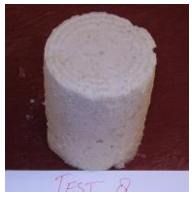
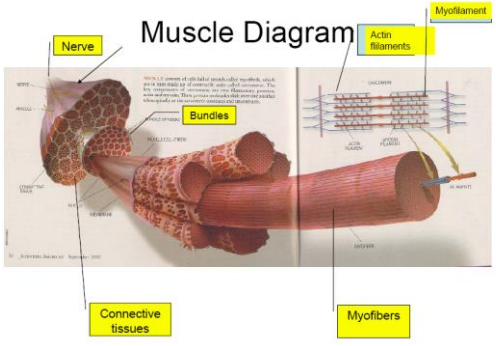
Water and fat binding capacity of meat and meat products

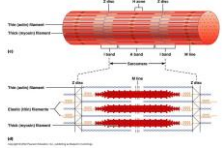


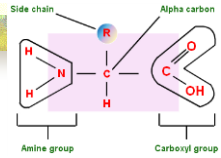


Meat proteins

3 types:

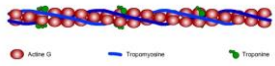
1. myofibril proteins (muscle contraction)
   - +/- 55% of the total amount of muscle proteins
   - But: 80% responsible for the WHC and binding properties
     - Salt soluble (best soluble at 4% - 5% salt) (brine strength 6 - 8%)

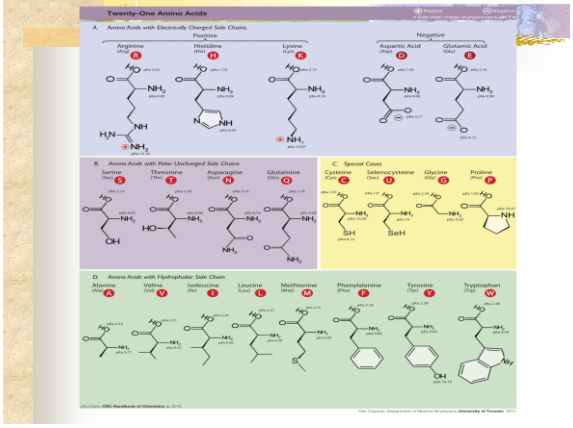




1. Myofibril proteins

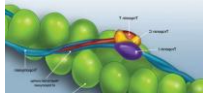
- Most important proteins because of:
  - WBC (polar character of amino acids)
  - Emulsifying properties
  - Heat gelling, responsible for structure and consistency (long filament like molecules)
  - It is in large quantities present in lean meat



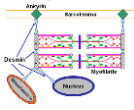


1. Myofibril proteins comprise:

myosin ~55%
actin
troponin } 40 - 45%
tropomyosin



desmin, synemin, α actinin, nebulin and some proteins responsible for structure } 1 -5%

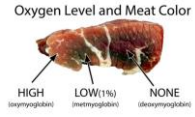


2. Sarcoplasmic proteins (water-soluble, intracellular fluid)

- ~ 30% of the total amount of muscle proteins
- ~ 20% of the WHC and binding
- Isoelectric point lies most commonly between pH 6 - 7
- Hundreds of enzymes responsible for growth and energy supply
- Mostly molecules with a low molecule weight (small molecules)

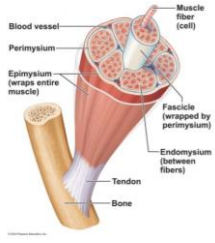
Importance of sarcoplasmic proteins

1. Enzyme activity
   - Maturation of the meat
   - Post mortal glycolysis
     - Change of pH
   - Potential contribution to the taste of the meat by protein destruction → hydrolyzed proteins
2. Color
   - Myoglobin
     - Responsible for the color and color changes of the meat

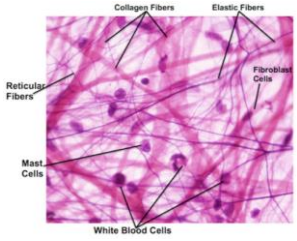


3. Connective tissue proteins

- Muscle fibers are surrounded by a network of connective tissue structures: **the endomysium**
- The fascicle is surrounded by: **the perimysium**
- The muscle itself is surrounded by: **the epimysium**



