution to the carcase, generally via the vascular system immediately post exsanguination. Infusion of carcases with agents such as calcium chloride has been shown to accelerate the ageing process, resulting in enhanced tenderness of the meat. Several workers have shown that the post mortem infusion of carcases with calcium chloride can drastically speed up the ageing process of red meats, particularly lamb. The use of calcium chloride can give rise to undesirable flavours.

**inspection** see meat inspection.

**intermuscular fat** is the fatty tissue formed by depots of fat cells (adipocytes) situated between the muscles.

**interstitial fat** is the fatty tissue situated in the spaces between tissue.

**intrafibre fat** is the lipid that is deposited within the muscle fibres. This intracellular lipid is predominantly deposited as lipid globules in slow-contracting oxidative muscle fibres where it may well act as an energy supply.

**intramuscular fat (IMF)** is the fat found within the muscles. It comprises intrafibre fat and depots of fat cells between the muscle fibre cells and bundles of muscle fibre cells. The intrafibre fat is lipid within the muscle fibres whereas the collections of fat cells constitute small depostions of adipose tissue. These visible depots within the muscle are known as marbling fat. The amount of IMF depends upon a range of factors including genotype, sex and feeding regime. A positive, but low, correlation exists between IMF and subcutaneous fat (backfat thickness) amount, which tends to be strongly genotype dependant. IMF can be assessed subjectively by visual scoring of the amount of fatness within the lean (see subjective scoring), this “marbling score” tends to correlate reasonably well with alternative chemical methods. Two main chemical methods are used to quantify lipid in lean tissue. Triglycerides can be extracted with a solvent such as diethyl ether. If analysis of total lipid is required, i.e. including phospholipids in cell membranes, a more polar solvent such as chloroform:methanol (2:1) or ether can be used following acid hydrolysis. This latter method gives values some 20-30% greater than diethyl ether extraction, heavily depending on the fat content of the sample. The importance of intramuscular lipids with regard to the sensory properties of meat is a matter of much debate. There is a generally held view that higher levels of IMF are beneficial for eating quality but the scientific evidence to support this view is not strong.
intrascopc (optical probe) an insertion probe for use in the classification of carcases which, by use of a window and mirror, enables the operator to see the interface between fat and lean tissue and thus measure fat depths. Generally only used in the classification of pigs.

inverted dressing refers to a carcase dressing system used for sheep during which the animal is suspended from the fore legs, the hind legs or all four legs to suit each operation on the dressing line and ensure hygienic practise.

ischium one of the three bones making up each side of the pelvic girdle. The ischium forms much of the floor of the pelvis. Ischium suspension of the carcase involves use of a long hook to fit snugly under the tuber ischii (pin bone) which is a large roughened prominence of the ischium bone. This type of carcase suspension can be used in place of aitch bone hanging to avoid the problems that can occur with the latter if carcase splitting damages the aitch bone.

Japanese colour score a physical standard scale of six textured and coloured plastic blocks designed to appear like pork used to score the colour of pork. The scale is used to provide a standard against which the cut surface of muscles in pork can be subjectively scored for colour on a scale of 1 (extremely pale) to 6 (extremely dark). Similar score scales are also available for beef colour (1-7) and fat colour (1-7).

Jewish slaughter a method of religious slaughter in which animals are slaughtered while still conscious, termed Shechita slaughter. This method has much in common with Halal slaughter. Slaughter is achieved by drawing a very sharp knife across the throat, thus cutting both carotid arteries and both jugular veins with one stroke. This slaughter may only be carried out by an approved slaughter-man of the Jewish faith (usually a Rabbi). Only cattle, sheep, goats, deer (see venison) and poultry are allowed to be killed for Jewish consumption.

jointing (cutting) the process of sectioning the carcase. Following splitting the carcase into sides, it is then cut into primal joints which is then followed by the process of cutting into retail cuts.

juiciness the sensory attribute of foods related to the perception of moisture in the mouth, is one of the major eating quality attributes of meat, but remains a poorly understood aspect of meat eating quality. Juiciness has two organoleptic components in meat. The first is produced by the release of water from the meat during the beginning of chewing, and the second is more sustained and due to the stimulatory effect of the meat on salivation. Juiciness can be influenced by flavour. Some flavour components of meat can cause the rapid release of saliva, thus giving an impression of juiciness. Juiciness also plays a key role in the perception of meat texture, contributing between 10% and 40% to its variability. Cooking procedures have a dramatic effect on the juiciness of meat. In general, those cooking procedures that result in the greatest retention of fluids (see water content) will yield the juiciest meat. For this reason, juiciness varies inversely with cooking losses and drip loss, i.e. as cooking and drip losses increase, juiciness of the meat decreases. Factors predisposing carcases to excessive fluid loss, particularly abnormal ultimate pH, and hence affecting the amount of moisture present in the meat (see PSE, DFD), will reduce the juiciness of the product. There is some debate as to whether the amount of fat present in meat influences juiciness, with some workers demonstrating an improvement in juiciness with increasing fat content, and others showing no such relationship. An indirect role of fatness level on juiciness is however clear. Fat may stimulate saliva flow, thus increasing the perception of juiciness of the product. Fat cover around the lean (subcutaneous fat) also protects the meat from excessive moisture loss during cooking, hence preventing loss of juiciness. Juiciness of meat is a subjective property with no objective equivalent measurement and therefore the only reliable and consistent measure of juiciness is achieved by sensory evaluation.

kidney the kidneys are organs that filter blood plasma, re-absorbing water and useful constituents and ultimately excreting waste products and excess constituents. The kidneys are retroperitoneal, that is to say, outside of the peritoneal cavity but are closely attached to the abdominal wall.

killing out percentage (KO%) the dressed weight of a carcase as a proportion of the liveweight of the animal prior to slaughter. Typically killing out percentages vary between 45 and 55% for ruminant species such as cattle and sheep. The KO% of pigs is higher (around 75%) due to the relatively lower weight of the viscera and their carcases including the skin and normally the head and feet. Killing out percentage will vary within a species, due to factors such as amount of gut fill at
slaghter determined by the timing of the last feed and water consumption prior to slaughter, the degree of fatness and the age of the animal (the ratio of gut to other body parts is greater in young animals). Care should be taken to check the methods used to calculate KO% when making comparisons of this trait between different data sets, as the timing and accuracy of the final liveweight and the definition of carcase weight may vary greatly between each experiment thus affecting the resultant KO% quoted. An alternative term for killing out percentage is carcase yield (not to be confused with saleable meat yield) or dressing proportion.

KKCF (kidney knob and channel fat) the retroperitoneal and perinephric (or perirenal) fat of ruminants. Known as the flare fat in pigs this layer of fat surrounds the kidneys.

knacker’s yard place of slaughter of animals unfit for human consumption. The carcases from such premises may be purchased by the pet food industry or may go to rendering.

L* See CIELAB.

lactic acid (lactate) is the acid product of glycogen breakdown (glycolysis). The rate of production of lactic acid will determine the speed at which pH falls in the carcase following slaughter (post-mortem acidification) and hence strongly influence the likelihood of PSE. The amount of lactic acid formation determines the ultimate pH and hence likelihood of DFD.

lairage area of an abattoir where animals are held (rested) before slaughter. Once at the abattoir, animals should be unloaded as soon as possible, ensuring careful, calm and quiet handling is carried out. A holding period may allow the animal to recover from the experiences of transportation and unloading, and thus adrenaline concentrations in the bloodstream fall. An adequate lairage period will therefore help to ensure that following slaughter, the carcase pH falls normally reducing the risk of meat quality problems such as PSE and DFD. The design and management of a lairage is extremely important to the ease of movement of animals within it and thus the standard of animal welfare. The timing of the last feed before slaughter (i.e. the period the animal is fasted), can considerably influence the incidence of meat quality problems. This period will depend upon the feeding regime employed on the farm, and particularly on the length of time the animal is in transport and lairage before slaughter. A long period between last feed and slaughter can lead to glycerogen (energy store) levels in the muscle being lower than would be optimum to ensure the normal extent of post-mortem acidification, thus predisposing the animals to develop DFD meat. Long term fasting before slaughter can also lead to a loss of carcase yield (see killing out percentage) and reduction in muscle mass, particularly if dehydration occurs. On the other hand, increasing the fasting time before slaughter can have beneficial effects of a lower mortality rate in transport (particularly in pigs), improvements in meat colour and water-holding capacity, lower carcase weight losses during chilling and cutting, and reduced risk of bacterial contamination from gut contents at evisceration. Water must be available to animals in lairage

lamb (i) meat from young ovine animals. Note that the term “lamb” as part of the customary name of certain traditional meat products may refer to lamb, or to mutton, or to a mixture of these. (ii) in the UK carcase classification scheme, carcases of ovine animals are classified as lambs (those born and marketed within a year beginning the 1 January or born after the beginning of October in the year prior to marketing), old season lamb (other clean sheep with no permanent incisor teeth erupted) or mature sheep (clean sheep with one or more permanent incisor teeth erupted).

lean (lean tissue/lean meat) the skeletal muscle of the carcase, with all visible subcutaneous and intermuscular fatty tissue removed. When lean meat is separated from fat and other tissues with a butchers knife then some traces of fat may remain with the muscle. This type of lean meat can be referred to as knife separable lean.

lean meat percentage the percentage of the carcase that is lean meat. This is estimated in pig carcase classification by use of an optical probe or automatic recording probe.

linoleic acid a major polyunsaturated fatty acid of meat with 18 Carbon atoms and two double bonds (C18:2). It is an essential nutrient in the diet of humans. A high concentration of linoleic acid in the fat of carcases tends to predispose the carcase to poor firmness with a greater tendency to rancidity (see fat quality).
lipid  a general term referring to a group of substances comprising of fats and fat derived materials that are insoluble in water but soluble in solvents such as alcohol ether. Simple lipids are the triglycerides (esters of triacylglycerol and one or more fatty acids) which are important energy stores and body insulators. Compound lipids are important structural components of cell membranes and include phospholipids. Most body lipid is deposited in fats within subcutaneous adipose tissue, and in fat depots around the organs. Lipids are also found in depots of fat cells (adipocytes) situated between the muscles (intramuscular fat) and in fat cells and fat droplets within the muscles (intramuscular fat). Lipid is also deposited within the muscle fibres (intrafibre fat). The generation of rancid off-flavours in meat by lipid oxidation is well known, although the role of lipid in the formation of desirable flavour is rather more contentious. Contrasting results have been found in those studies attempting to evaluate meat flavour in carcases differing in lipid concentration (both subcutaneous fat and intramuscular fat). The fat quality rather than the quantity does appear to have some role in determining eating quality as well as influencing the appearance and firmness of the carcase.

lipid oxidation  see oxidation and muscle colour.

