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Lec. 2 : (Chemical composition of meat and quality)

In general , meat is composed of 60 – 70 % water , 10 – 20 % protein , 4 – 20 % fat and 1 % ash . there will be some exceptions to the above compositional ranges . in that moisture content could be as low as 40 % in raw materials that are high in fat likewise , the fat content could be as high as 50 % in fatter meat cuts .

Moisture :

Water is the largest components , comprising 70 % of lean tissues . there is relatively consistent relationship between the moisture and the protein content of muscle . this means that one part of muscle protein can typically bind or hold about 3.5 to 3.7 parts of water (moisture : protein ratio 3.5 – 3.7) . as fat content of muscle increases or decreases , the content of moisture and protein combined will shift in the possible direction .

There are 3 forms of water in meat ...

1- is the bound which is a small amount (5 – 10 g / 100 g protein = 4 – 5 % of total water) .and is held very tightly by the charged hydrophilic groups on the muscle protein even during application of severe mechanical or physical force .

2- is the immobilized water which forms 2 – 3 molecule layer attracted to the bound water molecules around protein groups (50 – 60 g / 100 g protein) , and become successively weaker as the distance from the reactive group on the protein becomes greater .

3- is the free water (300 g / 100 g protein) which is loosely held and very dependent upon capillary space between and within muscle proteins

Muscle protein :

Meat is an excellent source of high quality protein which is the most important component of meat products . product costs are largely based upon the quantity of meat protein in their formulations . on the basis of its



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location , meat proteins can be divided into the sarcoplasmic , Myofibrillar and connective tissues protein .

Sarcoplasmic " plasma" protein :

The sarcoplasmic "soluble" protein make about 25 – 35 % of the total muscle protein . they are soluble in water , and easily lost through improper processing procedures e.g. thawing frozen meat through normal commercial practice (commonly observed as drip , seen in the bottom of bins or tanks of thawing meat) . these proteins are often discarded in the meat industry , because of the assumption that they are blood . they contain albumins as myoglobin (1 % of the total muscle protein) which is responsible for meat color .

Meat color is largely due to the water – soluble protein " myoglobin" . the difference in myoglobin concentration is the reason why there is often one muscle group lighter or darker than another in the same carcass . the concentration of myoglobin in meat is affected by species and age of the animals as well as the type of muscle fibers . beef has more myoglobin than pork , veal or lamb , thus giving beef a more intense color . the maturity of the animals also influences pigments intensity , with older animals having darker pigmentation .

Myofibrillar " structural / contractile " protein :

Myofibrillar proteins consists about 55 % of the total muscle protein they are responsible for muscle rigidity . Myofibrillar proteins are composed of myosin (55%) , actin , troponin and tropomyosin (40- 45%) .

Connective tissue " stromal" protein :

The connective tissue of muscle comprises 10 – 15 % of total muscle proteins , and composed mainly of collagen and elastin . collagen is the most common connective tissue protein in meat , it forms a fibrous network .



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Species	Protein %	Water %	Fat %	Ash %
Beef	16.5-21.9	55.7-74 .0	4.6-27	0.8-1.1
Veal	19.5-20	70-74	5.5-10	1-1.1
Sheep	14.5-18.5	74.5-76	5.8-6.2	0.8-1.2
Pork	12.7-20	45-70	6.3-11	0.7-1

Fat :

Fat is the most variable component in meat in terms of compositions (8 – 30 %) . fats accumulate in and around the muscles (70 % of fat is subcutaneous or intramuscular) . about 90% of adipose tissues is triglycerides . triglycerides consist of one molecule of glycerol and several types of fatty acids .

In the animal body there are subcutaneous fat deposit (under the skin) and fat (intramuscular fat) . fat deposit between the fibers of a muscle bundles are called intramuscular fat and lead in higher accumulations to marbling . marbling of muscle meat contributes to tenderness and flavor of meat . for processed meat products , fat are added to make products softer and also for taste and flavor improvement . buffalo fat has a whiter color than beef fat and is therefore well suited for processing . the limiting factors for utilization of beef / buffalo fat is it is limited availability , as beef / buffalo carcasses do not provide high quantities of body fats suitable for the manufacture of meat products .