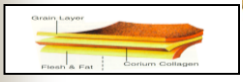
Connective tissue

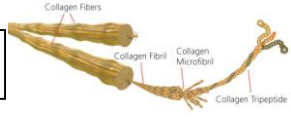


Connective tissue consists of a basic mass, containing; proteins, fats, polysaccharides, collagen fibres and elastic fibres

Collagen fibers

- Collagen is a protein consisting of strong but small fibrils forming a fiber
- Collagen fibers are build by tropocollagen (a helix of three polypeptide chains)
- When insufficient heated, collagen fibers are mainly responsible for the toughness of the meat
- A network of collagen fibers is particularly present in (pig) skin tissue



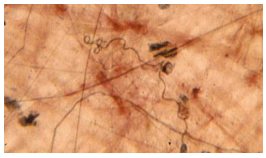


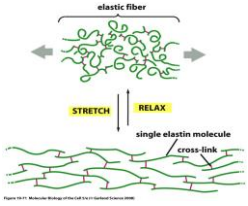
Stability of collagen fibers

- Collagen fibers are shrinking in hot water (> 65°C.)
- The helix will collapse into gelatin chains → more tender meat
- The total amount of collagen en the number of crosslinking's between the chains in the helix increases when an animal gets older
  - Longer heating process is needed
  - Strong diminishing
- Due to a long heating process (dry conditions), collagen becomes hard and impervious (collagen casings)
- Collagen is resistant against enzymes so enzymatic tenderization has hardly any effect

Elastin and elastin fibers

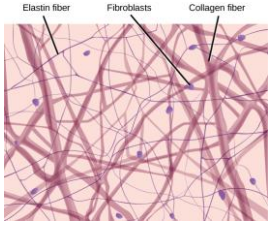
- Maximum stretch of collagen fibers is approx. 5%
- Stretch of elastin fibers is many times her own length. Mostly present in t he walls of blood vessels and knee/anklets





Elastin and elastin fibers

- Elastin fibers are more resistant to extreme acid environments, alkaline environments and heating comparing to collagen fibers
- Elastin fibers are not converted and that's why they are responsible for permanent toughness (it's important to clear meat from elastin)



Creating a good binding is essential for making meat products (cured ham and sausages)

- Binding
  - Coherence of meat parts mutual, before or after heating
  - Binding of water: degree of binding capacity of it's own water or added water
  - Binding of fat: degree of binding it's own or added fat by emulsifying or inclusion

Water & fat binding: definitions

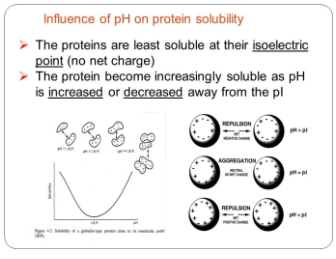
- WHC = Water Holding Capacity
  - Capability of meat to retain it's own moisture
- Drip loss
  - Loss of moisture because of the fact that the meat can't hold it's own water
- WBC = Water Binding Capacity
  - The meat's capability of binding added water
- Cooking loss
  - Water, fat or jelly that withdraws from the meat (product) during heating

Importance of a good binding concerning meat and meat products

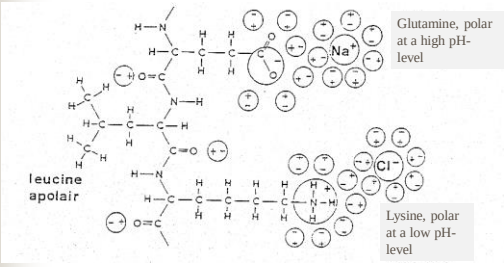
- Meat
  - Efficiency
  - Appearance (drip inside the tray's)
  - "tenderness" / juiciness of the meat
- Cured meat products
  - Efficiency
  - Appearance (grease or jelly deposits)
  - Structure/coherence meat parts/grease parts (important during slicing)
  - Less dry finished product

Influence of pH on the WBC of meat proteins

- I.E.P. (PI) = pH level where the net charge is neutral and the WBC is minimal
- I.E.P. meat proteins
  - Actomyosin = 5,0
  - Collagen = 7,0
  - Gelatin = 4,7