Listeria  
(Listeria monocytogenes)  a species of bacteria, acknowledged as a food-borne pathogen (thus disease causing). If found in meat it is of particular concern since it is capable of growing at refrigerated temperatures and is relatively resistant to heat and curing salts. See microbiology, contamination.

liver  a large dark red organ located in the abdomen. Its functions in the live animal include the filtration of blood and conversion of sugars into glycogen. This organ is classed as viscera, but is used for human consumption. The liver is important in carcase inspections carried out at the abattoir, as a good indicator of animal health problems.

liveweight  a live animal’s weight. Animals fasted prior to slaughter will have a lower liveweight at slaughter, due to a loss of gut fill, and a higher killing out percentage. The rate at which an animal grows is termed liveweight gain and is usually expressed in g/day. See dead weight, carcase weight.

loin  the primal cut from a carcase of which the main muscle is the Longissimus thoracis et lumborum running along the back of the animal.

Longissimus dorsi (LD)  outdated but still commonly used term for the Longissimus thoracis et lumborum.

Longissimus thoracis et lumborum (LTL)  the major muscle running the length of the loin and therefore the major muscle in loin chops and sirloin steaks. Commonly termed the eye muscle. This is the predominant muscle used as an indicator muscle for evaluating carcase quality. This name for a single muscle (previously called the Longissimus dorsi) enables researchers to distinguish that portion of the muscle posterior to the ribs of the animal (in the lumbar region, Longissimus lumborum), from that in the thorax (anterior to the last rib, Longissimus thoracis).

lymphatic system  a vascular network of thin walled capillaries and larger vessels that drain fluid (lymph) from tissue spaces into the venous system. Along the vessels are accumulations of tissues called lymph nodes. It is used in the meat inspection process as an indicator of health issues.

Maillard reaction  is a complex chemical reaction between amino acids and reducing sugars (carbohydrates) in the meat, which yields brown coloured products and volatile (easily evaporated) aroma compounds on cooking. This reaction is also known as the non-enzymatic browning reaction and is fundamental to the development of the characteristic flavours and odours of cooked meat.

marbling (fat)  see intramuscular fat.

maturation  see ageing.

maws  refers to the stomach of the pig, from which a casing can be prepared.
meat generally refers to the flesh of mammals used as food by humans. Legal definitions of which tissues constitute meat do exist but the definitions vary according to the legal context and also whether or not the tissue is to be sold as raw meat or included in a cooked meat product.

meat and bonemeal the final high protein meal resulting from rendering after the extraction of tallow. See greaves.

meat inspection the process of examining carcases post-mortem for evidence of disease or damage making the meat unfit for human consumption (see condemnation). Meat Inspection in the UK is a service under veterinary control operated by the Food Standards Agency and paid for by the individual abattoir.

meat quality although there is no generally accepted single definition of the term “meat quality”, it is common to include at least hygienic (see microbiology, contamination), nutritional (see nutritional composition, proteins, fat), technological (suitability for processing, ease of handling, see water holding capacity) and sensory (see appearance, muscle colour, fat quality, eating quality) qualities of meat within this term. Some definitions of meat quality also include aspects of the perceived animal welfare of the system of production and even the environmental impact of that system. The term meat quality has different meanings to different people and for different purposes. Good meat quality has been defined as that which the public likes best and for which consumers are prepared to pay more than average prices.

mesenteric fat the layer of fat covering the mesentery (the folds of the peritoneum that attach the small intestine in place).

microbiology is the study of micro-organisms, including bacteria, fungi and viruses. Fresh meat is a good medium for microbial, particularly bacterial, growth and is subject to rapid spoilage unless precautions are taken to retard microbial growth and activity. Organisms found on or in meat come from many sources. These include transfer to the carcase from the hide (see de-hiding) and viscera, from air and water, from workers and processing equipment and even from consumers and kitchen equipment. The meat of the carcase is relatively free from micro-organisms at slaughter and it is subsequently that contamination occurs. Handling of the carcase and procedures such as de-hiding, evisceration, jointing and de-boning should always be carried out in a way which minimises contamination with, and growth of, undesirable organisms. The rate at which rigor takes place and the ultimate pH attained can influence the growth of micro-organisms on a carcase. DFD carcases, because of an elevated ultimate pH are more prone to microbial infection than normal muscle. The temperature and relative humidity at which meat is stored are also important. Low temperature, near or below the freezing point, and low humidity, are generally beneficial in that they retard bacterial growth. The types of spoilage caused by micro-organisms depends upon the availability of oxygen. Some species of micro-organisms require oxygen to survive and develop (aerobic) while others do not (anaerobic). Thus even with vacuum packaging and modified atmospheric packaging of meat, microbial growth can still occur. Severe growth of micro-organisms can lead to the development of off odours and slime formation. The curing of meat is a successful method to inhibit microbial growth. Contamination of meat with pathogenic micro-organisms can lead to infection or poisoning and can have legal consequences. See E. coli, Listeria.

middles (i) refers to the large intestine. The middles of pigs can be used to prepare casings. See chitterlings.
(ii) the loin and belly from bacon weight (see baconer) pigs used for curing.

mitochondria are microscopic components of muscle cells, found in the sarcoplasm, that are the principal sites of ATP synthesis. Mitochondria are found within the muscle cell, close to alignment with the myofibrils within a muscle fibre. Mitochondria are involved in a great number of biochemical reactions. These contain DNA, RNA, and a number of extremely important enzymes. Slow-twitch oxidative muscle fibre types contain more mitochondria than fast-twitch glycolytic fibres.

MLC Blueprints see blueprints.
MLCWL (Meat and Livestock Commercial Services Ltd) formed in April 2006, providing a commercial service to the livestock industry. Originally part of the former Meat and Livestock Commission (MLC). MLCWL provides services, equipment and advice on a national basis throughout GB contributing to the industries efficiency and profitability. MLCWL is split into four main departments: Authentication Services, MLCWL Consulting, MLCWL Equipment and MLCWL Auditing. The authentication department is the only national provider of classification services in GB, providing independent carcass classification of cattle, sheep and pigs.

Modified atmosphere packaging (MAP) is the process by which meat is packed in a mixture of gasses designed to extend the shelf life of meat by minimising microbial growth (see microbiology). It is sometimes confused with controlled atmospheric packaging (CAP) in which some active means of controlling the gas mixture is also employed. Normal aerobic microbial spoilage is inhibited and in some gas mixtures the oxidation of red oxymyoglobin to brown metmyoglobin is reduced (see muscle colour). This results in colour stability over longer periods than possible with conventional packaging methods. Modified atmospheric packaging involves the injection of a gas mixture into a gas-impermeable package. Although several different gas combinations have been tested, (including carbon dioxide, oxygen and nitrogen), pure carbon dioxide, or combinations of carbon dioxide with oxygen and/or nitrogen appear to be the most useful for retail packs of meat. The use of modified atmospheres must be indicated on the labels of foods intended for sale to consumers.

Monogastric an organism with a single chambered stomach. Pigs are monogastrics whereas cattle and sheep are ruminants.

Moisture see water content.

Muscle a tissue composed of bundles of elongated cells (muscle fibres) embedded in connective tissue and capable of contraction and relaxation. Generally attached to the skeleton, muscles use bones and joint as levers to bring about locomotion. There are more than 500 muscles in a beef animal. The economic production of protein rich muscle (lean) tissue is the major objective of meat production. There are a large number of complex changes that are involved during the conversion from muscle to meat. The muscle cell basically refers to the muscle fibre and its various constituents. The muscle fibre type within a muscle will vary depending on its purpose. This will determine the muscle cell’s contents (i.e. myoglobin, enzymes, glycogen). See sarcomere, muscle colour, mitochondria, muscularity, myofibril, haem.

Muscle cell at the cellular level the contractile unit of skeletal muscle. Also known as the muscle fibre. Approximately 80% of the muscle mass is comprised of muscle cells. The number of muscle cells in large meat animal species is thought to be in the range of hundreds of millions. Other cell types found within the muscle include nerve and fat cells, and those involved with the synthesis of collagen. See sarcomere, myofibril.

Muscle (meat) colour in red meats a bright red colour is perceived by consumers as being indicative of freshness, whilst meat that has turned brown in colour is discriminated against. Hence, meat colour is a major influence on the visual appeal of meat. The principal pigments in muscle tissue are the oxygen carrying proteins: myoglobin which is located within the muscle cell and, to a much smaller extent, haemoglobin, the pigment of red blood cells which is primarily associated with the muscle vasculature. These two pigments are collectively referred to as haem pigments. Other pigments are also found in muscle but are present in such small amounts that their contribution to meat colour is minor. The colour of meat is primarily dependant on the concentration and chemical state of these major meat pigments and on the physical characteristics of the meat, such as its light scattering and absorption properties. When an animal is bled (see exsanguination), the blood and associated haemoglobin are drained from the body, thus leaving myoglobin as the primary pigment responsible for meat colour. When meat is exposed to the oxygen in air, the purple-red myoglobin absorbs oxygen and is converted to bright red oxymyoglobin. After prolonged exposure, oxymyoglobin is chemically oxidised (see oxidation) to brown metmyoglobin, this process is often termed “browning”. Metmyoglobin is the major pigment noticed on discoloured meat and results from the oxidation of the iron within the myoglobin. The degree of muscle oxidation, muscle pH (see post mortem acidification) and temperature, will influence the development of micro-organisms which can have a major influence on muscle colour (see contamination, microbiology, vacuum packaging). The function within the live animal will determine the fibre type composition of the muscle and is the most obvious factor accounting for the normal colour differentiation between muscles. Another factor involved in muscle colour
determination is the amount of lipid that is deposited within and around muscle fibres. Muscle colour can be assessed by both subjective (see subjective scoring and Japanese colour scale) and objective methods. Objective evaluations of muscle colour are based on measuring reflectance properties of the muscle surface (see EEL reflectance) or upon colour matching functions (see CIELAB).

**muscle condition score** is a method of subjective scoring, used to assess the appearance (colour, wetness, texture) of a muscle (usually the Longissimus dorsi). Muscle condition score is most often used to evaluate pig muscle for incidence of PSE or DFD.

**muscle depth** see eye muscle.

**muscle fibres** skeletal muscle fibres (muscle cells) range in length from a few millimetres to many centimetres and are densely packed with myofibrils. They also vary in colour from white to deep red. Skeletal muscle consists of a mixture of fibre types. These are split into two main categories depending upon their contractile and metabolic properties (see myofibril). Various different schemes for classifying muscle cells have been devised but one of the more popular is: Type I (slow-twitch-oxidative, SO), Type IIA (fast-twitch-oxidative-glycolytic, FOG) and Type IIB (fast-twitch-glycolytic, FG). Types I and IIA have a higher oxidative capacity than type IIB. Each muscle fibre is surrounded by a thin membrane called the sarcolemma. The fluid within the muscle fibre and surrounding the myofibrils is called sarcoplasm. The sarcoplasm contains a network of internal membranes termed the sarcoplasmic reticulum. Between, and in alignment with, the myofibrils within a muscle fibre are the mitochondria. Fibre type can vary within a muscle, and some muscles have major regions of predominantly type I (red) and/or predominantly type II (white) muscle fibres. This variation in fibre type between muscle and within a muscle leads to considerable variations on how the muscle reacts following slaughter. This can subsequently affect the quality of the meat in the carcase. See myofibril, muscle colour.

