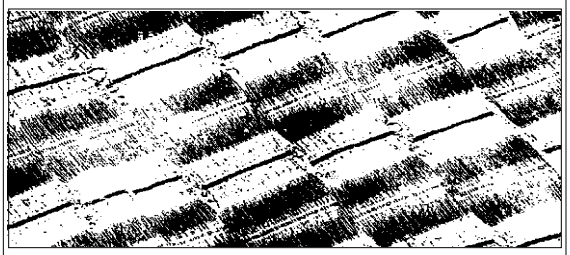
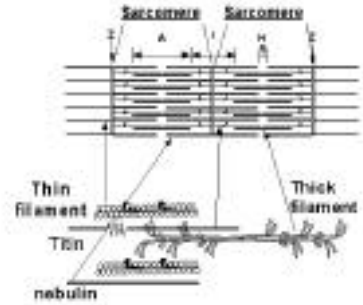
Muscle Structure

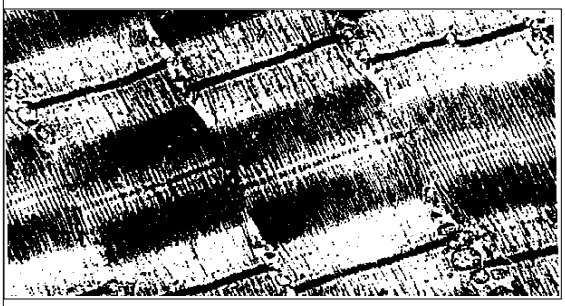


Fiber

Sarcomere



Structure



Thin Filaments

Actin	42,000
β-actinin	
BI	35,000
BII	31,000
Tropomyosin	
α-tropomyosin	33,000
β-tropomyosin	36,000
Troponin	
C	18,000
I	20,900
T	30,500

Thick Filaments

Myosin	
Heavy chain	220,000
Alkali light chain	16,000 - 22,000
DTNB light chain	18,000
C-Protein	128,000
H-Protein	69,000
X-Protein	152,000

Sarcomere Structure

α-actinin	100,000
Desmin	55,000
Nebulin	700,000 - 900,000
Titin	1,000,000
Myomesin	170,000
I-Protein	50,000

Myosin

Myosin makes up approximately 45 to 50% of the contractile proteins Its properties include:

Molecular weight	480,000
Number of polypeptides	6
Axil ratio	40:1
pI	5.4 in KCl
pI in presence of Ca or Mg	>9.0

Myosin Composition

- Heavy chains
  - Two in each myosin
  - Molecular weight 200,000 - 220,000
  - Globular head and filamentous tail regions
  - Tail is essentially 100% a-helix
- Light chains
  - Two alkali chains with molecular weight of from 16,000 - 22,000
  - Two DTNB chains with molecular weights of 18,000

Myosin ATPase

Located in head regions

Activated by calcium

Modified by actin - in the presence of actin, magnesium activates the ATPase

pH sensitive

Involved in muscle contraction.

Actin

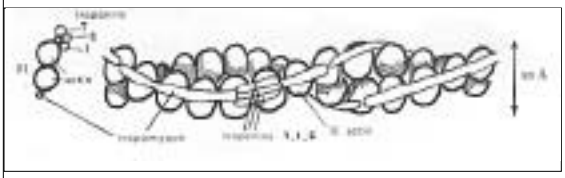
Globular - G actin 46,000

Contains ATPase activity

Can polymerize to from F actin with a molecular weight of 14,000,000

Interacts with troponin and tropomyosin to form thin filaments

Thin Filaments



Tropomysin

Two polypeptides α– and β–tropomyosin

5 to 8% of the myofibrillar protein

Polypeptides aggregate to form long filaments that fit within the grove formed by the two chains of actin

Each molecule spans seven actin molecules and controls the reactivity of these actin molecules

Troponin

Troponin - three sub units

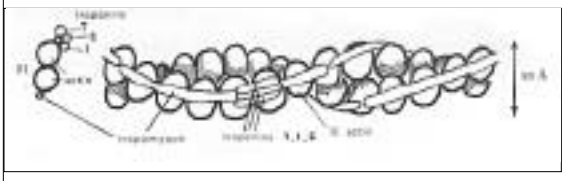
Troponin C - calcium binding

Troponin T interacts with tropomyosin

Troponin I can block the actin binding site for myosin

One set of subunits is associated with each molecule of tropomyosin and is involved with the activity of seven actin molecules

Thin Filaments



Thick Filaments

Associated with the thick filaments are the C, H and X proteins. These proteins appear to form rings around the thick filament at roughly even intervals. It has been suggested that they aid in the structure of thick filaments, possibly preventing helping in the maintenance of thick filament structure during contraction.

