

Meat Quality: Color

Objectives

- **What protein causes meat color and how does oxygen affect this protein?**
- **How does it's concentration differ:**
 - **Species**
 - **Age**
 - **Muscle Activity**
- **How can we preserve meat color?**

Meat Color

- What is Meat Quality?
- Color
- Most important aspect
- 20% discounted or discarded due to loss of color



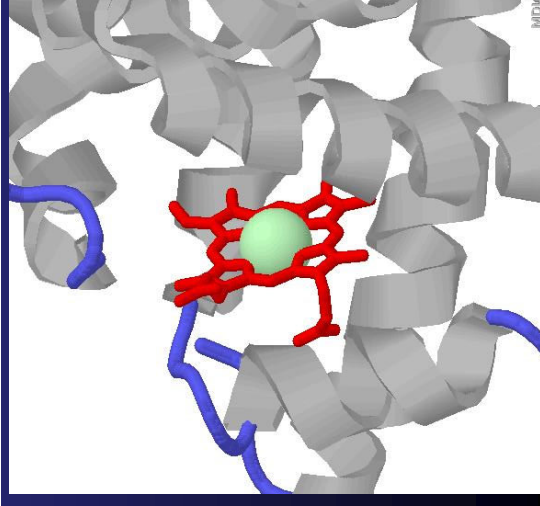
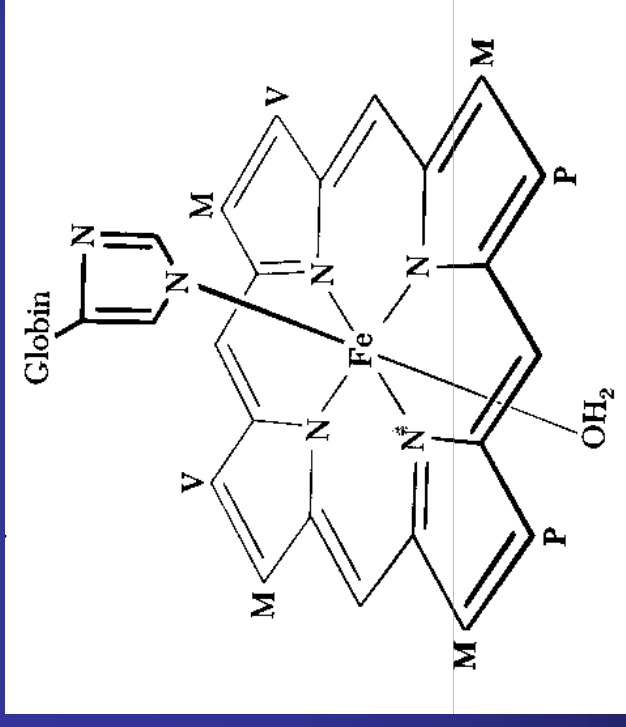
Meat Color