**muscle structure** see structure.

**muscle temperature** see temperature.

**muscularity** is the major determinant of conformation and refers to the amount of muscle relative to animal/skeletal size, particularly referring to muscles of a high value. Muscularity will vary within a species depending upon sex (males have superior levels), genotype and feeding regime. A genetic condition seen in cattle is that of double muscling which results in an increased muscularity, particularly of the upper hind limb. Pig genotypes noted for superior muscularity, are often prone to the porcine stress syndrome and there was a historical problem of these carrying the halothane gene.

**mutton** meat from the carcase of an older sheep, especially that from a mature sheep.

**myofibril (myofibrillar proteins)** The contractile elements of muscle fibres. Myofibrils occupy approximately 83% of the volume of muscle fibres in living muscle and are composed of contractile proteins. These myofibrillar proteins undergo slight degradative changes during ageing of meat (predominantly due to post-mortem proteolysis) and when exposed to heat during the cooking process (see cooking procedures), which influence meat tenderness and the water holding capacity of the meat. The myofibrillar structure is responsible for the contraction of muscle in the live animal and in the muscle up to the point of rigor mortis (see cold shortening).

**myofibrillar fragmentation index (MFI)** a laboratory test used as an indicator of the extent of post mortem proteolysis of myofibrillar proteins. In experiments evaluating MFI and tenderness, a reasonably significant positive relationship has been shown, demonstrating that MFI values tend to increase with improving tenderness of meat.

**myoglobin (Mb)** a principal haem containing pigment in muscle tissue responsible for oxygen transport into the muscle and associated with muscle colour.

**myosin** see contractile proteins
near infrared reflectance spectroscopy (NIRRS) is the measurement of the wavelength and intensity of the reflectance of near-infrared light by a sample. Near-infrared light spans the 800 nm - 2.5 µm (12,500 - 4000 cm-1) range. NIR spectroscopy is typically used for quantitative measurement of organic functional groups. It is a rapid, non-destructive method of analysis. The technique can be applied to evaluate component analysis, sensory quality as well as enable product discrimination.

nitrate see curing.

nitrite see curing.

nitrosohaemochrome see curing.

nitrosomyoglobin see curing.

non-enzymatic browning reaction see Maillard reaction.

nutritional composition the proportions of the various macro-nutrients (fat, proteins, water, carbohydrate) and micro-nutrients (vitamins and minerals) of a food. Meat is a highly nutritious source of proteins and essential amino acids, fats and essential fatty acids, energy, vitamins (vitamin A and vitamin B12) and minerals (Iron and Zinc). The nutritional value of meat can, however, be affected by the method of cooking (see cooking procedure).

odour see aroma.

offal edible or inedible soft tissues (i.e. excluding bone) of a carcase removed during the dressing of the carcase of an animal killed for food. There are two main classes of offal. Green offal refers to the digestive tract and associated organs. Red offal refers to the more commonly consumed offal from the carcase such as the liver, kidney and heart. See variety meat.

omental fat (caul fat) fat associated with the omentum, an anatomical structure composed of two layers of peritoneum located between the liver, stomach (rumen in ruminants) and other intestinal organs such as the duodenum.

omega 3 (Ω3) fatty acids are unsaturated fatty acids with a double bond 3 carbon atoms from the terminal methyl group of the molecule. Also called n-3 fatty acids, these are thought to be associated with certain health advantages relative to the omega 6 fatty acids.

omega 6 (Ω6) fatty acids are unsaturated fatty acids with a double bond 6 carbon atoms from the terminal methyl group of the molecule. Also called n-6 fatty acids. It is thought that the current diet contains too high a proportion of these relative to the omega 3 fatty acids.

optical probe see intrascope.

organic meat describes meat produced to a specification under legislative requirements which excludes feed additives (e.g. growth promoters) and most drugs (e.g. antibiotics) and requires the feed for such animals to be produced without inorganic fertilisers and agrochemicals. Production of “organic” meat is expensive and therefore is marketed at a higher price than conventional meat. Because of the higher price of such products, the market is relatively limited. From July 2010, the EU organic logo (a green logo featuring the 12 EU stars set out in the shape of a leaf) is required to appear on all pre-packaged organic food produced in any of the EU-27 countries. Any national or organic certifications scheme logos can appear alongside the EU logo.

organoleptic a term for a factor which affects the bodily organs of sense. This term is particularly used to describe the senses of texture (sense of “feel” in the mouth), taste (as perceived in the mouth) and aroma (as perceived by the nose). The major eating quality characteristics of meat, tenderness, juiciness, flavour and aroma, are organoleptic properties. Organoleptic characteristics can be subjectively evaluated using sensory evaluation (see subjective scoring). To date few reliable objective methods of evaluating organoleptic characteristics are available (for an exception see shear force).
outdoor bred are animals born outside in fields where they are kept until weaning. This can refer to cattle, sheep or pig systems. In the case of pigs, breeding sows are kept outside in fields for their productive lives, although where soil types and climate are a constraint, producers can apply for a derogation to keep gestating sows inside, in groups on deep straw bedding for a maximum of seven weeks at the start of each production cycle. The pigs are provided with food, water and shelter with generous minimum space allowances. Pork and pork products labeled as Outdoor Bred will also contain a statement about how the pigs are subsequently farmed.

outdoor pigs the UK pig industry has witnessed an increased number of breeding sows being kept in outdoor systems. Although these animals farrow outdoors in arcs (mobile shelters), the vast majority of the piglets produced are reared and finished in conventional indoor systems. This system of keeping sows is perceived to be a higher animal welfare system than conventional methods of keeping sows indoors. This system of producing piglets is often referred to as a “free-range” system and complies with the requirements to qualify for the freedom food label.

outdoor reared animals that are born outside and reared for a certain period of their life. Predominantly used in pork labelling where it refers to that are born outside in fields and reared for approximately half their life (defined as at least 30kg).

overall acceptability is the subjective score given by sensory panellists (see sensory evaluation) or consumers to describe how much they like a sample. It is often included as a final parameter for panel members when judging the eating quality of meat. Tenderness is the eating quality attribute that tends to correlate most highly with overall acceptability. A difference in the assessment of overall acceptability between two groups of samples, by a trained sensory panel should not be taken as an indication that consumers will identify the same difference as often consumers are unable to detect small differences.

ovine the Latin term pertaining to, characteristic of sheep.

ox (plural, oxen) any bovine animal, although the term is most generally used when referring to mature steers used for draught purposes.

oxidation in simplest terms is the combination of oxygen with another molecule. The rate of discoloration of meat is related to the oxidative processes (see muscle colour). Oxidation can be reduced by the inclusion of fat soluble vitamin E into animal diets, which acts as a free radical scavenger reducing the peroxidation of phospholipid membranes and metmyoglobin formation, and hence avoiding discoloration of the meat over time. Such vitamins are referred to as antioxidants. Lipids can break down via oxidative reactions of the fatty acids resulting in the production of compounds that contribute to both undesirable and desirable flavours. In meat that is stored after cooking, lipid oxidation is very rapid and is accompanied by a deterioration in flavour and increase in abnormal odours (see warmed-over flavour). One of the factors that can affect the rate of oxidation is the degree of un-saturation of the fatty acids in the meat. Polyunsaturated fatty acids e.g. linoleic acid, are much more susceptible to oxidation than monounsaturated or saturated fatty acids. See TBARS. It has also been shown that high oxygen packaging can result in protein oxidation. This results in cross linking of protein in meat and increased toughness on prolonged storage.

oxygenation the saturation of a substance with oxygen. For example, the oxygenation of purple-red myoglobin forms bright pink oxymyoglobin (see muscle colour).

P2 (P1+P3) the probe positions, level with the head of the last rib, on a pig carcase from which backfat thickness is evaluated in GB pig carcase classification.

paleness see muscle colour, PSE.

papain a proteolytic enzyme obtained from the papaya plant used to improve the tenderness of meat. Papain is the active ingredient in most meat tenderisers (see tenderisation). The activity of papain increases at 55-70°C and therefore continues to tenderise the meat during cooking. A characteristic of papain is its ability to degrade the major contractile proteins myosin, which is not normally noted to degrade during conventional meat ageing. The amount of tenderisation
depends on the concentration of papain, the muscle and the temperature, with maximum tenderisation occurring at 70°C.

pathogen is a micro-organism that causes disease in its host (see microbiology).

paunch the rumen or first stomach of the ruminant species. The term is used in America to refer to the contents of the rumen or stomach rather than the organ itself.

pelt the skin of sheep as removed at the abattoir which will include a wool covering. The amount of wool present on the skin will depend on the time of year the animal is slaughtered and whether shearing had taken place prior to slaughter. The amount of wool on a pelt will affect its value. See pelting.

pelting the process of removing the skin (pelt) of sheep as carried out following slaughter in an abattoir. The process of pelting requires care if bacterial contamination of the carcase by the pelt is to be avoided.

pelvic suspension see aitch-bone hanging.

penetrometer an instrument used to objectively evaluate fat firmness by the use of a spring mounted probe. This measurement is normally taken above the eye muscle and thus assess the firmness of the inner layer of backfat. The higher the score, the harder the fat.

perirenal/perinephric fat the fat around the kidneys. Together with the other retroperitoneal fat, is known as the flare fat in pigs and the kidney knob and channel fat in ruminants.

peritoneum the membrane lining the abdominal cavity and forming a covering for the organs contained in it.

petechial haemorrhage see blood splash.

pH is a value used to represent acidity or alkalinity of the muscle. It is mathematically related to the concentration of hydrogen ions in a solution such that pure water gives a pH value of 7, termed neutral. pH is recorded on a scale of 0 to 14, with values less than 7 referred to as acidic, and greater than 7 as alkaline. The pH of muscle in the live animal is approximately 7.3. Muscle pH declines (becomes more acidic) rapidly following slaughter, as a result of the accumulation of lactic acid (see glycolysis). The rate and extent to which this fall in pH takes place post-mortem in relation to the changes in muscle temperature, is influential in affecting a great many of the changes that occur in the conversion of muscle to meat (see post-mortem acidification). When relating pH to post-mortem changes in the carcase it is normal to consider and measure pH either prior to rigor (at about 45 minutes post slaughter in non-electrically stimulated carcases, pH45) or post rigor (ultimate pH, pHu). It is the relationship between pH and temperature that gives rise to hot shortening or cold shortening. Muscle colour is strongly related to pH. It is generally accepted that a higher ultimate pH is associated with increased tenderness, however the relationship has been shown to be curvilinear in the case of shear force. The influence of pH on meat tenderness has been shown to be related to the effect pH has on the water holding capacity of meat, and that a higher water-holding capacity results in an increased tenderness. It is perhaps not surprising therefore that a higher ultimate pH also tends to be associated with an increase in juiciness. The pH of the muscle after slaughter has also been shown to affect the subsequent flavour of meat. Much of the published work on relationships between pH and physical aspects of meat quality (particularly in pigs) is marred by the failure to separate genetic causes of low pH (porcine stress syndrome) from environmental causes (transport, pre-slaughter handling, slaughter and ante-mortem factors). This factor could help to explain the confused findings between experiments attempting to evaluate differences in eating quality between normal and PSE pork. The pH of a muscle may be measured in a number of ways, ranging from a strip of special indicator paper applied to the cut surface of the muscle, the colour change of which indicating the pH of the muscle, to sophisticated glass electrodes which when suitably calibrated, by insertion into homogenates of muscle samples or directly into the muscle, will rapidly and accurately measure pH. This latter method can be used on the slaughterline.
**pH₄₅** (also referred to as pH₁) the measurement of acidity or alkalinity of the muscle taken at 45 minutes (or one hour) after slaughter. This measurement gives an indication of the rate at which post-mortem acidification is taking place, which along with the extent of acidification (pHu) and the temperature of the muscle when these events occur, can have a strong influence on the major meat quality attributes. A pH₄₅ reading of less than 6.0 is particularly indicative of a pig carcase likely to exhibit the PSE condition. At 45 minutes post-mortem, the pH of the muscle is taken prior to the attainment of rigor mortis and before post-mortem acidification is completed.

