Meat Color

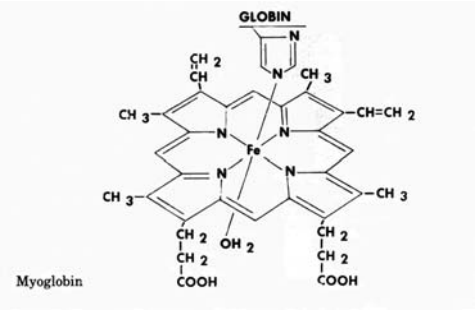
- Meat color is important because it is the initial impression a consumer gets of a product.
- Color has a major impact on the purchase decision.
- Color is dependent on:
  - pigment content
  - ultimate pH
  - rate of pH decline postmortem
  - physical characteristics of muscle
  - ingredients

Meat Color

- Pigments
  - Two main pigments are myoglobin and hemoglobin.
  - Majority of color due to myoglobin
  - Color reactions similar for both compounds.
  - Hemoglobin (MW 67,000)
    - four heme molecules and four globin proteins
    - in live animals carries oxygen in th blood
    - most lost during the harvest processes

Myoglobin

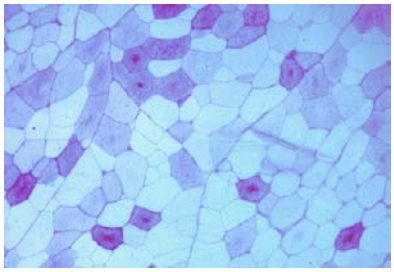
- MW 16,000, Sarcoplasmic protein
- Iron porphyrin compound with globin moiety attached
- Iron has 6 bond orbitals, four covalently attached to four nitrogen of the porphyrin ring structure, one attached to a globin protein
- The 6th bond orbital is open for formation of complexes with several compounds
- Oxidation state of iron and chemical occupying the 6th orbital determine color of meat.



Myoglobin

Meat Color

- Meat is a combination of different fiber types.
- These fiber types affect the perceived color of the meat product.
- Muscles are made up of a mixture of fiber types.
- The myoglobin content of each fiber type is different, contributing to the differences in color



Color Intensity

- Color Intensity is affected by many factors with most being related to the amount of myoglobin
  - species
  - muscle location and function
  - age
  - nutrition
  - exercise

Color Intensity

Effect of species on the myoglobin content of meat

Species	Color	Myoglobin mg/g wet
Pork	Grayish pink	1-3
Lamb	Brick red	4-8
Beef	Bright cherry red	4-10
Poultry (dark)	Light tan	1-2
Tuna	White	0.5-1

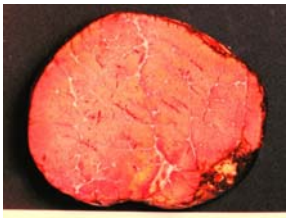
Color Intensity

Age	Myoglobin content (mg/g) wet tissue
Veal	1-3
Young Beef	4-10
Mature Beef	16-20

Color Intensity

Effect of muscle location and function on myoglobin content

Muscle	Myoglobin mg/g wet tissue
Leg	1.75-2.0
Heart	2.8-2.9
Gizzard	19.6-26.5



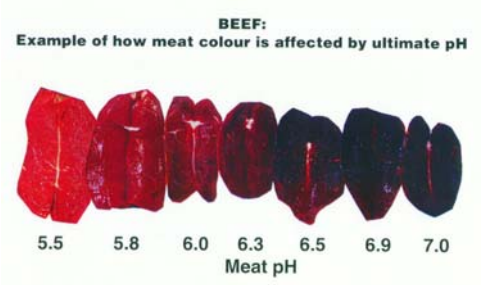
Nitrosylhemochrome

Meat Color and pH

- The rate and extent that muscle pH declines postmortem greatly affects meat color.
- If the pH declines to the normal pH of 5.5-5.7 within 45 min or less, the muscle will appear very pale and soft (PSE).
- A very low ultimate pH (<5.4) will also result in a paler color.

Meat Color and pH

- If the pH does not drop postmortem, the meat will be dark.
- The color changes observed with PSE and DFD meat are mostly due to structural changes in muscle.



Meat Color and pH

- Some of the changes are due to the rate of myoglobin oxygenation.
- The changes in pH affect the charge on the proteins making up the muscle.
- Changes in protein charges alter the spacing between the fibres of the meat, and this affects how light is reflected and absorbed, and thus affects the visual appearance.

Color Stability

- High ultimate pH affects enzyme activity and the rate of myoglobin oxygenation.
- The dry surface of DFD meat s inhibits the penetration of oxygen into the meat and thus slows down the oxygenation process.
- The length of time the meat has been stored postmortem affects the color stability of the meat or meat product.

Color Stability

- Increased time from slaughter results in reduced color stability because co-factors necessary for the reduction of metmyoglobin are depleted as postmortem time increases.
- Products made with frozen meat will be darker initially and will not maintain the fresh color for as long as products made from meat which has never been frozen

Color Stability

- Both storage time and temperature have a great effect on color stability.
- Color acceptability decreases as storage time increases; however, the length of time the color is acceptable is greatly affected by storage temperature.
- Fresh meat and meat products should be stored at -1.5°C (29.3°F) to give maximum color shelf-life and safety of products.