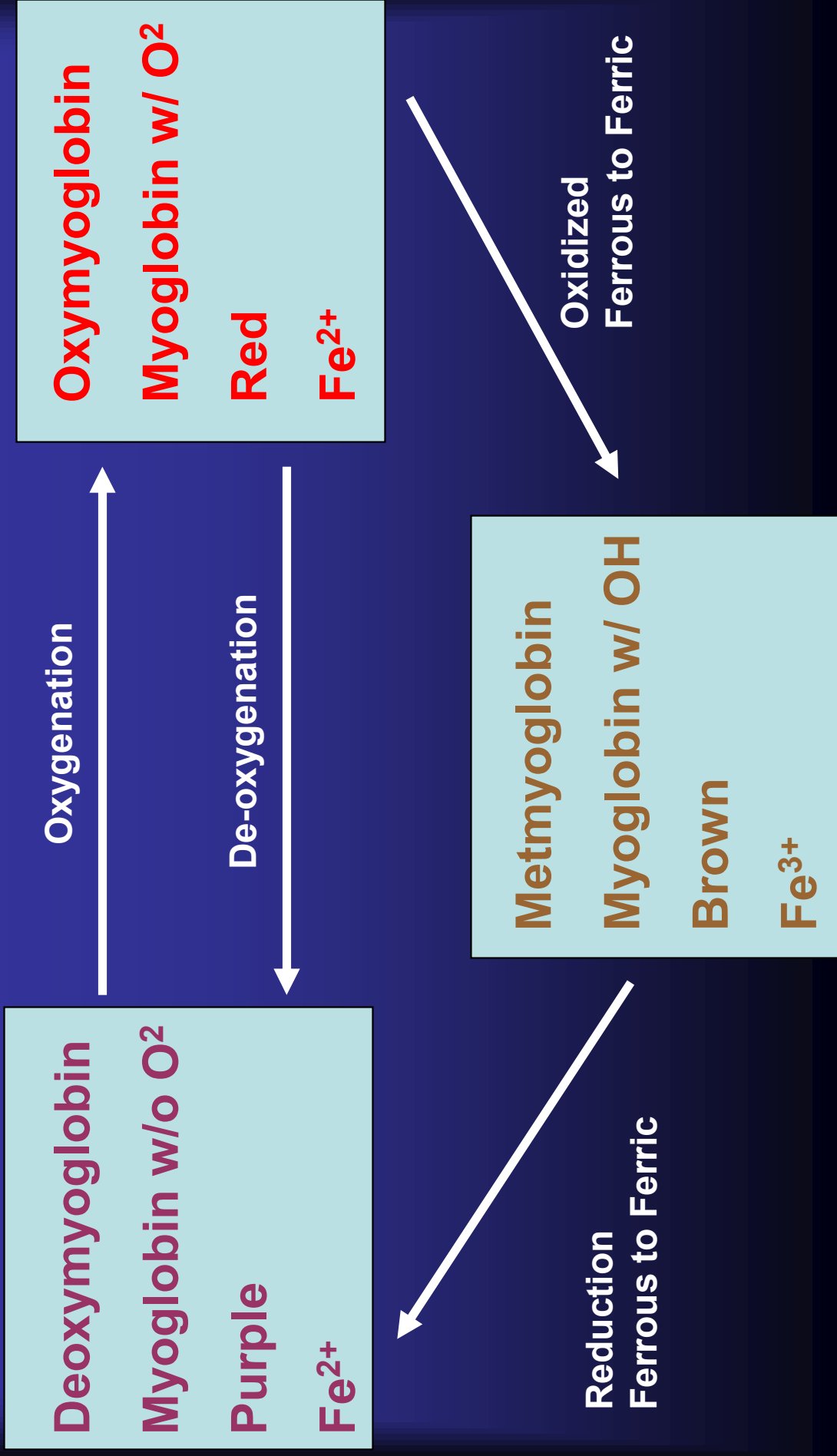
- **Meat color or Pigment**
 - Hemoglobin
 - Myoglobin
- **Well-bled animal or muscle**
 - Myoglobin = 80 to 90% of the total pigment
- **Other pigments**
 - Catalase and Cytochrome enzymes are minor contributors

Myoglobin

- 80% of color
- Hemoglobin = 20%
- Protein = globin
- Non protein = Heme ring
- Heme = color
- State of Fe affects color