**pHₜ (ultimate pH)** the measurement of acidity or alkalinity of the muscle taken after the completion of post-mortem acidification and rigor mortis. This measurement of pH is normally taken at 24 or 48 hours after slaughter (alternatively denoted pH₂₄ and pH₄₈) and gives an indication of the extent of acidification of the muscle, which can influence the major meat quality attributes. Ultimate pH can particularly identify DFD carcases which are normally classed as those carcases with a pHₜ of above 5.8 (or, some would argue, 6.0).

**pH/temperature window** a phrase used to describe the relationship between temperature and pH that occurs during post-mortem acidification. If the decline in pH and temperature does not pass through the ideal window, eating quality (tenderness) will be negatively affected (see cold shortening and hot shortening). Ideally lamb carcases should reach a pH of 6.0 between 18-35°C, with beef carcases reaching a pH of 6.0 between 15-35°C.

**phospholipases** are enzymes that break down phospholipid within cell membranes. There are several types of phospholipases (A₁, A₂, B, C and D) which each have particular actions on phospholipids. Enhanced phospholipase A₂ activities, resulting in increased levels of saturated fatty acids within the muscle sarcoplasm, have been observed in halothane sensitive pigs, thus implicating this enzyme with the PSE condition. Phospholipase A₂ is also suggested to be involved in the determination of meat flavours.

**phospholipid** a group of lipid compounds containing phosphorus. They are the major structural component of cell membranes. Most phospholipid is found in the membranes of muscle and fat cells. The total content of phospholipid in the body varies little. The phospholipids are less saturated than the triglycerides, therefore meat with a low total lipid content has a lesser amount of saturated fatty acids than meat with medium or high levels of lipid. The oxidation of phospholipids is thought to contribute to flavour formation with slight oxidation being desirable but excessive oxidation being partly responsible for the development of warmed-over flavour.

**piece curing** curing of cuts (rather than whole sides) of pig carcases.

**Pietrain** is a breed of pig extensively used in Belgium and Germany. This breed is very heavily muscled with excellent conformation and muscularity. Its major disadvantage however, is its susceptibility to the porcine stress syndrome, as identified from an extremely high frequency of halothane reactors in the breed (see halothane gene). The muscles in the carcases of this breed therefore have a high tendency to show PSE. Higher levels of boar taint have also been noted in the Pietrain, compared to the predominantly used Large White breeds of the UK. Due to these disadvantages, this breed is not popular in the UK.

**pig** an animal of the porcine genus of which there are several species. It is a simple stomached non-ruminant, often referred to as a monogastric (see ruminant). An entire male pig is called a boar and female pigs are termed sows or gilts, castrated male pigs are referred to as castrates, barrows or hogs. Modern pig breeds descend from the wild boar. The main breeds used in the UK are the Large White, Landrace and hybrids based predominantly on these two breeds. The incorporation of the Duroc breed into UK pig breeding programmes has also occurred. Pigs are also referred to as swine.

**pig carcase classification** the placing of pig carcases into classes based on carcase measurements. Since 1988 classification in the EU has been based on placing carcases into lean meat percentage groups. MLCSL has been classifying pigs in the UK since 1971. Methods of pig carcase classification used in the UK are based on estimating carcase lean meat percentage from the carcase weight, muscle depth and backfat thickness. These methods involve taking carcase measurements with EU-approved measuring equipment: the Optical Probe or an approved automatic recording probe.
piglet  pig (of either sex) from birth to weaning (between 3 to 8 weeks depending on system), also called a suckler or suckling pig.

pigmeat  meat derived from the porcine species. It is marketed as either fresh (or frozen) pork cuts, as cured sides or cuts (see curing), or for inclusion in a myriad of processed meat products.

pigment  a term used to describe a substance that imparts colour to another substance. The pigments within a muscle are largely responsible for determining muscle colour. The major pigment of muscle is haem in myoglobin. To a lesser extent, carotenoid pigments also contribute to the colour of meat (particularly fat). The muscles from older animals generally have higher concentrations of pigment and are thus darker in colour than younger animals.

pinking  is the term used to describe the development of a pink colour in meat. It is most easily seen in paler meats such as pork. It can be a desirable feature such as providing the unique colour of cured meats. However, undesirable pink colour can develop in cooked or uncooked meats due to cross-contamination with nitrite or nitrate (from curing operations, vegetables or the water source) or gases such as Carbon Monoxide (from ovens).

polled  describes an animal born without horns, or which has had horns removed. Polled cattle are less dangerous to handle and can be kept to greater stocking densities on the farm, in transport and in lairage. Less hide damage is seen in groups of polled cattle compared to those with horns.

porcine  the Latin term pertaining to, characteristic of the pig.

porcine stress syndrome (PSS)  certain breeds of pig, which tend to be those with above average conformation and leanness, are highly susceptible to developing porcine stress syndrome, and subsequent PSE carcases. These animals also tend to be very excitable and frequently suffer stress related problems (including death due to heart failure). PSE carcases are not, however, specific to genotypes prone to porcine stress syndrome. Animals are classed as susceptible to PSS if they react to the halothane and creatine phosphokinase tests or more recently, if a sample of the animal’s DNA, identifies the presence of the halothane gene. The Duroc is an example of a breed of pig resistant to the porcine stress syndrome whereas the Pietrain is highly susceptible. Careful handling of pigs susceptible to PSS prior to slaughter is extremely important to reduce the incidence of meat quality problems and deaths in transit.

pork  a general term for the pigmeat usually used to refer to meat that has not been cured.

post-mortem  meaning after death (slaughter). In contrast to ante-mortem.

post-mortem acidification  describes the way the carcase pH changes from neutral (7.3) before slaughter, to acidic (approx. 5.5) within hours of slaughter. How the carcase acidifies in the period shortly after an animal is slaughtered can influence the major quality attributes of meat (see meat quality). There are three important aspects to post-mortem acidification: (i) the extent of acidification of the muscle (resulting in ultimate pH), (ii) the rate of its acidification (indicated by pH45), and (iii) the temperature of the muscle when these events occur. The first two are mainly influenced by interactions between the animal and its environment prior to and during slaughter, whereas the third is mainly dependant on methods employed in the handling of the carcase after slaughter. The rate and degree of post-mortem acidification will determine the occurrence of meat quality problems such as PSE and DFD and toughness. See pH, glycolysis, lactic acid.

post-mortem proteolysis  is the breakdown of the myofibrillar proteins of muscle in the carcase caused by proteolytic enzymes. The storage of animal carcases at refrigerated temperatures (ageing) improves meat tenderness. This well known improvement in tenderness with ageing is thought to occur largely from proteolysis. Extensive proteolysis of the collagen and elastin of connective tissue does not occur during meat ageing. The myofibrillar proteins which appear to be most affected in this ageing process include troponin-T, desmin, titin, and nebulin, however the main contractile proteins of muscle myosin and actin appear to be little affected.

poultry  refers to farmed species of birds (e.g. chickens, turkeys, ducks)
pre-slaughter stunning see stunning.

primal joints see jointing.

prime cattle see clean cattle.

probe used to measure a carcase or meat characteristic. Generally probes are sharp instruments which are inserted into the carcase or meat. Examples include those used to measure backfat thickness, eye muscle depth and pH, and the fibre optic probe. More recently ultrasound probes have been developed to measure characteristics such as backfat thickness. These probes are not inserted into the carcase or meat. See automatic-recording probes.

processed food having been treated in such a way as to change one or more of its properties.

proteins the name given to chemical compounds consisting of long chains of sub-units called amino acids. They are essential constituents of all living cells. Proteins form a large and essential part of the body mass, comprising especially cell walls, membranes, connective tissue, muscles, enzymes and some hormones. The basis of economic meat production is that of maximising the deposition of lean tissues and minimising fat, bone and viscera, deposition in the carcase. The lean tissue of the carcase is comprised predominantly of muscle protein. Muscle protein growth is a balance between protein synthesis and protein degradation, with rates of synthesis exceeding those of degradation resulting in increased net lean tissue (protein) deposition. The proteins in muscle can be broadly divided into those which are soluble in water (the sarcoplasmic proteins, i.e. contained within the sarcoplasm) or those which are insoluble (the myofibrillar and connective tissue proteins). The sarcoplasmic proteins include the enzymes and myoglobin. The most abundant of the myofibrillar proteins of muscle is myosin. Approximately 25% of muscle mass is protein.

proteolysis the degradation (breakdown) of proteins by proteolytic enzymes such as the calcium activated proteases and cathepsins. These events have been implicated in the improvement of tenderness post mortem (post mortem proteolysis) and during the ageing of meat. See proteins.

proteolytic enzymes (proteases) are protein degrading enzymes which have been implicated in the post mortem improvements seen in the tenderness of meat. Of the many proteolytic enzyme types identified in muscle tissue, two groups (together with their endogenous inhibitors) have been extensively studied by meat scientists in the context of meat tenderisation. These are the cathepsins (and cystatin endogenous inhibitor) which are optimally active at an acidic pH, and the calcium activated proteases, calpains I and II (and calpastatin endogenous inhibitor) which are most active at a neutral pH. Proteolytic enzymes each have an optimum temperature and pH at which they are most active. In addition, proteases may require activation (for example by minimum levels of certain elements such as calcium in the case of the calpains). Another method of controlling the activity of individual proteases in the muscle is the level of specific endogenous inhibitors present. These inhibitors are compounds which reduce the observed activity of particular enzymes. In the case of calpains, the level of the specific inhibitor to those enzymes, calpastatin, is thought to be more important in determining rate of meat tenderisation than the actual variation in the levels of the enzymes themselves.

