# Composition Of Hardness Of Spent Poultry Meat (A Review)

**Saad K.J. Al-Waeli , Jassim K.M. Al-Gharawi and Hussain M. K. Al-Dhalimi**

Animal Production Department, Agriculture College, Al-Muthanna University, Iraq.

**Abstract**

A quality can be defined as a set of properties, that characterize the individual units that are important in determining the degree of acceptance of the unit by the consumer, regardless of the animal species, skeletal muscles have similar structural and chemical properties, they all contain approximately 75% water by weight and 20% protein, with varying amounts of fats and carbohydrates and small amounts of dissolved organic compounds, these components have a role in the development of the different sensory properties of meat, water plays a key role in the juiciness of the meat, the meat tenderness. Fat has an important role in the development of both meat tissues, although the mechanism of this is unknown, meat flavor because fatty substances are the primary source of most of the volatile compounds responsible for the flavor of meat.

**Keywords:** Composition, hardness, spent poultry meat, review.

## Introduction

Poultry meat is one of the most important food sources in the world, because it contains some elements necessary for human nutrition (Ristic et al., 2006). Laying hens whose purpose is to produce table eggs, its meat is not used for food. Therefore, there are large numbers of laying hens, which has not been used after the end of the egg production period, because of the lack of consumer demand for it due to its poor quality and the hardness of its meat, their disposal is one of the most important economic and environmental problems for the poultry industry (Souza et al., 2011).

After the increase in the breeding and production of table chickens, it became difficult to sell old laying hens at reasonable prices, which affects the profits of producers. End-of-production laying hens are usually slaughtered and used for feed in some countries (Kondaiah, 1993).

Several studies have been conducted for the purpose of improving the quality of aged chicken meat, which makes it acceptable to consumers, many methods improve meat tenderness by enzymes (Naveena and Mendiratta, 2004), salts and phosphates (Tan et al., 2018) and calcium chloride (Gerelt et al., 2000).

Tenderizing meat physical such as pressure processing, ultrasound (Jayasooriya et al., 2007), and electrical stimulation (Said, 2004).

Using enzymes to tenderize meat, plant obtained, bacterial and fungal sources. At recent years, attention has been focused on the development and use of the best methods for producing meat while improving its tenderness and preserving its nutritional qualities, these methods try to reduce the hardness of the meat, by reducing the amount of connective tissue in meat without leading to the breakdown of meat proteins, this is done by improving the various physical and chemical properties of the softening process, plant-based enzymes have been used to alter the connective tissue structure and myofiber integrity of all meat, including poultry (Minh et al., 2012).

The study aimed indicate the hardness of poultry meat in all its aspects, and addressing the composition of the spent meat of birds.

**Hardness of meat of spent poultry:**

The meat of adult or elderly birds is generally characterized, poor quality qualities, causing a decrease in its nutritional value, due to two main factors, the first was due to the hypertrophy and stiffness of the myofibrillar toughness (Perez-Chabela et al., 2005). The other factor was the background toughness, as a result of the formation of indivisible bonds between collagen molecules, the main reason for decreasing its quality is due to the hardness of the meat, as a result of increased connections across the connective tissue of adult chickens (Baily and Light, 1989). Li (2006) showed that the toughness of aged chicken meat, it may be due to the stiffness of the muscle fibers resulting from the interaction of contractile proteins (actin and myosin) with each other in the muscle.

The high collagen levels in aged laying hens, increases the hardness of the meat of aged laying hens. In addition, the composition of collagen does not make it easy to dissolve, because of the high fiber strength resulting from the bonding of tropocollagen molecules with each other. Therefore, we find that the meat of laying hens contains the most amount of collagen protein as it increases in age, when measuring their softness by cutting force, its value is low (Trindade et al., 2004).