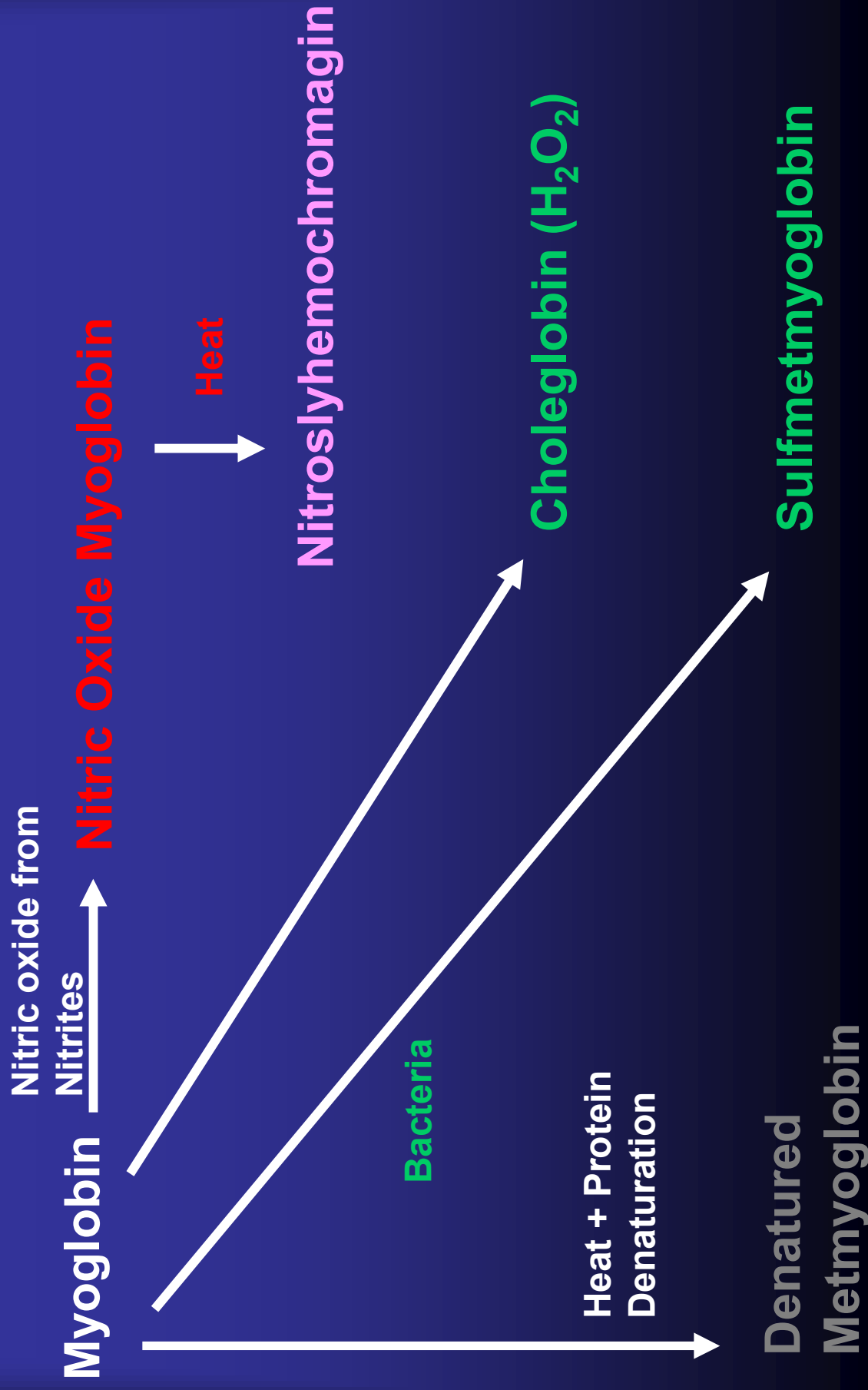
Three main states in Fresh Meat



**Due to the Partial Pressure of
Oxygen; OxyMb is only a few cm**



Other States of Myoglobin



Factors that Affect Myoglobin

- **Species**
- **Age**
- **Sex**
 - Intact males have more than females or castrates at same age
- **Muscle**
- **Physical Activity**

Differences in Myoglobin

Differences in Age

Age Myoglobin

Veal 2 mg/g

Calf 4 mg/g

Young Bf 8 mg/g

Old Beef 18 mg/g

Differences in Species

Species Myoglobin

Pork 2 mg/g

Lamb 6 mg/g

Beef 8 mg/g

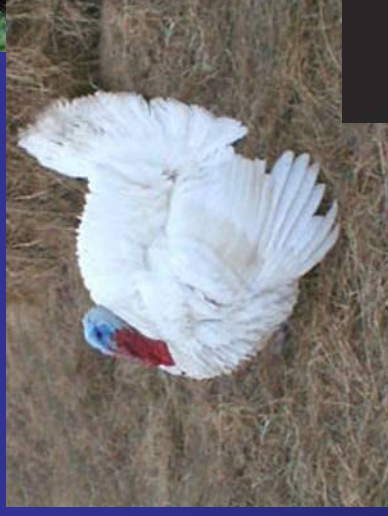
Muscle to Muscle Variation

- Myoglobin content can differ from muscle to muscle
 - High proportions of red muscle fibers (Type I or Type IIA; 30 to 40%) are darker red
- Poultry
 - White meat vs Dark meat