PSE (pale, soft, exudative meat) a stress related condition found in muscle as a result of rapid glycolysis with elevated lactic acid formation immediately after death. The muscles of such affected animals therefore show an extremely rapid fall in pH immediately after slaughter (pH45). This condition is a particular problem in pig carcases. Certain genotypes of pig, which tend to be those with above average conformation and leanness, are highly susceptible to developing the porcine stress syndrome (PSS), and subsequently PSE carcases. These animals react positively to halothane gas, and carry the halothane gene within their genetic make-up. PSE carcases are not however exclusive to genotypes prone to porcine stress syndrome. Animals failing to react to the halothane test, and thus not classified as PSS animals, can also produce PSE meat. In some cases this may be because they are carriers of the halothane gene but, even in animals without this gene, it is possible to produce the PSE condition if animals are acutely stressed prior to slaughter. The paleness of pork has been shown to increase with increasing acidity of the muscle (lowering of pH). These conditions (low pH at elevated temperatures) favour denaturation of sarcoplasmic and myofibrillar proteins and reduce their water holding capacity. Consequently PSE meat is associated with the formation of a large amount of drip post mortem (see drip loss). In
addition the denaturation of the myofibrillar proteins causes a lateral shrinkage of the myofibril and this changes the light reflectance properties of the muscle making it appear paler.

**Pseudomonas** are Gram-negative, rod shaped, aerobic bacteria. They are one of the most common bacteria in meat and are particularly associated with spoilage.

**ram** un-castrated male sheep (see castrate), often referred to as an entire or a tup.

**rancidity** a general term used to describe fats that have undergone decomposition, leading to the liberation of fatty acids, which is accompanied by undesirable flavours and the development of taints in meat. These changes to the fat are often due to oxidation (oxidative rancidity). The incorporation of salt to meat (see curing) can increase the tendency for oxidative rancidity. Rancidity can be accompanied by discoloration of the meat (see muscle colour) brought about by enhanced metmyoglobin formation due to the increased levels of fat oxidation.

**red meat** red meat is usually taken to refer to beef, lamb and pork. In certain contexts it may include game and other meats but would not include white meats such as poultry meat. The redness of the muscles of these species is brought about by the fibre types (see muscle fibres) present in the meat and the levels of haem pigments in the muscle.

**reflectance** the measurement of light reflected from the meat surface can be used to evaluate muscle colour and indicate the state of pigment oxygenation or oxidation taking place in the muscle. The various forms of myoglobin (the principal pigment of muscle tissue, see muscle colour), have sufficiently different absorption properties such that optical techniques such as spectrophotometry can be used to estimate their relative proportions on meat surfaces. See EEL reflectometer. The structural properties of meat also affect light reflectance from the meat surface and therefore influence its paleness. In particular as the myofibrillar lattice shrinks and the extracellular space increases, the scattering of light increases allowing more to be reflected back from the meat surface, in turn giving it a paler appearance.

**re-formed** meat products which have the appearance of a cut, joint, slice or portion of meat are termed re-formed. This is often achieved by the use of tumbling or specific alignment of fibres with or without the addition of finely comminuted meat, a meat emulsion or other agent to bind the pieces together, and then forming into shapes. Salt (sodium chloride) and phosphates are the most common ingredients to enhance binding but alternative binders to sodium chloride include sodium alginates and purified transglutaminase.

**refrigeration** the maintenance of temperatures at a level selected to reduce spoilage (especially bacterial spoilage), normally taken to be in the range 0 to 4°C. See ageing, chilling.

**religious slaughter** the slaughter of animals by specific methods required by certain religious faiths. Most religious slaughter carried out in the UK and Europe is carried out by the Jewish or Halal methods (see Jewish and Halal slaughter respectively). The slaughter of animals by such methods is exempt from the requirement to stun animals prior to slaughter (see pre-slaughter stunning).

**rendering** the process of liberating the fat (lipid) from animals tissues. This is performed by heating the tissues to a temperature that achieves melting of the fat with subsequent collection and solidification of the molten fat. The heating can be either dry (dry rendering) or when water is present (wet rendering). See tallow, greaves, meat and bonemeal.

**residue** portion of the administered dose of a veterinary agent (i.e. medicine) or other agent (e.g. pesticide) in the tissues, body fluids and excreta of an animal arising from its treatment with that agent. Such residues could potentially be harmful to human health thus present a threat to the saleability of animal products if contamination with such residues is present above a very low level. Residues are the target for very stringent food legislation, including strict withdrawal periods of drugs (e.g. antibiotics) and growth promoting agents before slaughter. Levels of such residues in meat and meat products are monitored by residue testing of carcasses on the slaughter line, with severe penalties imposed on producers found deliberately administering illegal substances to
their animals or not following correct withdrawal periods. In the UK the incidence of exceeding maximum residue levels is extremely low.

**restricted feeding** feeding of animals at a level lower than the amount they would eat given free access to food. See ad libitum feeding.

**restructured meat** the forming together of pieces of meat combined in such a way as to be re-formed into steaks and joints. This is particularly common in the production of sliced cooked ham and must be indicated in food labelling.

**retail cuts** portions of meat prepared for sale to the consumer in the raw state. See jointing.

**retroperitoneal** located outside the peritoneal cavity. The retroperitoneal fat is, together with the perirenal fat known as the flare fat in pigs and the kidney knob and channel fat in ruminants.

**rigor (rigor mortis)** the stiffening of a dead body (carcase) accompanying the depletion of ATP in the muscle fibres. Skeletal muscle remains “alive” after the slaughter of the animal, until rigor mortis is complete. The most noticeable change in the carcase during the process of rigor mortis is the transition from a soft, pliable state, to a more rigid and stiff state. This increase in stiffness is brought about as a result of the muscle contractile proteins, myosin and actin locking together. When rigor is complete, the carcase is said to be set. The rate at which rigor occurs and is completed is dependant upon species, muscle fibre type, temperature, slaughter procedure and whether electrical stimulation of the carcase has taken place. Rigor is more rapid in pig muscles than beef and sheep, and in red muscles than those of predominantly white fibre types. Rigor is completed more rapidly at higher temperatures and also if electrical stimulation of the carcase has taken place. Muscles that are shortened or contracted as they go into rigor will become fixed resulting in shortening (see cold shortening, sarcomere) and the pH of the muscle will fall (see post-mortem acidification, glycolysis). Freshly slaughtered pre-rigor meat is tender but becomes tough at the onset of rigor mortis. Subsequently, as the meat passes through rigor mortis and the ageing process, it increases in tenderness (see hot shortening).

**rigor meter** a spring loaded probe device used to assess the firmness of muscle and hence, when used at a standard time, the extent to which rigor has developed.

**rind** the skin of a pig. Pig meat is often sold, and may be cooked, with the rind left on. Between the rind and the lean tissue is found a layer of subcutaneous fat (referred to as backfat when on the back of the pig). See rindside damage, de-hairing, scalding.

**rindside damage** the physical damage caused to the skin of pigs, this may be due to a skin condition of the live pig or, more often, abrasions caused by fighting during transport and lairage. This problem is increased if animals are transported and lairaged in large groups, which causes mixing of animals and a disruption of hierarchy (pecking order). This problem can be minimised by the grouping of animals in transport and lairage in the same groups as reared on the farm. Rindside damage can be subjectively scored (see subjective scoring), and excessive amounts can incur price penalties on the carcase. Substantial damage to the rind (skin) may indicate bruising of the underlying muscle tissue.

**ritual slaughter** see religious slaughter.

**RN’ (Rendement Napole) gene** a gene in Hampshire pigs (see Hampshire type meat), the presence of which is known to result in poor processing qualities of hams. This gene received its name from the French quality indicator measurement of cooked ham yield which it strongly influences, the Rendement Napole. The presence of this gene results in meat that is pale and somewhat wet, although less exudative than typical PSE meat. The rate of pH fall post-mortem tends to be normal, although a lower ultimate pH is reached. This latter finding is thought to arise due to the RN’ gene increasing the glycogen content of the muscle (see post-mortem acidification, glycolysis). These factors result in the decreased suitability of the hams for processing by curing-cooking.

**ruler probe** a simple insertion probe used to measure fat depth in carcases. It resembles a metal ruler with a sharp end.
ruminant  an animal that has a stomach which is divided into four compartments: rumen, reticulum, omasum and abomasum. These animals characteristically regurgitate undigested food from the rumen into the mouth to be re-chewed (chewing the cud) and then returned to the rumen for further digestion. Cattle, sheep and goats are all ruminant species. In direct contrast to ruminant farm animals are species such as the pig and chicken, which are classed as non ruminants, monogastric or simple stomached animals.

runners  refers to the part of the small intestine of cattle, sheep and pigs that can be used to prepare casings.

ryanodine receptor gene  an abnormal version of this gene which codes for a protein involved in the regulation of calcium flow within the cell has been identified in pig muscles as responsible for causing the rapid elevation of free calcium in the cell seen in post mortem muscle of porcine stress syndrome animals (PSS). This gene is also known as the halothane gene because susceptibility to PSS can be detected by assessing an animals reaction to halothane anaesthesia.

saleable meat  that portion of the carcase which can be sold to the consumer. Saleable meat includes lean meat, fat, bone and other tissues (such as rind with pigmeat). The amount of saleable meat will depend on the butchery practices involved, for example the sale of cuts bone-in or boneless. It is therefore only possible to compare values for saleable meat yield within the same study using a defined cutting specification. At a given fat content of retail cuts the saleable yield decreases as the fatness of the carcase increases.

Salmonella  is a genus of rod shaped Gram negative bacteria that are facultative anaerobes. Infections are zoonotic and generally due to ingestion of contaminated food. Salmonella enteritidis and Salmonella thyphimurium are the two most common serotypes that are isolated in humans.

sarcomere (length)  the basic contractile unit of muscle structure between two Z lines along a myofibril. Under a powerful microscope, it can be seen that muscle fibres comprise of alternate light and dark bands, traversed by thin dark lines. These bands are due to the regular arrangement of the contractile proteins actin (seen as thin filaments) and myosin (thick filaments). The dark lines traversing these bands are called Z lines. The section of a myofibril between two Z lines is called a sarcomere. Sarcomere lengths change depending on the contractile state of the muscle. The conditions referred to as hot shortening and cold shortening result in considerably shorter sarcomere lengths at rigor mortis, with a resultant decrease in the tenderness of the muscle.

sarcoplasm  is the fluid within the muscle fibre and surrounding the myofibrils. Each muscle fibre is surrounded by a thin membrane called the sarcolemma, the fluid within is termed the sarcoplasm. Mitochondria are found in the sarcoplasm as well as a large amount of glycogen. The sarcoplasm also contains a large number of enzymes and soluble proteins such as myoglobin (sarcoplasmic proteins).

sarcoplasmic reticulum  a network of internal membranes in the sarcoplasm.

scalding  see de-hairing, rind.

seam butchery  the preparation of cuts from a carcase based on cutting along the natural joins between muscles.

sensory evaluation  the determination of the quality of food based on the human senses (therefore relying on the judgement of assessors). It is used to evaluate and compare the eating quality attributes and/or the appearance of meat samples. The ultimate decision as to the eating quality of a piece of meat has to be made by the person or persons eating it. Thus, it is necessary to rely on human judgements to assess juiciness, tenderness, flavour, and other palatability characteristics of meat. Subjective sensory evaluation of the eating quality and/or appearance of meat is normally carried out by sensory panels, of which there are two types: (i) the trained sensory panel; designed to determine differences in treatments and the magnitude of the differences, and (ii) the consumer panel; designed to indicate a preference and/or the degree of preference for the sample or samples being evaluated. These two subjective methods (see subjective scoring) have been described as analytical and effective, representing trained and
consumer panels respectively. Objective methods of evaluation have been trialled but as yet have not been found to strongly relate to the subjective sensory panels.

