UV light and its effect on fresh meat

August 2002

Results for today; Ideas for tomorrow

UV light and its effect on bacteria

Ultraviolet (UV) light lamps are sometimes used in meat chillers. They differ physically from fluorescent lamps in that they do not contain phosphor and are constructed with a special type of glass to permit maximum emission of ultraviolet energy. The glass used in ordinary fluorescent lamps filters out much of the UV energy.

UV radiation, in the 200-300 nanometre (nm) wavelength range, is extremely effective in killing or damaging microorganisms. The most lethal wavelength is at 265 nm. At this wavelength, certain nucleic acid molecules in the nuclei of microorganisms absorb the radiation in this range and break, causing either death or inhibition of growth.

Bacteria on carcases and primals take longer to begin to grow when they are exposed to UV light (i.e. their lag time is longer) and when they eventually do begin to grow, their rate of increase in numbers is slower.

The effectiveness of UV light in inhibiting bacteria is proportionate to its intensity. This means that bacterial growth on meat surfaces that are near the UV source - within one metre – is less than on surfaces that are more distant. Although reflected UV light has some effect, there is less inhibition on surfaces that are shaded from direct UV irradiation. UV radiation does not penetrate meat surfaces and is therefore only capable of killing or injuring bacteria on smooth surfaces.

A substantial extension of storage life of chilled carcases is possible when UV light is used continuously in chillers to delay the onset of microbiological spoilage. For instance, there was an increase of 50% in the storage life of mutton carcases in a 1970 CSIRO investigation. Storage life in that investigation was limited by spoilage of areas of carcases shaded from direct irradiation.

Stermer *et al*. (1987) found UV light was effective in reducing bacteria on the surface of round beef steak, but the authors found that the rough surfaces of fresh meat, tended to shield the bacteria from the radiation. Kim *et al.* (2002) also found greater reductions in bacteria on smooth surfaces such as stainless steel, rather than on chicken meat. Neither study examined the effect of UV light on meat colour.

UV lamps that are used for their bactericidal effect have a limited life. The output of UV light in the wavelength range that is effective gradually declines, until after around 7000-8000 hours use, when the output has declined to a level where they are only marginally effective (Fig. 1).

The tubes should be replaced when they have been used for their rated life. The rated life for tubes will be available from the supplier but as a guide, tubes that are used for 12 hours or longer each day should be replaced about every 12 months.

Figure 1. Typical maintenance characteristics for ultraviolet lamps (From: Mpelkas, C. Sylvania Engineering Bulletin 0-342).

UV light and its effect on meat colour

The principal pigment of fresh meat is myoglobin, which can exist in various forms. Deoxymyoglobin is the form responsible for the purple colour of freshly cut meat or meat stored in the absence of oxygen, such as with vacuum packaged meat. When meat is exposed to oxygen, the bright red form, oxymyoglobin, rapidly develops. This form of myoglobin is responsible for the attractive bright red colour of meat typically

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associated with freshness by consumers. A third form, metmyoglobin, is brown and is irreversibly formed through the oxidation of myoglobin. Consumers relate the presence of this brown colour to the loss of freshness and are reluctant to purchase that particular product.

UV light can play a critical role in brown discolouration of meat, since it encourages metmyoglobin formation. The rate of product discolouration depends on the intensity of light and wavelength distribution used for retail display, in combination with the light permeability of the packaging material. Hood (1980) found that fluorescent light produced only a minor accelerating effect in fresh, pre-packaged beef but UV light produced serious discolouration in product displayed at 5°C and even at 0°C.

Renerre (1990) found that wavelengths within the visible part of the spectrum did not contribute to the production of metmyoglobin. However, even a short exposure to UV light was found to be detrimental to meat colour.

Djenane *et al*. (2001) studied the effect of lighting conditions on the retail display life of modified atmosphere packed, fresh beef steaks. The lighting conditions studied included:

- conventional supermarket fluorescent light;
- supermarket fluorescent light with a UV filter;
- low-UV, colour-balanced lamp; and
- darkness

Meat spoilage was assessed by:

- surface colour (redness indices and metmyoglobin percentage);
- lipid oxidation (rancidity);
- bacterial counts; and
- sensory evaluation (discoloration and odour)

The results showed that the elimination of UV radiation by using either the UV filter or a low-UV lamp can significantly extend the display life of meat, to one similar to that of meat held in the darkness.

Key points

Use of ultraviolet lamps to slow growth of bacteria, and to delay the onset of microbial spoilage of meat, may actually shorten the meat's retail display life. Even the smallest amount of UV radiation should be avoided in lighting devices for the retail display of fresh meat.

Where UV lights are used in holding chillers to extend the storage life of carcases and primal cuts, it is important to replace the tubes after the time specified by the suppliers. In most situations they should be replaced at least annually. If they are not, their bactericidal effectiveness will have dramatically diminished but they will continue to have a detrimental effect on meat colour.

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