**Muscle Structure**

Muscle is a fibrous tissue characterized by the ability to contract and relax and provides movement of the organism. Skeletal muscle consists of muscle bundles, each bundle consists of muscle fibers, called the sarcoplasm, and the myofiber membrane is called the sarcolemma. Myofibrils are made up of myofibrils. A single fiber consists of adjacent muscle pieces, muscle segments are composed of protein filaments, which are actin and myosin (Birbrair et al., 2013).

Skeletal muscles or striated muscles, it is the main component of the muscles of the body, consists of a bundle of thin fibers such as the muscles of the head, trunk and limbs, they allow movement and are called voluntary muscles (Zammit et al., 2006). Skeletal muscles include all the muscles attached to the skeleton, its muscle fibers appear as bright and opaque transverse strips alternating with each other, which gives the fibers a clear layout, they are also called voluntary muscles. K Voluntary muscles, it is responsible for moving the structure and some organs, these muscles make up the bulk of animal meat (Saladin, 2010). Skeletal muscle consists of parallel striated muscle fibers, they are bound together in bundles by loose connective tissue, each striated muscle fiber looks like a long structure encased in thin connective tissue, the diameter of the fiber ranges between 10-100 micrometers and 4 millimeters in length depending on its location, multinucleated striated muscle fibers (Lieber, 2002).

The cytoplasm or sarcoplasm of the striated muscle fiber contains longitudinally arranged muscle fibrils, running parallel to each other along the length of the fiber, in cross-sections myofibrils appear as small points (Pavelka and Roth, 2010). The reason for the planning in the muscle fibers is due to the presence of light and dark strips alternating with each other, the location of these fibrous strips is in the same plane as the adjacent fibrous strips, the whole muscle fiber appears transversely striped, the luminous bands are isotropic bands, it's called strips I, in the center of each strip is a thin line called the dark stripes called the Z line, these strips are of unequal properties, as for the strips A, in the middle of each strip A, there is a faint region called the Hensen Zone, or the H . zone, which is interrupted by a darker line known as the M line (Zammit et al., 2006). Each muscle fiber consists of thick and thin parallel rod-shaped muscle threads intertwined with each other, it is 2 micrometers long and 5 inches in diameter, it is made up of a structure known as actin, which consists of bands I to bands A up to band H, while the thicker filaments (1.5 μm in length and 100 Å in diameter) consist of a protein called myosin, muscle contains about 75% water, 19% protein, 2.5% fat, 1.2% carbohydrates and 2.3% non-protein substances (Yamada et al., 2003).

**Muscle Myofibrillar**

Myofibrils are proteins that are soluble in saline, represent about 45-50% of the total proteins of skeletal muscle, myofibrils contain thousands of myofibrils. It occupies a large area and only a small part of it remains for the cytocell. Myofibrils are classified into three main groups. The first are Actin-Myosin Proteins, which are Actin, the protein that makes up the fine filaments, the main protein in the form of thick filaments each part consists mainly of fine threads, exists in two forms: one, spherical, is G-actin, and the other, fibrous, is F-actin and has a molecular weight of about 42 kDa. Myosin, a motor protein in myofibrils, has two globular heads, one tail, and two spherical heads. The molecular weight of muscle myosin is about 200,000 daltons. The most abundant contraction proteins are myosin and actin, it comprises about 55 and 23% of the myofibrill proteins, supports myofipril as well as is responsible for muscle contraction and relaxation (Michael and Holmes, 2010).

The second group is the regulatory proteins, they are both troponin and tropomyosin, they are regulatory proteins associated with myofibrillar actin filaments, they participate in the regulation of muscle cell contraction. Troponin removes tropomyosin from actin filaments and exposes myosin sites to actin filaments. Therefore, troponin facilitates sarcomere contraction while tropomyosin facilitates muscle relaxation (Solaro and Rarick, 1998).