**sensory qualities** the attributes of meat assessed by the human senses. These encompass a broad spectrum of factors including appearance, juiciness, tenderness, flavour, aroma and even tactile qualities. See meat quality, eating quality, texture, sensory evaluation, organoleptic.

**sex** of an animal can have a considerable influence on its production characteristics such as growth rate and feed efficiency, and on carcase characteristics such as fatness and conformation. In addition, entire male animals (particularly pigs) can produce specific flavours in the meat (see boar taint) and, as they approach maturity, males tend to produce meat which is tougher due to changes in connective tissue (see collagen). This is especially the case for cattle. Producers have an option of rearing male animals entire, or to castrate them. Therefore three sexes of meat animal can occur, male, female and castrate. Castrated animals divert more energy intake into the synthesis of fat at the expense of lean and are less efficient in food conversion (see food conversion ratio), producing fatter carcasses. Castration can therefore only be justified on the basis of its effect on sexual and aggressive behaviour, thus making management of the animals easier/safer for the stockworkers, or in some cases, the reduction of the risk of quality problems with the meat. For such reasons, castration is still widely used in beef and sheep production, but is not thought to be justified (in the UK) for pig production (see castration).

**shear force** is the most commonly used method of objectively predicting the sensory tenderness of meat. Shear force is commonly evaluated using a Warner Bratzler shear or Volodkevich bite jaws device, while in the US Slice Shear Force (SSF) is often used. Correlations between Warner Bratzler shear (WB) or Volodkevich jaws and tenderness as evaluated by sensory panel (see sensory evaluation) tend to be moderately high. Care must be taken, in how one interprets measurements quoted for shear force readings. It should be noted that these data explain shear force alone, and not tenderness per se. The vast majority of studies evaluating mechanical shear tests have dealt mainly with cooked meat, although this measurement can also be taken on raw samples. In assessing shear force in cooked samples, it should be emphasised that the cooking procedure and preparation of samples prior to cooking must be controlled to the same extent as with taste panel evaluation (see trained sensory panel), or these factors may mask possible treatment effects.

**Shechita slaughter** See Jewish slaughter.

**sheep** an animal of the ovine species. Sheep are ruminants. They are suited to a wide range of environmental and management conditions. A mature female sheep is termed a ewe and a mature male a ram with their offspring referred to as lambs. Sheep breeds tend to be categorised according to the geographical location in which they were developed and are best suited, hence hill breeds such as Scottish Blackface and Swaledale, and Down breeds such as the Suffolk and the Texel. An additional form of classification of breeds is on the basis of whether they have been bred for wool, milk or meat production characteristics.

**sheep carcase classification scheme** the scheme used in the UK for sheep carcase classification is based on the subjective assessment of conformation class and fat class, carcase weight and category (lamb, old season lamb or mature sheep).

**shelf life** of meat is the period of time on retail display that the product can be considered safe and of acceptable quality for human consumption. The length of this period will be determined by two main factors, microbial spoilage (see microbiology) and colour stability (see muscle colour, oxidation). Controlled or modified atmospheric packaging can increase the shelf life of meat by reducing both microbial growth and colour deterioration. Colour stability of meat can also be influenced by the inclusion of vitamin E into the animal’s diet which reduces oxidation. Shelf life of meat can be extended by the processes of curing and smoking.

**shortening** see hot shortening, cold shortening.

**shoulder puller** a variety of hide puller used on inverted dressing lines for sheep. The shoulder puller pulls the hide back and down from the shoulder, whilst the carcase is suspended from the front legs, leaving the skin half way down the back. The final puller then pulls the skin over the buttocks and the back legs.
shearling a sheep following its first shearing but before it’s second is called a shearling. It is assumed to refer to an uncastrated male unless some qualifying term is used (e.g. shearling gimmer would refer to a female).

shrinkage of meat is the weight loss that can occur during the processes of chilling, storage and cooking. This is caused by evaporative loss from the surface (see evaporative weight loss), a loss of water holding capacity and/or collagen shrinkage on cooking. The weight loss on chilling or storage is primarily water whereas cooking loss includes a proportion of fat.

side one of the lateral halves of the carcase of an animal. The carcases of cattle and pigs and ewes are normally split into sides soon after dressing to enable easier handling of the carcase. Splitting also makes the process of post-mortem meat inspection easier.

singeing the burning off of hairs from a pig carcase. This process normally follows scalding. See de-hairing.

sire male parent of an animal (see terminal sire).

skatole (3-methylindole) is a breakdown product of the amino acid tryptophan which has been implicated in the generation of boar taint in pig meat. Skatole belongs to a group of compounds known as indoles. This compound is deposited at higher levels in the fat of entire male pigs compared to either castrates or females. As skatole is produced by the digestion of tryptophan in the hind gut, the type and amount of carbohydrate consumed, is thought to have an effect on the production of skatole. Increasing the level of digestible fibre in pig diets appears to reduce the concentration of skatole in fat tissues and the perception of abnormal flavours and odours in the meat. High levels of peas in pig diets have been implicated in reduced flavour of pork and also increased skatole concentrations in the meat. Danish evidence has suggested that stocking density and faecal contamination of the live pig are factors determining skatole and indole concentrations in the fat of pigs.

skin the outer covering and largest organ of the body. It serves to protect the internal organs and tissues from physical damage and microbial contamination. The skin of cattle (hide) and of sheep (pelt) is normally removed on the slaughterline. The skin of pigs (rind) is not normally removed and pig meat is sold and often cooked with the skin on (see de-hairing). The process of removing the skin in sheep and cattle (see pelting, de-hiding) is a ready source of bacterial contamination to the carcase, which until that time is well protected by the skin cover. Severe damage to the skin of a pig carcase in the form of bruising or scratching (see rindside damage) can be a cause of carcase condemnation or price penalties. The value of the skin of cattle or sheep to the tanning industry is an important contribution to the economics of animal production.

skin-on-sheep refers to mutton or goat meat, where the skin has been de-haired and scorched (removing any remaining hair) giving the skin a light golden colour and the meat a wood smoke flavour. This product is commonly referred to as ‘smokies’. The production of skin-on-sheep in the UK is currently an illegal practice.

slaughter the killing of animals for the preparation of meat for human consumption normally carried out at an abattoir. There are many methods legally employed within the EU to slaughter farm species, the use of which depends upon species, religious (see religious slaughter) and welfare considerations (see stress). Normal practise in the UK is stunning followed by exsanguination. The act of slaughter is carried out by a trained and licensed slaughterman in the slaughterhall. The way animals are handled prior to and during slaughter has implications for both animal welfare and meat quality (see handling).

slaughter weight the weight of the animal (liveweight) at slaughter. For considerations involved in the choice of optimum slaughter weights see bone, carcase weight, dead weight and killing out percentage.

slaughterhall the part of an abattoir in which the act of slaughtering of animals (see slaughter) takes place. Also may be called the slaughter floor.
slaughterhouse  see abattoir.

slaughterline  production line (often semi-automated) along which the various processes involved in the slaughter and dressing, meat inspection, weighing and classification of carcases take place within the abattoir. The part of the slaughterline on which dressing takes place is often termed the dressing line.

slime  formation on meat arises from severe microbial growth (see microbiology, contamination). Slime formation results from bacterial colonies, typically Pseudomonas, increasing in size and number to the point where they coalesce to form a sticky coating.

smoking  originated as a method of preserving cured meat (extending its shelf life), most commonly bacon and frankfurters by inhibiting microbial contamination (see microbiology), retarding fat oxidation and preserving muscle colour. Smoking also imparts a unique flavour to the product which is preferred by some consumers ensuring the continuation of this process in the advent of other methods of preservation. Traditionally the meat is cured (see curing) then smoked in a smoke house or a kiln, using special woods to impart particular flavours.

soft fat  see fat quality, firmness.

somatotropin (somatotrophin, somatotrophic hormone)  naturally occurring growth hormone in the body of animals which is instrumental in regulating the speed of growth and the proportion of fat to lean in the carcase. Bovine somatotrophic hormone (bST) given by injection will increase milk yield and meat production in cattle. Although there is little evidence to suggest adverse effects on the animal, or carcase problems arising from the administration of this hormone to cattle, public opposition to its use makes it unlikely to be legalised for widespread use within the EU. Porcine somatotrophin (pST), although legal to administer to pigs in Australia, is also not permitted within the EU. Most of the published data would suggest little effect of pST on carcase meat quality. Some workers have shown an increased incidence of carcases designated as PSE following administration of this drug, although others have shown no such relationship. It is generally observed that the administration of pST does not reduce the eating quality of pork, in direct contrast to the administration of beta-adrenergic agonists.

sow  term given to a female pig after her first farrowing.

spleen  a lymphatic organ associated with the circulatory system. It is both a storage organ for blood and a site for the recycling of spent red blood cells. It is attached to the stomach by a ligament in most species but directly with connective tissue to the rumen in ruminants.

splitting  the division of a carcase into sides. This is now usually achieved by the use of a saw or automated cleaver but historically a manual cleaver was used. The use of a saw results in less splintered bone but more bone dust. For this reason many pig abattoirs use mechanical cleavers.

spoilage  is any perceivable change in meat that renders it unwholesome or unacceptable for use. It is usually the result of enzyme or microbial action or oxidation of muscle pigments to brown metmyoglobin.

spoilage bloom  the term given to the discoloration (browning) of meat occurring mainly as a result of the oxidation of oxymyoglobin to metmyoglobin (see muscle colour, oxidation). This results in a change of colour of meat from a cherry red or pink to a brown colour, often referred to as a loss of bloom. Such discoloration can also be caused by microbial contamination (see microbiology).

sprinklers  cold water sprays used to cool pigs during lairage or immediately prior to slaughter to reduce heat stress.

steer  castrated bovine animal often referred to as a bullock.

sticking  see exsanguination.

stirk  a weaned heifer or bullock up to the age of 12 months of age.
steatosis is a poorly understood condition in which abnormal development of adipose tissue within muscle replaces muscle fibres. It is more common in cattle and pigs than in sheep. This gives the appearance of meat with high levels of marbling fat but is normally distinguished by being seen only in restricted areas.

store generally refers to weaned animals requiring further feeding before slaughter. This term can be used with reference to any species but is more commonly used for cattle and sheep (e.g. store lambs).

