

Avian Muscular System

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For anyone interested in raising poultry for meat, an understanding of the avian muscular system—particularly the muscular system of poultry—is essential for recognizing problems that may occur and taking action to correct them. Also, it is important to know what happens as muscle becomes meat and to be aware of issues that can arise with poultry meat.

The muscular system comprises approximately three-quarters of the body weight of a chicken. Chickens, like all animals, have three types of muscle: smooth, cardiac, and skeletal. **Smooth muscle** is controlled by the autonomic nervous system (ANS) and is found in the blood vessels, gizzard, intestines, and organs. **Cardiac muscle** is the specialized muscle of the heart. **Skeletal muscle** (also called **striated muscle**) is the muscle that forms the shape of a chicken and is used for the chicken's voluntary movements. Tendons are tough, fibrous strands that attach these muscles to bone.

The poultry meat we eat is skeletal muscle. The breast meat of chicken often is referred to as **white meat**. White meat results from muscles that are used less frequently. Chickens usually do not fly. Consequently, they do not use their breast muscles as often as they would if they flew more frequently or for longer distances on a regular basis. The leg meat, such as thigh meat, typically is referred to as **dark meat**. Dark meat results from muscles that are used for sustained activity. Chickens use their legs for walking. The higher activity of the leg muscles increases the muscles' need for oxygen. The darker color of more active muscles comes from a chemical compound in the muscle called **myoglobin**, which is important for oxygen transport. Other species of poultry that are capable of flight (such as some ducks, geese, and guinea fowl) have dark meat throughout their bodies (that is, in the breast, thigh, and drumstick).

U.S. consumers, in general, tend to prefer white chicken meat, which typically is used in value-added products, such as chicken nuggets and chicken fingers. White meat often is considered the healthier of the two types of chicken meat because it has less fat and more protein than dark meat. The higher fat content of dark chicken meat gives it more flavor.

Converting Muscle to Meat

After a chicken is slaughtered, plucked, and eviscerated (evisceration is the removal of internal organs), the muscles undergo changes that affect the quality and appearance of the meat. After slaughter, the heart is no longer pumping and supplying oxygen to the muscles. Due to the lack of blood supply, lactic acid accumulates in the muscles, and the pH declines (the muscles become more acidic). The rate of the pH decline and the final value it reaches are important factors affecting meat quality and color. The pH typically needs to decline from the normal of 7 to 5.8. If the pH does not decline enough (usually because of excess activity before slaughter), the meat will be dark, firm, and dry. On the other hand, if the pH drops too quickly immediately after slaughter, the result is the occurrence of **pale, soft, exudative** (PSE) meat.

Another aspect of converting muscle to meat has to do with aging the meat. As is commonly observed after death, **rigor mortis** sets in soon after slaughter, resulting in a stiffness of the body. At this state, the muscles are temporarily tough. After a period of time, the muscles become more flexible again. For this reason, chicken is aged rather than eaten immediately after being processed.

Issues with Poultry Meat

In the commercial turkey and chicken industries, the occurrence of PSE meat has increased during the past several years. Poultry processors are concerned about PSE meat in fresh tray packs because its pale color can affect color uniformity within the package. Although pale meat is as healthful and safe as more highly colored meat, it is less appealing to consumers. Moreover, while all poultry meat loses moisture during processing, pale-meat chicken loses more moisture than other poultry meat. It is estimated that pale meat results in an annual loss of about \$200 million for the U.S. broiler industry.

Deep pectoral myopathy (DPM), or green muscle disease, was first identified in commercial turkey production and involves the necrosis, or death, of a part of the breast tenderloin (minor pectoral muscles), which results in yellowish-green tissue. Because the tenderloin is deep in the breast, the diseased tissue typically goes unnoticed in a carcass that is sold whole until the carcass is carved for serving.

It is believed that green muscle disease results from vigorous activity of the breast muscles, but only the tenderloins are affected. During vigorous activity, muscles normally swell from increased blood flow supplying oxygen and nutrients needed by the muscles. Compared to other muscles, the tenderloins have a more rigid muscle cover and are confined to a tighter space within the body. Consequently, they cannot expand to accommodate this increased blood flow. The net result of the muscle's being confined and compressed is self-strangulation, suffocation, and, eventually, death of portions of the tissue.

The incidence of green muscle disease increases with increasing market weight in broilers, and more cases are reported in higher-yielding crosses, especially males. Increased broiler activity induced by such factors as feed or water outages, lighting programs, catching and live haul, and even excessive noise, may result in an increased incidence of green muscle disease. The increased activity associated with free-range broiler production, especially if predators are in the area, has resulted in an increased incidence of green muscle disease as well.