Physical Activity

- Wild game tend to have darker muscles than domestic animals
- Higher myoglobin due to physical activity
- Domestic Turkey vs Wild Turkey
- Deer vs Lamb
- Moose vs Cattle



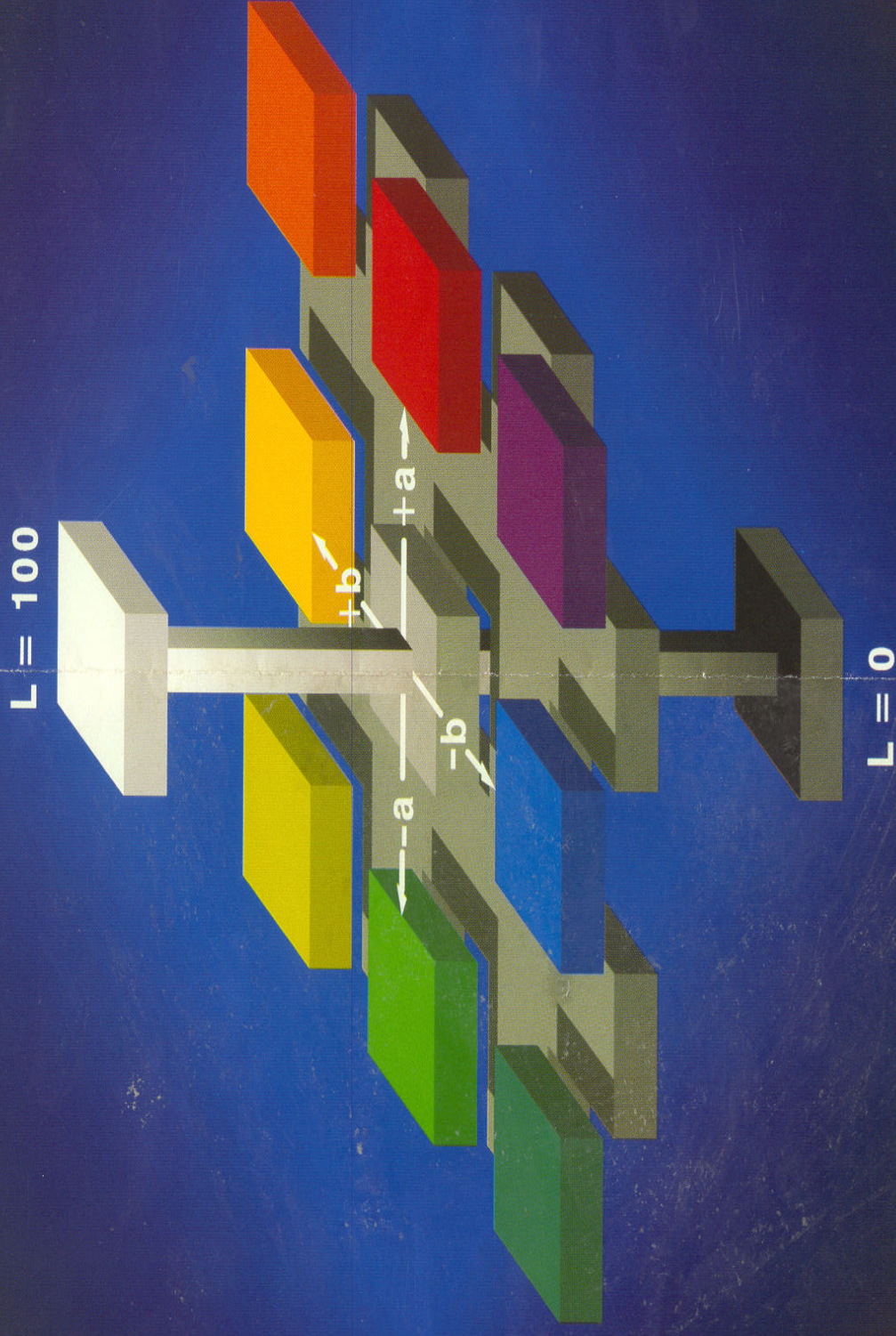
Our Eyes

- Our eyes are made of rods and cones
- Rods see black and white
- Cones; red cones, blue cones and green cones
- Everyone is born color blind