stress situations that increase the amount of unaccustomed physical or emotional activity of an animal cause stress. There are basically three types of stress to which meat animals are exposed. These are: (i) social, e.g. the mixing of groups of animals leading to a loss of hierarchy (pecking order) which can lead to bullying; (ii) environmental, e.g. extremes of temperature; and (iii) physical which includes stresses imposed during the movement, transportation and slaughter of animals. In preparation for a “fight or flight” response, stress triggers the release of hormones such as adrenaline into the blood stream which stimulates the metabolism of muscles and increases susceptibility of an animal to developing meat quality problems such as PSE and DFD in the carcase. Stress can be minimised by careful handling of animals. Stress susceptibility, particularly in pigs, can depend upon the genetic make-up of the animal (see porcine stress syndrome, halothane gene).

structure (muscle structure) of meat is extremely complex but can be regarded as essentially a two component system made up of fibres (myofibril) and intramuscular connective tissue (mainly present as collagen and to a lesser extent elastin). The structure of muscle is fundamental to the determination of the appearance, technological quality (particularly water content and water holding capacity) and eating quality (particularly tenderness) of meat.

stunning refers to methods used to render an animal insensible at slaughter. In pigs, this is generally carried out by applying electrical current through the brain. The current is either passed through a pair of hand-held tongs (lower voltage) clamped to the head or applied automatically to an animal in a restrainer (high voltage). Both systems are designed to deliver a minimum current (amperage) which varies with species. In cattle, a captive bolt pistol is usually used to stun the animal, although some abattoirs use specially designed electrical stun boxes. Sheep can be stunned using either captive bolt or electricity, the latter method being more common. Another method of stunning pigs is the use of carbon dioxide anaesthesia (see CO2 stunning). In the UK legislation states that when using gas, the animal must remain in the mixture until death, thus it classed as a killing method. In other countries the use of gas a stunning method. Careful handling of animals both prior to and during the act of stunning is essential to minimise stress and reduce the incidence of meat quality problems such as PSE. Following stunning, the carcase should be bled (see exsanguination) as soon as possible to reduce the risk of blood splash. Certain religious slaughter methods employed in the UK do not use stunning.

subcutaneous means beneath the layers of skin (or rind). Most commonly used to describe backfat (subcutaneous fat) or the position of an injection or infusion.

subjective scoring refers to methods used to evaluate and quantify meat quality attributes that rely on human judgement. The assessment of eating quality attributes of meat (i.e. tenderness, juiciness and flavour) relies upon subjective sensory evaluation of the meat due to a lack of accurate and reliable objective methods available to evaluate such parameters (see trained sensory panel, consumer panel, shear force). Other meat quality attributes such as colour and fat qualities, can be measured objectively or subjectively. However, subjective methods are still often preferred on the grounds of direct relevance to the consumer, ease of use and cheapness. Care should always be taken when using subjective techniques to evaluate meat quality parameters, that variability in scoring method is kept to a minimum and human fatigue does not influence the scoring process. For some subjective assessments, such as marbling score, a photographic standard may be used to aid the standardisation of assessors. Although the cost of carrying out subjective assessments compared to the capital and running costs of objective methods can be lower, the low repeatability and high levels of variation and error that can be incurred from subjective methods must be considered.

succulence refers to the organoleptic, eating quality attributes of meat, mainly with reference to juiciness.
**suckler** a young animal that is drawing milk from its dam, i.e. suckler calf or lamb. May also be used to refer to a suckler cow.

**suckler cow** a cow that is nursing a calf. The milk produced during lactation is used solely to feed a calf (single suckling) or several calves (multiple suckling). These animals are normally beef breeds, or females resulting from beef bulls crossed onto dairy cows. The meat from these animals (cull cow) following slaughter at the end of their productive lives tends to be tough (see tenderness) due to the amount of connective tissue present (see collagen).

**suckling pig** an un-weaned, milk-fed piglet. The meat from such animals is a delicacy in many parts of the world, the carcasses are cooked whole. It is not, however, common practice to slaughter such young pigs in the UK.

**swine** pertaining to or emanating from pig.

**taint** generally refers to some form of contamination of meat by uncharacteristic odours and/or flavours. Such taints can be caused by substances contained within certain raw material foodstuffs, microbial contamination (see microbiology), or oxidation of fats present in the meat (see warmed-over flavour). Taints can also be caused by the absorption of undesirable odours and flavours from atmospheric contaminants. Unpleasant odours and flavours due to sex related compounds in entire male animals (especially pigs, see boar taint) are also referred to as taint, even though they are naturally present and therefore cannot be considered as contamination. See also bone taint, rancidity.

**tallow** hard animal fat chiefly from cattle or sheep, used to make soap, candles, lubricants and many other products. It is high in calories and, subject to processing regulations, can be used as an energy source in animal feeds, however is now largely used for the manufacture of biodiesel. Tallow is produced by rendering.

**taste** is an important constituent of the evaluation of the eating quality of meat. There are four “basic” tastes: sweet, sour, salt and bitter. See sensory evaluation, organoleptic, texture.

**taste panelling** an alternative (less accurate) term for sensory evaluation.

**TBARS (Thiobarbituric acid reactive substances)** also known as the TBA test. This is a laboratory method for measuring the oxidation of lipids in meat and meat products. It has been reported to correlate well with sensory scores for oxidised and warmed-over flavours.

**temperature (muscle temperature)** the temperature at which post-mortem acidification (see pH, glycolysis, PSE, DFD) and rigor mortis take place can have overwhelming influence on the major quality attributes of meat (see meat quality). Beneficial effects on meat tenderness have been shown with slower reduction in temperature post-mortem. The temperature at which animals are held in lairage prior to slaughter will influence the body temperature of the animal at slaughter. This has been shown to subsequently affect the rate at which the muscles in the carcase cool following slaughter, thus influencing the incidence of meat quality problems such as PSE and DFD. See chilling, refrigeration, freezing.

**tenderisation** is an improvement in tenderness of meat. This occurs naturally due to proteolysis during the ageing process, or artificially. Artificial tenderisation can be carried out by stretching or pounding the meat, electrical stimulation of the carcase, blade tenderisation, or by the application of a commercial enzyme preparation to the meat such as papain. Marinating meat in acids such as vinegar and lemon juice has also been shown to tenderise meat but can be ineffective, or even toughen the meat, if the acid used is not sufficiently strong. Infusion of carcases with calcium chloride or high pressure treatment of meat can also increase tenderisation of meat.

**tenderness** is one of the major and most variable eating quality (organoleptic) attributes of meat. Consumer studies have shown that tenderness is the most important factor in consumer acceptance of meat. The causes of tenderness variation are extremely complex and not fully understood but are thought to involve elements of muscle structure (size and types of muscle fibres, connective tissue distribution), the nature and extent of post-mortem biochemical changes...
Tenderness can be evaluated in meat subjectively using sensory evaluation, or objectively by measuring shear force. The type and nature of connective tissue in meat (mainly present as collagen and to a lesser extent elastin) are major determinants of tenderness. The amount and maturation of collagen and the collagen cross-linking play an important role in the determination of tenderness in meat (referred to as background toughness) and account for the increased toughness of older animals and differences in toughness between different types of muscle. Myofibrillar toughness is influenced by two processes, namely, the development of rigor mortis, and tenderisation arising from the ageing of meat. The myofibrillar structure is responsible for the contraction of muscle. The state of contraction of the muscle when it sets in rigor mortis has a marked effect on the subsequent meat tenderness (see hot shortening, cold shortening). Over the last half century, investigations have focused upon the nature of the changes that occur to muscle fibres during meat ageing, and on the endogenous proteolytic enzymes which are very likely important causative agents in this process (see post-mortem proteolysis).

**tenderometer** a device used to instrumentally measure physical parameters of meat indicative of sensory tenderness. The best known example is the MIIRNZ tenderometer widely used in New Zealand.

**tendon** a band of strong white fibrous connective tissue that connects a muscle to a bone. Tendons consist predominantly of collagen.

**terminal sire** a sire used to produce the slaughter generation when crossed with a female of another breed, line or strain. The terminal sire used for producing a slaughter generation should confer the traits of high growth rates, good feed conversion efficiency and good carcase quality to his progeny. Boars produced specifically to confer these traits may be referred to as meat-type sires.

**testes** (testicles) the male animal’s gonads (sex organs) which, in mammals, are situated in the scrotum.

**texture** is used as an important indicator of meat quality and in particular eating quality. Texture is a measure of how food feels in the mouth during eating and also how the food handles on the plate. Tenderness (or how easily the meat is broken up in the mouth) and juiciness (or succulence) are the two key components of texture.

**thaw loss** is the loss in weight resulting from the formation of exudate (see exudation) from meat following freezing and thawing (see chilling). Such losses are lower following rapid (blast) chilling than conventional chilling methods. See water holding capacity, drip loss, water content.

**thaw rigor (thaw shortening)** is the shortening of the muscle that occurs upon thawing of meat which has been frozen in the pre-rigor state (i.e. before rigor mortis is completed). Thaw rigor is similar in respect to cold shortening in that it appears to be brought about by increased levels of calcium in the muscle cell, and results in an appreciable reduction in the tenderness of meat. Thaw rigor also causes excessive drip loss from tissues upon thawing.

**thaw shortening** see thaw rigor.

**tissue separation** the failure of fat tissue and lean tissue to remain connected in the carcase or cut of meat particularly associated with very lean pigs. See fat quality.

**trained sensory panel** used in the sensory evaluation of meat. The panel consists of members selected for their ability to perceive differences between samples. A screening process is performed on prospective candidates to select those with the most developed sense of taste and smell. Selected panellists then participate in training programmes over which time they will be monitored and must display stable and consistent assessments. When carrying out sensory panel evaluations of meat, it should be remembered that a crucial factor in the panelling procedures should be uniformity in the cutting and size of samples and uniformity and standardisation of cooking method, otherwise treatment effects will not be detected due to strong cooking effects (see cooking procedures). A variety of methods can be used to assess the samples such as category or line scales and sensory descriptors. The organoleptic parameters most often assessed in sensory panels evaluating the eating quality of lean meat include those of juiciness,
tenderness, flavour intensity, abnormal flavour and in the case of pigs, boar taint intensity. Assessment of fat normally includes flavour intensity, abnormal flavour intensity and for pig meat, boar flavour intensity. Odour evaluation is also often carried out on meat samples, particularly of the fat especially when evaluating pig meat. Overall acceptability is often included as a final parameter for panel members to assess. Appearance attributes both before and after cooking can also be evaluated using sensory panels.

transport see handling.

triglyceride (triacylglycerol) a compound formed by the esterification of one glycerol molecule with three fatty acid molecules. The principal form in which lipid is stored in an animal. See also phospholipid.

tumbling refers to the procedure of massaging pieces of meat against one another in a rotating drum. It is used to aid distribution of curing salts. It also can be used to draw out salt soluble proteins to the meat surface for use in binding cuts to make re-formed meat products. See re-structured meat.

two-toning describes a muscle which has different colours across its section. This generally occurs because one part of the muscle is exhibiting a muscle condition defect (PSE or DFD). It also refers to different colours in adjacent muscles due to a muscle condition defect.

ultimate pH see pHu.

ultrasonic (ultrasound/ultrasonography) refers to devices which use mechanical radiant energy at frequencies above the audible range. Reflections (echoes) of ultrasound can be used to form images of deep structures of the body or simply to detect structural interfaces which can cause reflections, for example the depth under the skin of the fat/muscle interface in a live animal. Ultrasonic methods are used to determine the body composition of live animals and carcasses (see carcass composition). Ultrasonic methods can also be used in pregnancy diagnosis of the live animal. Ultrasonic techniques range from simple probes to sophisticated scanners.

unsaturated see fatty acid.