Structural Components

M line (Myomesmin) through center of the sarcomere and controls alignment of filaments

Z shaped line at each end are called the Z lines

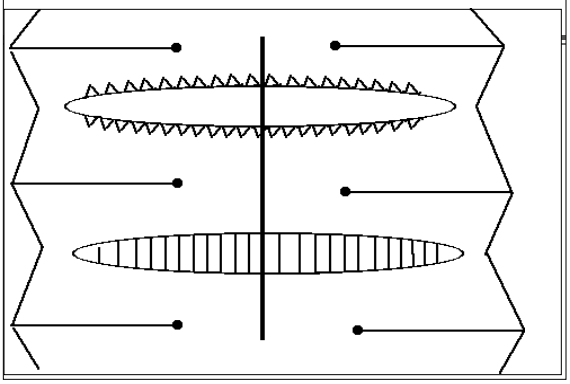
Above and below each thick filament are the think filaments composed of actin, tropomyosin and troponin

Structural Components

Beta actinin is made up of two proteins and is found at the end of the thin filaments. May control extent of contraction

Desmin is a normal component of the cytoskelleton of the cell and is capable of assuming a filamentous structure

Sarcomere Structure



Structural Components

Titan, with a molecular weight of 1,000,000 makes up 10% of the total sarcomere protein. It can interact with myosin, α-actinin and M-line proteins and is thought to have a role in determining the length of the Sarcomere.

Nebulin makes up about 5% of the total protein and has a molecular weight of about 800,000. It has many actin binding sites and is thought to help determine the length of thin filaments.

Sarcoplasmic Reticulum

- **Runs through muscle cell**
- **Branches**
- **Junctions contain a Ca ATPase**
- **Controls Ca content of cell**
- **Responds to nerve impulses**

Contraction

- **Nerve impulse depolarizes membrane**
- **Calcium concentration increases**
- **Calcium binds to troponin C**
- **Tropomyosin-troponin complex moves**

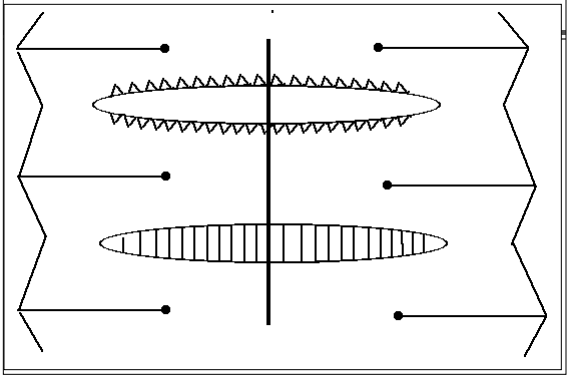
Contraction

- **Actin can interact with myosin**
- **ATP hydrolysis occurs**
- **Conformational change**
- **Filaments slide**

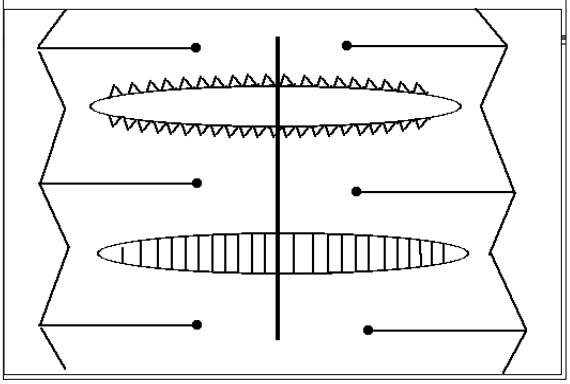
Contraction

- **Contraction continues as long as calcium and ATP are present**
- **Nerve impulse ceases**
- **Calcium pumped out of muscle**
- **Tropomyosin-troponin complex moves**
- **Muscle relaxes**

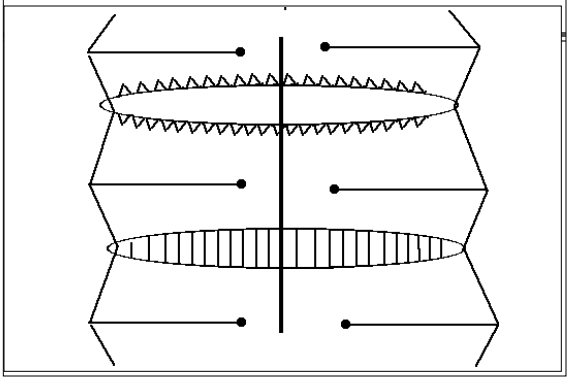
Contraction



Contraction



Contraction



Post Mortem Changes

- Loss of oxygen
  - Anaerobic conditions
  - Lactic acid accumulation
- Mitochondria cease to function
- Lipid metabolism ceases
- ATP depleted by ATPases

Post Mortem Changes

- Creatine PO_4 converted to ATP and creatine
- Glycolysis yields ATP and lactic acid
- Glycolysis controlled by PFK
- PFK inactive around pH 5.1-5.5
- pH of inactivation is higher at higher temperatures

PSE

- Stressed animal (high adrenaline)
- Rapid the rate of depletion of ATP
- Low ultimate pH at high temperature
- Protein denaturation
- Loss of water holding capacity
- Pale-soft exudate (PSE)

DFD

- Exhausted animal
- Low energy
- High ultimate pH
- Microbial spoilage
- Dark colored and dry
- Dark, firm and dry (DFD)

Cold Shortening

- Cool too fast
- Change in the crystalline state of the lipids of the sacroplasmic reticulum
- Loss of membrane integrity and sudden increase in calcium content of the tissue
- Results in a rapid contraction that is difficult to relax and causes the resulting meat to be tough