MEAT RESEARCH NEWS LETTER

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MEAT RESEARCH LABORATORY

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FRESH MEAT COLOUR

The most important single factor in the appeal of lean meat is colour. This is particularly true for consumers buying pre-packaged meat.

The appearance of the meat to the consumer depends on the type and quantity of the pigment present and on the physical condition of other components of the meat.

Myoglobin is a muscle pigment and normally constitutes about 80% of the pigments whilst the blood pigment, haemoglobin, constitutes about 20% of the pigments. The reactions undergone by these pigments in colour change are identical but, because of the relative quantities, myoglobin is the more important.

FACTORS DETERMINING COLOUR

1. Chemical Nature of Myoglobin

Most of the differences in the colour of meat surfaces arise from the chemical nature of the pigment.

There are three forms of the pigment:

(a) purplish red reduced myoglobin

(b) bright red oxymyoglobin

(c) brown metmyoglobin

The total effect seen by the consumer depends partly on the oxymyoglobin on or near the surface, partly on metmyoglobin just inside the surface and partly on reduced myoglobin remaining unchanged at these or greater depths.

In fresh meat, the most important chemical form is oxymyoglobin. Although it occurs only on the surface of the meat, this pigment represents the bright red colour desired by the consumer.

In meat that is newly cut, the reduced myoglobin pigment predominates. Very quickly oxygen diffuses inwards a short distance from the meat surface exposed to air and the bright red oxymyoglobin is formed. The colour of meat is brighter at low storage temperatures just above 29°F because oxygen is able to move to a greater depth, thus the depth of this bright red layer is greater.

Because the bright red colour of oxymyoglobin is desirable, most prepacked meat is placed in an oxygen permeable wrap (cellophane or polythene) and sealed. The wrap allows passage of oxygen but prevents undesirable drying out. Temperatures are kept as low as possible to produce maximum development of oxymyoglobin.

Patented spray or dip solutions are available to stabilise the desirable colour but little is known of their effectiveness.

Undesirable brown discolouration in fresh meat is predominantly caused by oxidation of the myoglobins to metmyoglobin.

The formation of metmyoglobin is highest at low oxygen levels, i.e. at lower levels than that required to form oxymyoglobin. The thin layer of brown metmyoglobin is formed a little below the meat surface, when stored in air, for this reason. Storage conditions which cause drying out of the meat surface may also promote metmyoglobin formation.

If the meat is vacuum packed in oxygen impermeable films, the meat and bacteria will use up the oxygen and the final oxygen level will normally be around 1% At 1% oxygen the formation of brown metmyoglobin is maximal, being 2-3 times the amount formed in air (air has approximately 21% oxygen). Some methods of controlled atmosphere storage maintain the oxygen concentration above 5% or attempt to keep the oxygen concentration below 0.1% to limit the undesirable metmyoglobin formation between these levels.

If the meat is packed quickly while the pigment is in the purple myoglobin form, then on opening to air the bright red oxymyoglobin would quickly form. Once produced, the brown metmyoglobin is very stable.

2. Quantity of Myoglobin

The greater the concentration of myoglobin then the darker the meat.

A high level of muscular activity gives rise to more myoglobin. The colour also varies due to species, breed, sex, age and type of muscle. Thus, old bulls have more myoglobin than cows and steers, and calves have the least amount of pigment.

If chilled or frozen meat is allowed to lose moisture or dry out, then this will result in concentration of the pigment and contribute to a darkening effect.

3. The Effect of Light and Meat Texture

Examples of this physical effect are:

(a) when the surface of meat dries out, the way the light is reflected and absorbed gives a dark appearance;

(b) slow freezing gives large ice crystals which cause the light to be reflected and absorbed in such a way that a dark appearance is given. Rapid freezing results in small crystals and the colour is lighter;

(c) meat illuminated with red light will reflect more red than meat stored in white light and thus appear redder to an observer;

(d) visible light, especially light of short wave length (ultra violet), will speed up metmyoglobin formation in meat. The greater the intensity the greater will be the formation.

4. Bacterial Growth

If the environment is right, certain bacteria may grow on the surface of the meat, causing a discolouration, e.g. some strains of Pseudomonas can produce hydrogen sulphide when the oxygen and acidity levels are low. The hydrogen sulphide reacts with myoglobin to form sulphmyoglobin which is green.

5. Acidity of Meat

Dark cutting beef is caused by low acidity of the tissue.

At low acid levels in the meat there is also less oxymyoglobin formation at the surface so that the reduced myoglobin under the surface gives a dark appearance to the meat.

RECOMMENDATIONS

To obtain maximum colour appeal of packaged meats, the following procedures should be used:

(i) For fresh meat packaging in air permeable films: Use low temperatures (and if freezing, freeze quickly), seal the film to guard against moisture loss. Use conditions of atmosphere in which oxygen is above 5% and films of high oxygen permeability. There are now available grades of non-fogging permeable films which prevent condensation of moisture on the inner surface of the film.

(ii) For fresh meat packaging in air impermeable films which retard spoilage due to bacterial growth and surface oxidation: Pack the meat as soon as possible after cutting, use low temperatures and freeze quickly if freezing, check seals. If practicable use atmospheres in which the oxygen is less than 0.1% or greater than 5% (allowing for the usage of oxygen by meat and bacteria in the pack).

Under these conditions, colour stability will be limited by bacterial growth and spoilage.

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NEWS JOTTINGS

Next Issue will be Weight Loss on Holding Live Animals.

The building of the second stage of the Laboratory was completed last month. The new Cold Rooms, are expected to be completed and tested this month.

Some Works in Queensland are experiencing "dark cutting beef" in cattle from some areas. This is due to drought conditions which tend to reduce the energy reserved, or glycogen, of cattle. Cold conditions, lengthy transport time and harsh handling will accelerate this condition. On slaughtering there is not sufficient glycogen to produce the natural acid and a dark appearance will result from low acidity (pH above 6).