USDA (United States Department of Agriculture) founded in 1862. The department focus is to provide a safe, sustainable and nutritious food supply through science, marketing, trade conservation and rural development. The USDA Quality Standards are operated through the USDA’s Agricultural Marketing Service. These standards are based on measurable attributes that describe the value and utility of the product. Beef quality standards are based on attributes such as intramuscular fat, colour (see muscle colour; fat quality), firmness, texture, and age of the animal.

vacuum packaging is the storage of meat in the absence of oxygen or any other gas. This is an effective method of extending the shelf life of uncooked meats. The shelf life of vacuum packed meat will depend upon the oxygen transmission rate of the packaging film, the extent of any contamination of the meat with bacteria which can grow anaerobically (see anaerobe) and the storage temperature. Inhibiting access of oxygen to the meat reduces oxidation. This stops the transformation of red oxy myoglobin to a brown metmyoglobin and the oxidation of protein, thus maintaining muscle colour and preventing the toughening of meat. This anaerobic atmosphere also inhibits the accumulation of many harmful micro-organisms (see microbiology) thus reducing bacterial deterioration of the meat. See also modified-atmospheric packaging.

variety meats is an American term used to describe offals. They are used in many processed meat products and include tongues, livers, hearts and tripe.

vascular perfusion chilling (VPC) a method of chilling carcases whereby a cold fluid is circulated through the intact vascular system. Research has shown VPC to significantly reduce the time taken to cool carcases.

veal the meat from calves usually slaughtered between 16 to 26 weeks of age (but less than 8 months of age), depending on breed, sex and feeding regime. Under UK rules, calf diets must include
iron, to prevent anaemia, and fibre to stimulate rumen development. Veal production systems used in the UK allow groups of calves freedom of movement with ad libitum access to a roughage and milk. This does however, lead to lower feed efficiencies (due to rumen development) and produces a darker coloured meat (see muscle colour). Thus, veal produced in the UK is pink or red (referred to as rose veal) which has consistently been shown not to be of a reduced eating quality compared with white veal, and to have the same colour after cooking. In fact, the flavour intensity of veal has been shown to improve with pigment concentration of the muscle. The increased “pinkness” of the meat, results from the higher intake of iron, which increases muscle haem content. From a consumer perspective UK systems provide a more “welfare friendly” method of veal production than the more traditional white veal systems widely used on the Continent. White veal is obtained from a calf fed a virtually iron-free diet of mainly milk. Such animals are reared in an iron-free environment, usually in pens of 4-7 animals, with limited access to roughage, and often kept for long periods in darkness. White veal production systems are, in essence, producing an anaemic animal.

VIA (Video Image Analysis) an automated method of objectively assessing (see objective scoring) carcase conformation class and fat class (see carcase classification; beef carcase classification scheme; sheep carcase classification scheme). It is also able to accurately predict the saleable meat yield of a carcase. The unit is integrated into the slaughter line, after the completion of dressing. The suspended carcases are illuminated and images of the carcase are taken with video cameras. Using specialised software, the computer then interprets these images to extract data such as curvature to establish the carcase conformation. The fat level is determined by interpreting the colour of the carcasse.

viscera collective name for the large organs of the chest and abdominal cavities of an animal; they include the stomach, intestines, liver, spleen, pancreas, and parts of the urinary and reproductive tracts. Such organs are normally removed from the body (visceration) following slaughter of an animal. The viscera can variously be used for human consumption, by the petfood industry or are rendered.

vitamin A a generic descriptor for a group of compounds that are fat soluble and exhibit the biological activity of the most important member of the group - retinol. Storage of vitamin A and carotenoids (also from plant tissue) in subcutaneous fat has been associated with yellow fat particularly seen in the carcases of grazing beef animals. Vitamin A is formed from carotenoids.

vitamin E a generic descriptor for a group of compounds that are fat soluble vitamins with the biological activity of the most important member of the group - α-tocopherol. They act as antioxidants (free radical scavengers) in the live animal and continue to function post-mortem reducing the oxidative breakdown of polyunsaturated fatty acids and minimising metmyoglobin formation, helping to avoid discoloration of the meat over time (see oxidation, muscle colour). Some animal diets are naturally higher in vitamin E than others and diets can be supplemented with vitamin E in the form of α-tocopherol acetate.

Volodkevich bite jaws provide an objective prediction of meat tenderness. The jaws, which work by simulating the action of the incisor tooth, consist of upper and lower 3mm diameter knife edges. The upper knife is attached to a texture analyzer load cell. A rectangular meat sample is placed on the lower knife edge, whilst the load cell moves the upper knife edge downwards to compress or shear the sample in a guillotine like action. The greater the force required, the tougher the meat samples. The Volodkevich method provides an alternative to the Warner Bratzler shear method (see shear force).

warble fly are flies that worry and irritate grazing cattle during the summer months as they lay their eggs on the animals legs. The eggs then hatch and the larvae penetrate the skin, migrating through the body of the host animal. When reaching the back of the animal they form swellings (warbles) beneath the skin, and when mature (in the early summer) escape from the body by making a hole in the hide of the animal. The holes produced in the hide by such infestation reduces their value of the hide after slaughter. Warble fly has not been identified in the UK since 1991 following a compulsory treatment programme.

warmed over flavour is a term often given to the deterioration in flavour and increase in abnormal flavours that is associated with lipid oxidation, particularly in meat stored after cooking and
subsequently reheated. When meats are cooked, the rate of oxidation is greatly accelerated and pro-oxidant ions are released from iron containing compounds such as myoglobin. On reheating low levels of oxidation products already present coupled with pro-oxidants substantially accelerate the oxidation of phospholipids which contain high levels of polyunsaturated fatty acids. Products of the oxidation of these lipids is thought to be mainly responsible for “warmed-over flavour”. Cured meats do not develop warmed over flavour due to the inhibitory effects of the salts used in the curing process.

**Warner Bratzler shear** is a methodology for the mechanical measurement of the amount of force required to shear a cylindrical sample of meat with a 1mm thick triangular blade. This measurement is often used as an objective prediction of meat tenderness (see shear force). The greater the force required, the tougher the meat samples.

**water (moisture) content** the amount of water present in meat. This is normally expressed as either a percentage by weight or as g/kg of tissue. Moisture content of lean muscle tissue is normally around 70-75% depending upon species, amount of intramuscular fat present, muscle type and age and nutritional state of the animal. Most of the water present in the muscle is stored within the myofibrils (see water holding capacity). As animals get older and their carcases get fatter, the moisture content of the muscle and fat tissue declines (see fat quality). Generally, as the intramuscular fat content of a muscle goes up, the water content will come down. The water content, and its distribution within the meat, affects sensory properties and is also of great importance to the industry economically, when losses of moisture, hence carcase weight occur. The ability of meat to retain its natural water content is termed water holding capacity. The moisture content of meat when consumed is extremely important to the determination of juiciness. The water content of the carcase is liable to reduction if the animal is fasted before slaughtering, particularly if dehydrated due to the withdrawal of water prior to slaughter (see handling, lairage).

**water distribution** varies considerably between and within particular muscles of the carcase. It has been demonstrated that water distribution can vary along and between the sides of any particular muscle. This factor should always be taken into consideration when quality measurements are made on meat (see meat quality).

**water holding capacity (WHC)** or water binding capacity, as originally defined it, is the ability of meat to retain its natural water content despite the application of force but more recently has come to mean the ability of meat to hold its own or added water. A high WHC is extremely important to the processing, handling and sensory properties of meat. A low WHC will lead to unsightly meat, mean the ability of meat to hold its own or added water. A high WHC is extremely important to the processing and on cooking. The myofibrillar proteins of muscle are responsible for the binding of approximately 75% of the water in muscle tissue. Water is held in muscle: (i) within the myofibrils, (ii) between the myofibrils, and (iii) outside of the muscle cell (extracellular). The considerable changes in WHC occurring during storage and processing of meat are determined by the extent to which the bulk of the water is immobilised within the muscle structure. There are many different methods to measure WHC including quantifying weight of drip and cooking losses but there is no recognised reference methodology or units. The WHC is strongly determined by the rate and extent of pH fall of the meat after slaughter (see post mortem acidification). This pH drop, along with structural alterations of the muscle (particularly shrinkage of the myofibrils) that occur during rigor, decrease the WHC by commonly 1-3%. Poor WHC is a particular problem in pork as a result of PSE.

**welfare** see animal welfare.

**wet ageing** a method of ageing whereby primal joints or cuts (see jointing) are placed within vacuum packaging in a chill room for a period of time. The impermeable barrier prevents moisture from escaping thus minimising evaporative weight loss unlike in dry ageing.

**wether** young castrated male sheep (see castrate).

**wild boar** is the breed of pig from which modern genotypes originated. The meat of wild boar is classed as game and therefore licences are required to both kill and deal in wild boar. The meat of wild boar is reported to be rich in glucose which is thought to be responsible for a rapid an extensive post mortem acidification seen in the muscles of these animals. This it is thought influences the long shelf life of this product (see pH, microbiology, muscle colour, glycogen).
Wiltshire cure a traditional English method of curing a whole side of bacon which includes a period of maturation in a dry cool environment after several days immersion in brine.

withdrawal period the minimum amount of time as stated by law, between the administration of a veterinary preparation (e.g. antibiotic) and slaughter of an animal for human consumption or the taking from it of milk or eggs intended for human consumption. Such regulations are aimed at reducing the risk of potentially harmful chemical residues in meat on consumption. Also referred to as withholding period.

yellow fat carcase fat, especially of beef animals, may be coloured yellow due to the deposition of carotenoids (vitamin A precursors). This is strongly influenced by diet with grazed animals having yellower fat than cereal finished animals. In lambs, yellow fat may be caused by xanthophyll (also called lutein) or bilirubin. In pigs yellow fat can be the result of so called “yellow fat disease” thought to be due to the release of esterase by the pancreas. Yellow fat in beef is considered undesirable in some markets but desirable in others. Occasional examples of very yellow fat are seen in cattle, particularly in parts of Scotland. The precise reason for these cases is unclear.

Z lines (disks) see sarcomere.

zebu a group of breeds of Bos Indicus cattle characterised by a “humped” back (e.g. Brahman cattle).

zoonosis any infectious disease (e.g. Listeria; E.coli O157:H7; Salmonella) that can be transmitted between species, such as from animals to humans.
Appendix - Additional Reading

1. General Texts.


Journal of Animal Science, American Society of Animal Science, 2441 Village Green Place, Champaign, IL 61822

3. EBLEX and BPEX Publications.

EBLEX and BPEX produce a wide range of publications containing industry statistics and forecasts for the UK and other markets as well as a wide range of technical information. For further information see:

www.eblex.org.uk
www.bpex.org.uk