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Fresh Meat Color Changes

Color of unfrozen meat is often used as a guide to freshness. Meat color changes when meat is exposed to certain conditions at the processing plant, the retail store, and the home.

The initial color of fresh meat is due primarily to the muscle pigment, myoglobin. Veal and pork contain relatively low amounts of myoglobin compared to beef; beef from older animals contains relatively large amounts of myoglobin.

Immediately after the animal is slaughtered, the muscle pigment myoglobin predominates and results in a purplish red color such as that observed on the surface of a freshly cut piece of beef. This purplish red color can persist for a long time if the pigment is not exposed to oxygen. Cutting or grinding meat exposes the pigment to oxygen, and the purplish red color can be quickly converted to either a bright red (oxymyoglobin) or a brownish red (metmyoglobin). The conversion of the purplish red color to the desirable bright red or to brownish red depends upon the partial pressure of oxygen, the brownish red color occurring at low oxygen pressures. See figure 1 for an illustration of these conversions.

The surface of recently ground fresh beef is normally bright red whereas the interior often is purplish red because air has not yet come in contact with the myoglobin in the interior. After exposure to the air for 15 to 30 minutes, the purplish red color in the interior is converted to bright red. This is a normal phenomenon, but is often misunderstood.

However, if a package of ground beef is refrigerated too long and at too high a temperature, the bright red color on the exterior and the purplish red color of the interior both can be converted to brownish red because of bacterial action. The presence and growth of bacteria cause rapid discoloration of meat because of their oxygen requirement. Thus, the exterior usually turns brownish first. It is also important to recognize that the rate at which bacteria grow and thus discolor meat is influenced by temperature, the rate being slower at a lower temperature. To slow down the growth of bacteria, store meat at a low temperature, preferably 30°F.

The brownish red color can be converted back to purplish red because of enzymatic oxidation of available substrates and the resulting reducing action of reducing coenzymes (see figure 1). However, as soon as the oxidizable substrates are used up, this conversion can no longer take place and the brownish color predominates. The brownish red color can be converted back to bright red by

adding sodium sulfite ("dynamite") or ascorbate (in the presence of oxygen) to the product. These latter procedures "mask" freshness and are illegal in Minnesota meat processing establishments.

Upon breaking open a package of ground beef or hamburger that is bright red on the surface, you may frequently observe a brown ring immediately under the surface and a purplish red inner core. The brownish red ring is caused by a small amount of oxygen filtering through the meat, creating a low partial pressure of oxygen, and thus causing the conversion of the purplish red color to brownish red. Upon exposure to the air for 30 minutes, the purplish red color of the interior will change to bright red.

When the pigment that causes the brownish red color is further oxidized, a green color results. Consumption of fresh meat in the green state is not recommended. If allowed, meat in the green state can be further oxidized to the yellow or colorless state.

The following degrees of freshness in ground beef have been observed.

MOST FRESH

1. All purplish red
2. Bright red on surface, purplish red interior
3. Bright red on surface, purplish red interior core with a brown ring in between
4. Bright red surface, brownish red interior
5. Brownish red throughout
6. Green (spoiled)
7. Yellow or colorless (putrid)

LEAST FRESH

Meat that has advanced to stages 3, 4, and 5 often will not taste as good as meat in stages 1 and 2. Meat that possesses a brownish red color should be cooked to a well-done stage before it is eaten. Eating meat that has advanced to stage 6 or 7 is not recommended.

HOW TO MAINTAIN MEAT IN A "FRESH" STATE

1. Keep temperature of meat 30°F at all times (meat freezes at 28.6°F, not 32°F) to slow bacterial growth.
2. Keep meat in clear flexible packaging if it is not to be frozen. This allows oxygen to enter, prevents moisture from escaping, and eliminates the chance of bacterial contamination of the meat from your hands during rewrapping. The practice of wrapping meat loosely (to dry it out and thus supposedly to prevent bacterial growth) is not recommended because only the surface dries out and because the meat may absorb off-odors from other foods such as onions or fish if they are present in the refrigerator.