Measuring Color

L,a,b Color Solid



Measuring Color

- Hue Angle = measurement of “True Red”
- Saturation (Chroma) = measurement of how saturated or vivid a color appears

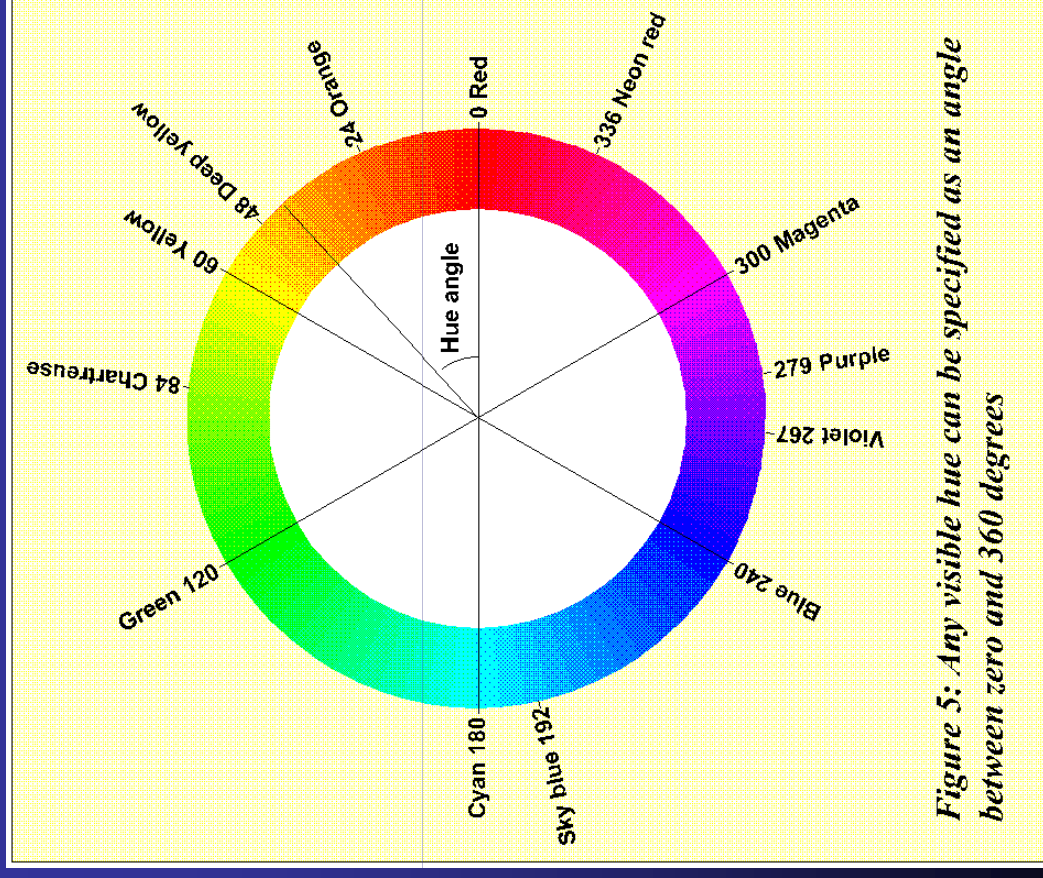
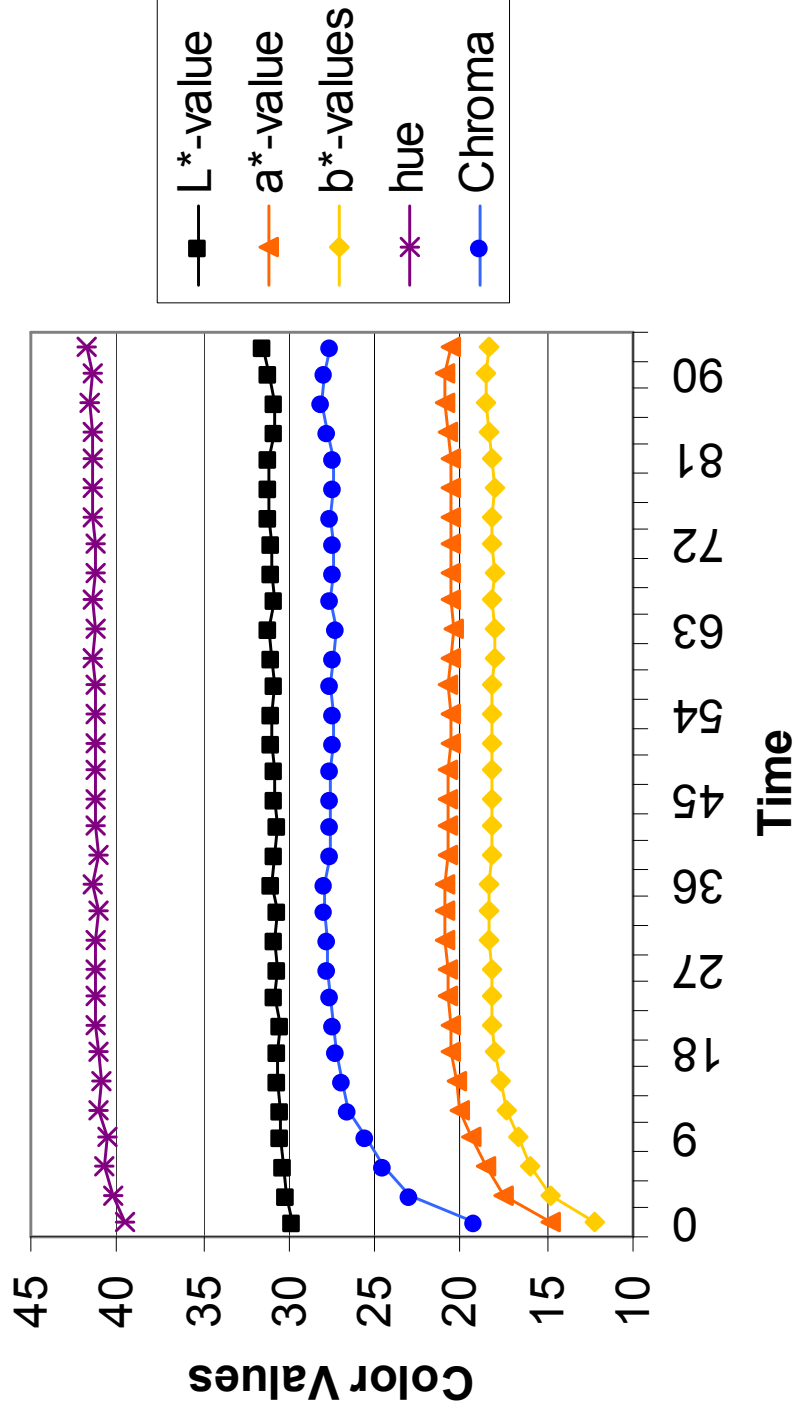


Figure 5: Any visible hue can be specified as an angle between zero and 360 degrees

Bloom Time

- Time needed to oxygenate myoglobin to form oxymyoglobin



Ways of Preserving or Extending Color

- Antioxidants
 - Vitamin E
- Tie up free radical
- Lipid oxidation
- Superoxide Radical



Vitamin E

- Holstein steers had higher a*-values; lower hue angle; higher Chroma; fed at 310 IU from 110-kg to 545-kg (Fuastman et al., 1989)
- 500 IU fed for 67 d had lower surface discoloration scores (Arnold et al., 1992)
- Liu et al. (1996) delayed metmyoglobin and lipid oxidation formation in three muscles; GM>SM>LD discolored faster