The third group is structural cellular proteins, including titin is a giant protein that acts as a spring molecule responsible for passive flexibility in muscles (Labeit et al., 1990). Nebulin is a protein associated with thin filaments in the sarcomere of skeletal muscle, it regulates the interactions between actin and myosin by inhibiting ATPase activity in a calcium-sensitive manner such as modulin and protein-C. The so-called auto prothromb in plays an important role in regulating processes such as blood clotting, inflammation, cell death, and maintaining the permeability of blood vessel walls (Nicolaes and Dahlback, 2003; Thomas and Keller, 1995).

**Sarcomere**

The sarcomere is the main component of muscle, it was contraction in a muscle fiber and its length is about 2-3 microns. The muscle fiber is composed of a series of many sarcomeres connected to each other, it binds within the muscle fibers (Soeno et al., 1999). The sarcomere is composed mainly of myosin filaments and actin filaments, and transverse tubes containing calcium (ca++). Mitochondria produce the energy required for sarcomere activity, surrounding all these elements is a cytoplasmic fluid, or cytoplasm called sarcoplasm. The sarcoplasm is responsible for the inotropic phenomenon after the sarcomere shortens, consequently, muscle contraction occurs (Martonosi, 2000).

The thick and thin filaments of myosin and actin are within each sarcomere, be in the form of a nested arrangement, this results in dark lines (A) and light lines (I). This arrangement gives the shape of a schematic, the region of overlap between actin and myosin is the A band. The region in band A that does not contain thin filaments is the region H, while the region where there are no thick filaments is region I (Toldra, 2002). Whereas the I domains are arrayed by Z . threads, it is divided by M (Chan, 2011).

**Conclusion**

build muscle fibers, which is the building block of muscle, about 92% of the muscle volume contains a large group of these fibers, these fibers differ in their diameters depending on the type of muscle and the type, sex and age of the animal, each muscle fiber consists of a large group of longitudinal and thin cylindrical fibers surrounded by sarcolemma called myofibrils, these fibrils are immersed in a fluid called sarcoplasm.

**References**

**Bailey**, A. J., and N. D. **Light**. **1989.** Connective Tissue in Meat. and Meat products . Elsevier Appl. Sci., London, UK.

**Birbrair, A., Z. Tan, W. Zhong-Min, M.M. Laura, E. N. Grigori, M. Akiva and D. Osvaldo. 2013.** Role of Pericytes in Skeletal Muscle Regeneration and Fat Accumulation. Stem Cells and Development. 22 (16): 2298–2314.

**Chan, J. T. Y. 2011.** Protein Functionality in Turkey Meat. Food Science and Technology. Department of Agricultural, Food and Nutritional Science. University of Alberta.

**Gerelt, B., Y. Ikeuchi and A. Suzuki. 2000.** Meat tenderization by proteolytic enzymes after osmotic dehydration. Meat Sci., 56:311-318.

**Jayasooriya, S.D., P.J. Torley, B.R. D'arcy, and B.R. Bhandari, 2007.** Effect of high power ultrasound and ageing on the physical properties of bovine semitendinosus and longissimus muscles. Meat Sci. 75: 628–639.

**Kondaiah N. 1993.** Products from spent hen. Poultry International; 49(1):46-47.

**Labeit S., D.P. Barlow, M. Gautel, T. Gibson, J. Holt, C.L. Hsieh, U. Francke, K. Leonard, J. Wardale and A. Whiting. 1990.** A regular pattern of two types of 100-residue motif in the sequence of titin. Nature. 345 (6272): 273–6.

**Li, C. T. 2006.** Myofibrillar protein extracts from spent hen meat to improve whole muscle processed meats. Meat Science. Volume 72, Issue 3, Pages 581-583.

**Lieber, R.L. 2002.** Skeletal muscle structure, function, and plasticity. Wolters Kluwer Health.

**Martonosi, A. N. 2000.** Animal electricity, Ca2+ and muscle contraction. A brief history of muscle research. Acta Biochimica Polonica. 47 (3): 493–516.

