Meat, Poultry, and Fish

In this discussion, meat is defined as the flesh of cattle, swine, sheep or goats that is consumed for food. It consists of muscle fibers held together by connective tissue and interspersed with nerves and blood vessels, which normally accompany the tissue. A single muscle contains a number of fiber bundles, held together by a sheath of connective tissue, the epimysium. Groups of fibers are associated into fiber bundles which, in turn, are surrounded by a sheath of connective tissue, the perimysium. The basic unit of muscle is the fiber, and it is bounded by the endomysium and sarcolemma.

A muscle fiber comprises a number of long, thin, cylindrical rods known as myofibrils, the essential contractile units of muscle, which are separated from one another by a highly specialized network of tubules, the sarcoplasmic reticulum. Myofibrils are bathed in an aqueous fluid (sarcoplasm), which is about 75–80% water and contains mitochondria, enzymes, glycogen, adenosine triphosphate, creatine, phosphate and myoglobin. Each myofibril consists of two sets of filaments: a thick set of filaments containing the protein myosin and a thin set of filaments containing the protein actin. These two sets of filaments are arranged within the myofibril. The thin filaments (I bands) extend longitudinally from the Z lines, while the thick filaments (A band) span the gaps between the tips of the opposing actin units. Contraction and relaxation of striated muscle appears to be related to the interaction between actin, myosin, and ATP. The energy released
by the calcium-activated enzymic dephosphorylation of adenosine triphosphate (ATP) brings about muscle contraction through the sliding action of the actin filaments over the myosin filaments, forming contractile actomyosin. On relaxation, the reverse process occurs.

Muscle fibers are not directly attached to the bones which they move; rather movement is transmitted via the connective tissue (endomysium, perimysium, and epimysium) to the tendons, which in turn are attached to the skeleton. Thus, contractile movement would be limited to the myofibrillar level were it not for the force-transmissive capabilities of the connective tissue. Collagen is the major component of the connective tissue, and it plays an important role in the textural properties of meat.

The conversion of muscle to meat involves a number of biochemical and biophysical changes, which appear to occur in stages. In the first stage (prerigor stage) immediately after death of animal, the muscle tissue is soft and pliable. As postmortem continues, and glycogen is converted to lactic acid, resulting in a concomitant decrease in pH, which reaches an ultimate value of pH 5.5 (after almost 24 hr). There also is a decrease in creatine phosphate, and as a consequence, a decrease in ATP because as the reserve creatine phosphate is depleted, the capacity to resynthesize ATP is lessened. The second postmortem stage is known as rigor mortis. During this stage, the myofibrillar proteins—actin and myosin—gradually associate to form actomyosin. This phenomenon occurs as a result of a decreasing level of ATP. It is the actomyosin that is responsible for the inextensible properties of muscle manifested as rigor mortis; i.e., the muscle ceases to be elastic and tends to stiffen. During the third stage, referred to as the postrigor stage, meat gradually tenderizes, becoming more acceptable as the aging process continues.

Composition of Meat

The major components of meat are water (56–72%), protein (15–22%), fat (5–34%), and soluble nonprotein substances (ca. 3.5%). This latter component includes carbohydrates, inorganic salts, soluble nitrogenous substances, trace metals, vitamins, etc. The actual composition of a piece of meat depends on the species, breed, age, sex, and diet of the animal from which it is derived and on its anatomical location. Average proximate analyses for different cuts of meat are presented in Table 13.1. The composition of meat is also influenced by how it is trimmed, curing and processing, and the cooking method.