Other ways of preserving color

- Packaging:
 - Freezer Paper
 - PVC overwrap
 - MAP (Modified Atmospheric Packaging)



MAP

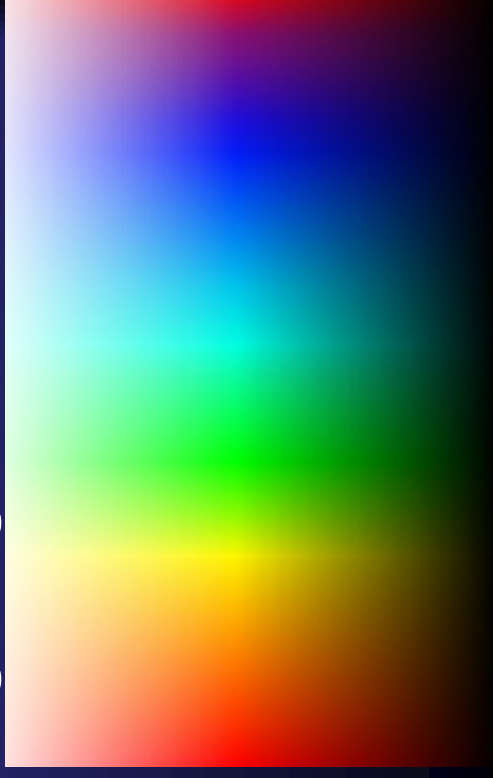
- Creating a favorable atmosphere

- O_2
- CO_2
- N_2
- CO



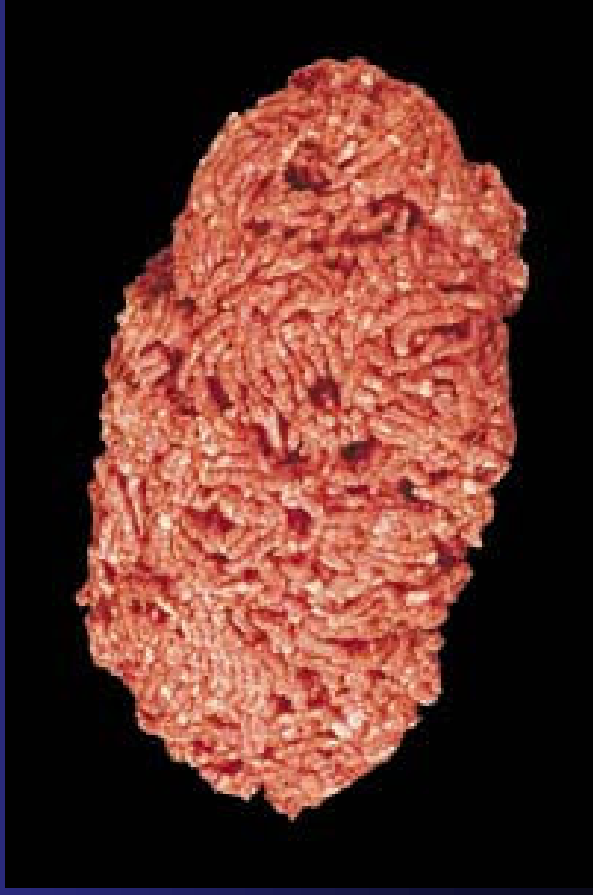
What causes color deterioration

- **Lipid oxidation**
 - Rancidity
 - Release of free radicals that can attack myoglobin
- **Temperature**
- **Light source**
 - Fluorescent vs. Incandescent lighting
- **Sanitation**
 - Growth of spoilage bacteria
 - Not washing your hands



Question

- Those lousy %\$#@*#\$\$%& at the grocery store covered old hamburger with fresh hamburger; I'm never going there again!!!



Premature Browning

- Cooked ground beef
- Clear juices
- Brown internal color
- State of myoglobin
- Metmyoglobin dominates
- Pink at 160° F internal
- pH >6.0 affect hemichrome development



Questions???