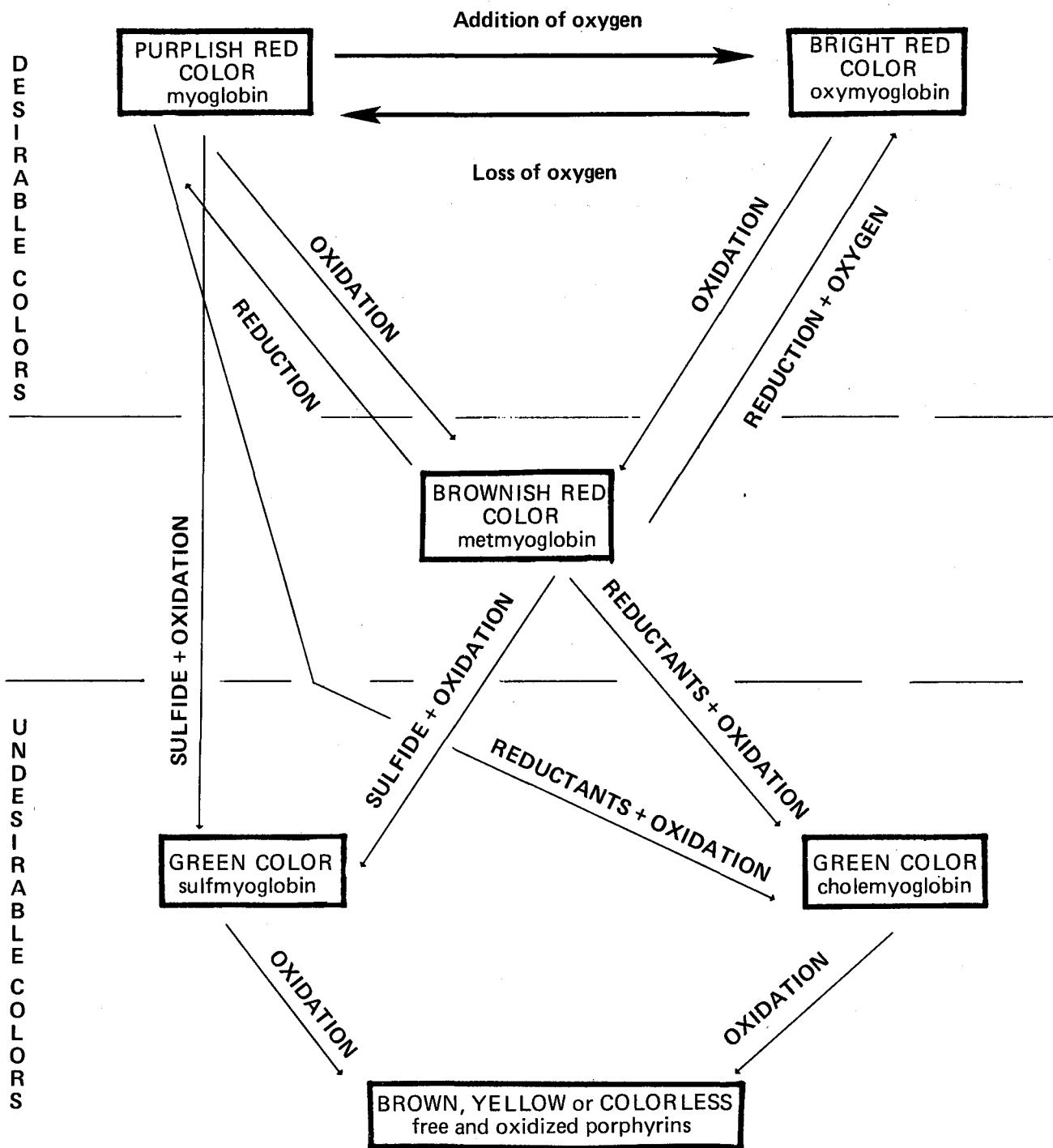


Figure 1. Color changes in fresh meat