Color Stability

- **Particle Size Reduction and Mixing**
  - The more air that is incorporated into a meat product, the more stress is put upon the natural reducing systems of meat which help maintain oxymyoglobin stability and keep metmyoglobin formation in check.
  - Longer mixing times and smaller meat particles results in shorter color shelf-life for meat products.
  - Use of vacuum mixers helps to improve color stability, but will not completely bring the stability back to what would be expected in whole muscle products.

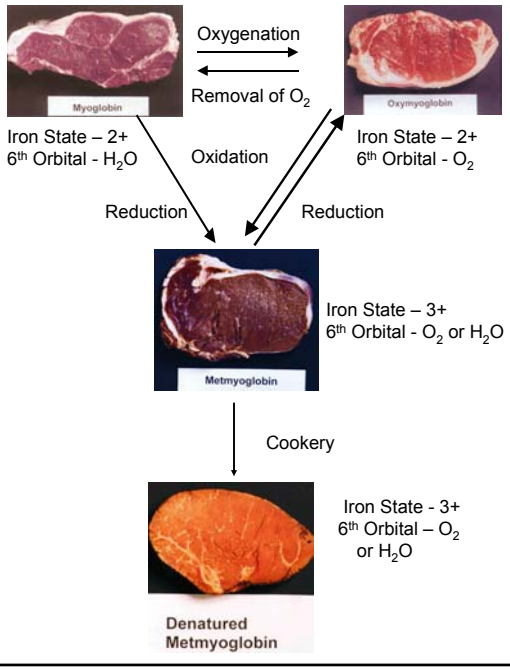
Cooked Meat Pigment

- During the cooking process, myoglobin is denatured.
- All of the pigment is not affected at the same time or to the same extent and this is why you get reddish color at different end point temperatures when cooking.
- Certain meat conditions can result in protection of the myoglobin.

Cooked Meat Pigment

- The ultimate pH of meat or meat products will affect how the meat color changes during cooking.
- If the meat has a high pH, it will have to be cooked to higher end-point temperatures to get the same visual degree of doneness as one with normal pH.
- Frequently, complaints of this hard to cook defect are associated with a high pH of the meat or meat product.

Fresh Meat Color Reactions



Pinking of Uncured Cooked Products

- Pinking is caused by many factors and should not be confused with the hard to cook phenomena caused by high meat pH.
- Cooked product can become contaminated with the nitrite.

Pinking of Uncured Cooked Products

- It takes only small amounts of nitrite to develop cured meat color.
- Although 50 parts per million are necessary to maintain the pink color in cooked ground beef, pink color can show up with levels as low as 5 parts per million

Pinking of Uncured Cooked Products

- A pink color can also be formed in slow cooked meat products that have not been contaminated with nitrite.
- It is caused by specific conditions that promote interaction of natural meat pigments and nitrogen containing constituents of meat.
- This color is actually desired in products such as Texas barbecue.

Pinking of Uncured Cooked Products

- Surface pinking, also termed “pink ring” can occur if gas ovens or barbecue grills are used to cook meat products.
- Incomplete burning of the gas or contaminates in the gas result in the formation of nitrogen dioxide and nitric oxide.

Pinking of Uncured Cooked Products

- Naturally occurring nitrates found in water and vegetables can be converted to nitrites during thermal processing and can cause a pink color to form.
- This occurrence is rare because nitrates take longer periods of time to be converted to nitrites which in turn yield nitric oxide that forms the color pigment necessary for the pink color.
- This color is usually seen in slow cooked soups or stews.

Pinking of Uncured Cooked Products

- Another cause of pink color is the presence of carbon monoxide (CO).
- Carbon monoxide combines with natural pigments in meat to produce a dark red color in raw and cooked meat.
- Small amounts of the gas may come from dry ice, or carbon dioxide freezer tunnels used in hamburger production and it will affect color.

Pinking of Uncured Cooked Products

- Carbon monoxide, which has a greater affinity for myoglobin than oxygen, binds almost irreversibly to the raw color pigment.
- Research has shown that if CO is used in modified atmosphere packages a dark red color develops and it remains after cooking.

Iridescence in Processed Meat Products

- Iridescence is a common problem in sliced roast beef and ham products.
- The iridescence of meat products is produced by a combination of the angle of incidence of the light on the muscle fibres and the wetness of the surface.
- If the fibres are pulled slightly out of alignment during slicing, the light strikes the fibre at an angle scattering light which appears as the rainbow or greenish color on the surface of the meat.
- Addition of phosphate seems to exacerbate the problem by increasing the amount of water that is retained by the product.

Meat Color

- **Color is the single most important factor of meat products that influences consumer buying decision and affects their perception of the freshness of the product.**
- **Knowing the factors that affect color is important to understanding problems when they occur.**
- **Everyone dealing with meat products should have a working knowledge of the color.**