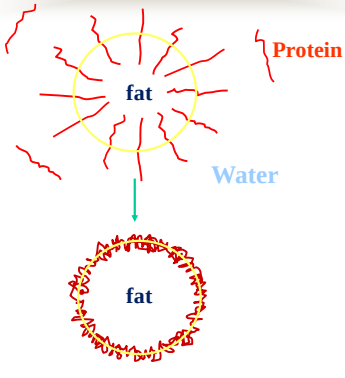


Influence of salt (NaCL) on the WBC of proteins



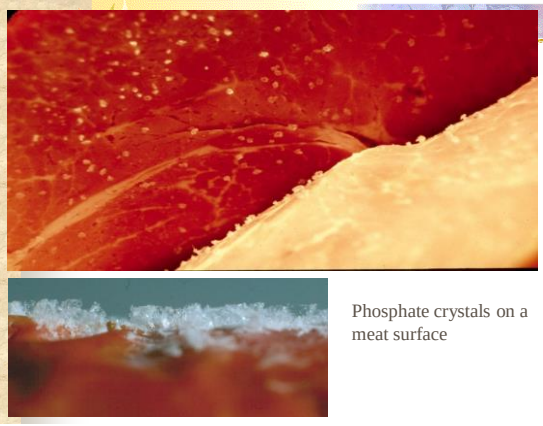
Fatbinding:

- Fat in the form of fat cells:
  - No free fat, fat cells can be immobilized in a protein network
- Free fat after damaging of the fat cells
  - Fat is emulsified by the SPP-fraction of the meat pulp. Meat protein is located on the border of fat droplets.
  - Emulsified fat droplets are enclosed in a protein network (next slide).
- A lot of free fat needs a great deal of protein for emulsification
  - Often results in large deposits of grease or jelly
  - Extra emulsifier is needed (for example; meat (non-meat) proteins)

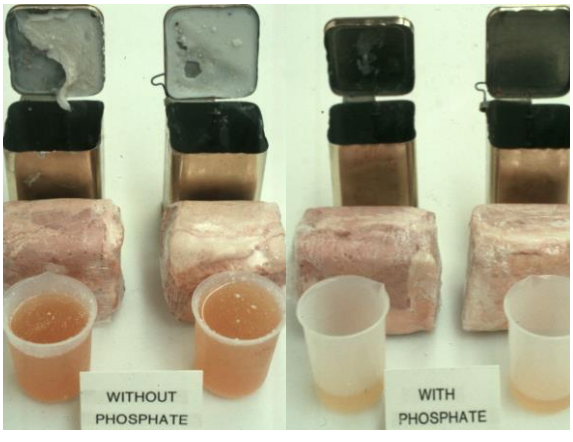


Influence of phosphates on WBC proteins

- Function phosphates
  - Improving water and fat binding
    - pH increasing
    - Splitting of actomyosin
    - Binding of two valued ions (Calcium)
- Maximum extent permission is 0,5% calculated as P_2O_5
  - At higher dosages → soap like off-taste
  - Dried product → crystallization of phosphate on the surface
- Mostly used in ready-to-use mixture for cutting processes or brines for injectors



Phosphate crystals on a meat surface



Non-meat proteins for improving binding capacities

	Plasma protein	Collagen protein	Soy protein isolate	Carrageenan
Origin	Animal	Animal	Vegetable	Vegetable
Meat protein	Yes	Yes / No	No	No
GMO free	Yes	Yes	At choice	Yes
Allergenicity	No	No	Possible	?
Solubility	+++	+ / ++	++	++
Gel forming	+++	++	++	++
Water binding	1 : 16	1 : 10 – 1 : 20	1 : 4 – 1 : 5	> 1 : 30
Emulsifying prop	> 1 : 5 : 5	> 1 : 5 : 5	1 : 4 : 4 – 1 : 5 : 5	0
Taste & smell	+	+++	++	++
Protein content	70 – 80%	> 95%	> 90%	n/a

Non-meat proteins for improving binding capacities

	Plasma protein	Sodium caseinate	Egg albumin	Whey Protein
Origin	Animal	Animal	Animal	Animal
Meat protein	Yes	No	No	No
GMO free	Yes	Yes	Yes	Yes
Allergenicity	No	Possible	Possible	Possible
Solubility	+++	+++	+++	+++
Gel formation	+++	+	+++	++
Water binding	1 : 16	1 : 5	1 : 8	1 : 4
Emulsifying prop	> 1 : 5 : 5	1 : 7 : 7 – 1 : 9 : 9	1 : 4 : 4	1 : 4 : 4
Taste & smell	+	+++	+++	+++
Protein content	70 – 80%	> 80%	> 80%	> 80%