**Michael L. and KC. Holmes 2010.** The actin-myosin interface. PNAS. vol. 107. no. 28. 12529–12534.

**Minh H., A.E.A. Bekhit and A. Carne. 2012.** Characterisation of commercial papain, bromelain, actinidin and zingibain protease preparations and their activities toward meat proteins. **Food Chemistry**, 134(1), 95-105.

**Naveena, B.M. and S.K. Mendiratta. 2004.** The tenderisation of buffalo using ginger extract. Journal of Muscle Foods 15(4): 235-244.

**Nicolaes G.A. and B. Dahlback. 2003.** Congenital and acquired activated protein C resistance. Seminars in Vascular Medicine. 3 (1): 33–46.

**Pavelka M. and J. Roth. 2010.** Myofibrils and Sarcomere. Functional Ultrastructure pp 300-301.

**Perez-Chabela M.L., I. Guerrero, M.C. Gutirrez-Ruitz and J.M. Betancourt-Rule. 2005.** Effect of calcium chloride marinating and collagen on beef, horse, rabbit and hen meat hardness. Volume 16, Issue 2: Pages 141–154.

**Richard M. and R.T.W. Huiatt. 1990.** Roles of the Cytoskeletal Desmin, Titin and Nebulin Proteins in Muscle. American Meat Science Association . 36th Reciprocal Meat Conference:116-124.

**Ristic, M., K. Damme, and P. Freudenreich. 2006.** Carcass value of ducks and geese in dependence of breed and age. Fleis- chwirtschaft 86:107–110.

**Said, B.A.H. 2004.** The Use of Electrostimulation Technology in Tinnitus, College of Agriculture - University of Baghdad. p. s. 243.

**Saladin, K.S. 2010.** Anatomy and Physiology (3rd ed.). New York: Watnick. pp. 405–406.

**Soeno Y., H. Yajima, Y. Kawamura, S. Kimura, K. Maruyama and T. Obinata. 1999.** Organization of connectin/titin filaments in sarcomeres of differentiating chicken skeletal muscle cells. Mol Cell Biochem. 190(1-2):125-31.

**Solaro RJ and Rarick HM. 1998.** Troponin and tropomyosin: proteins that switch on and tune in the activity of cardiac myofilaments. Circ Res. 83(5):471-80.

**Souza, K.M.R., R.B. Araujo, A.L. Santos, C.E.C. Rodrigues, D.E. Faria and M.A. Trindade. 2011.** Adding Value to the Meat of Spent Laying Hens Manufacturing Sausages with a Healthy Appeal. Brazilian Journal of Poultry Science. v.13 (1): 57-63.

**Tan, S.M.H., L. de Kock, G.A. Dykes, R. Coorey and E.M. Buys. 2018.** Enhancement of poultry meat: Trends, nutritional profile, legislation and challenges. South African Journal of Animal Science. vol.48 n.2 :117-125.

**Thomas C.S. and I.I. Keller. 1995.** Structure and function of titin and nebulin. Current Opinion in Cell Biology. Volume 7, Issue 1, Pages 32-38.

**Toldra, F. 2002.** Description of main muscle characteristics. Pages 7-26 in Dry cured Meat Products. F. Toldrá, ed. Food & Nutrition Press, Inc., USA.

**Trindade, M. A., P. E. de Felício and C. Jo. C. Castillo. 2004.** Mechanically separated meat of broiler breeder and white layer spent hens. Sci. agric. (Piracicaba, Braz.) vol.61 no.2: pp 217-226.

**Yamada T., Y. Kunioka, J. Wakayama, M. Aimi, Y.S. Noguchi, N. Akiyama and T. Kayamori. 2003.** Molecular organizations of myofibrils of skeletal muscle studied by atomic force microscopy. Adv Exp Med Biol. 538:285- 294.

**Zammit, P.S., T.A. Partridge and Z. Yablonka-Reuveni. 2006.** The skeletal muscle satellite cell: the stem cell that came in from the cold. Journal of Histochemistry and Cytochemistry. 54 (11): 1177–91.