The main value of chemical composition of meat for different food animals.

Proteins :

- 1- Myofibrillar (actin , myosin , actinomyosin) .
- 2- sarcoplasmic (myoglobin , hemoglobin , enzyme) .
- 3- connective tissue and organelles (collagen , elastin , reticulin , mitochondria) .



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Lipids :

Nature lipids , fatty acids , phospholipids .

Carbohydrate :

Glucose , glycogen , lactic acid , formic acid .

Vitamins :

Fat soluble (a,e,d,k) .

Water soluble (c , B complex) .

Note : large quantities of vit. Destroyed during cooking or processing .

Soluble non-protein substances :

1- nitrogenous substance (free amino acid) which responsible of flavor creatinin .

2- inorganic mineral (soluble phosphor , zinc , calcium , sodium , magnesium) with trace elements .

Nutritional value of meat :

1- high protein which require for growth and rebuilding and production or energy and heat .

2- meat contains nitrogenous substance rich with amino acid essential for human life .

3- contain important vit. Such as thymine , niacin , B complex .

4- meat contain or rich of iron and phosphorus .

Slaughter animals :

Its mean animals brought into an abattoir for slaughter & used for public human consumption . theoretically human needs animals for supplying meat fit for human consumption . in practice only a relatively small



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numbers of species are used today in many parts of the world . horse flesh forms an important article of human diets and slaughter in Denmark , Belgium , Holland ,England and Germany .

Nowadays , the production and consumption of the poultry meat and rabbits has extremely increased after the recent improvement in feed conversion rate and their quick turnover rabbits from subsidiary , but important source of meat because of their quick turnover and feed conversion rate 2:1 .

A great advantage of rabbits as meat producer is its high muscle/bone ratio due to 70% of the carcasses is composed of edible meat as compared with about 50% in the chicken

Rigor mortis or setting " post-mortem glycolysis " .

Rigor mortis is a state of reaction occurs after slaughter " death " as a result of excessive muscular contraction and exhaustion of oxidative enzymatic system and accumulation of metabolic products " lactic acid " resulting in coagulation of the muscle protein actin and myosin where the muscles and joints become stiff known as post-mortem rigidity or setting of the carcass .

Rigor mortis start in normal cases 2-3 hours P.M and stays for 1-6 days then disappears due to softening of coagulated actinomyosin . by the autolytic enzyme when actins become soluble . muscles in rigor mortis show Harding , stiffing , shortening , loss in elasticity and loss in transparency . the time of onset of rigor mortis dependent upon the speed of breakdown of ATP and the development of glycolysis .

Factor influencing rigor mortis ...

- 1- degree of muscular activity before slaughter , the stronger and the high activity of muscle during lives lead to rapid rigor mortis .
- 2- the health of the animal , glycogen may be lowered as a result of ante-mortem starvation , diseases or physical stress .



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3- the atmospheric temperature , high temp. accelerates the appearance of rigor mortis , while low temp. cold retard it .

Significance of rigor mortis ...

1- it plays an important role in the keeping quality of meat as the acid reaction reduces the multiplication of bacteria , thus retards the putrefaction of meat .

2- it renders the meat more tender and palatable , the reaction of muscle after slaughter is slightly alkaline , (after 3 – 6 hours it becomes acidic due to the formation of lactic acid , formic acid which cause swelling and loosening of connective tissues) .

3- rigor mortis is one of the keeping quality parameters .

4- rigor mortis can determine the degree of keeping quality of meat through measuring " rigor mortis " .

Comparison between fresh and set meat ...

No.	Subject	Fresh (before rigor mortis)	Set (after rigor mortis)
1	PH.	6.9 – 7.1	5.8
2	Muscular fiber	Swollen	Shrine
3	Inter fiber space	Small	Large
4	Pickling ability	Bad	Good
5	Loose H ₂ O	Small	Large
6	Ability to take H ₂ O	Good	Bad
7	aroma	No developed (unpalatable)	Developed
8	color	Dark red	Light red
9	appearance	Glistening	Turbid
10	Consistency	Course , tough , gummy	Tender and juicy

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Good luck

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