MEAT RESEARCH NEWS LETTER

CSIRO

NUMBER 70/2

DIVISION OF FOOD PRESERVATION,

DATE 23rd February, 1970

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STORAGE OF MEAT UNDER ULTRAVIOLET LIGHT (U.V.)

Ultraviolet light can be used to extend the storage life of chilled meat. This News Letter sets out some of the points which should be considered by users or intending users.

WHAT IS ULTRAVIOLET LIGHT?

Ultraviolet rays are invisible and occur at wave lengths of radiation between about 100 and 3800 Angstrom units. Not all wave lengths kill bacteria. The longer wave lengths produce suntan. Shorter wave lengths (less than 2000 Angstrom units) produce ozone by being absorbed by the oxygen in the air. Radiations of wave lengths between 2000 and 3000 Angstroms kill bacteria, moulds and yeasts. The most effective germicidal wave length is about 2537 Angstroms. It is the absorption of radiation near this figure by certain nucleic acid molecules of the bacteria and moulds that is mainly responsible for death or inhibition of growth of these organisms.

Approximately 90% of the radiation of commercial U.V. lamps is emitted at a wave length of about 2537 Angstroms. This radiation is generated in quartz tubes exhausted of air and filled with inert gases and a small amount of mercury. An electrical discharge between electrodes at opposite ends of the tube vaporises the mercury and causes the lamp to radiate energy in U.V. wave lengths. Lamps incorporating special silica glass are able to limit or block the shorter wave lengths which produce ozone.

CONDITIONS OF USAGE

The number of units to be recommended depends on the conditions under which the lamps are to operate. Before purchasing and installing, assurance should be obtained that the level of intensity at the meat surface will be in the required range. Proper application of ultraviolet lamps in industry requires knowledge of the intensity and it is not likely to be worth installing unless the intensity is over 0.2 micro-watts/ cm^2 at the meat surface.

The output of U.V. radiation from lamps slowly decreases throughout life. It is important that lamps be replaced when the output falls below minimum requirements for protection. The lamps operate most efficiently at room temperature, the output diminishing as the temperature increases or decreases from the optimum of about $80^{\circ}F$. Movements of air also decrease efficiency and it is important that lamps be located so that they do not receive direct blasts of air.

If an individual is working in an irradiated room for any length of time, he must wear protective glasses or the lamps should be turned off.

U.V. light accelerates oxidation in the irradiated product and as a result may hasten rancidity in fat and the formation of brown metmyoglobin in the lean. The acceleration of fat decomposition by U.V. light is particularly noticeable with pork and poultry and hence the application of U.V. should be restricted to the storage of beef, veal, mutton and lamb.

Although ozone is a useful means of killing bacteria, it also leads to rancidity. Hence, for applications on meat, lamps should be used which block the shorter wave lengths or limit them so that a maximum of 0.3 p.p.m. of ozone is produced. This amount of ozone has bacteria and mould killing effects without oxidising fat and pigments.

PRACTICAL VALUE OF U.V.

Providing the minimum intensity requirements are met, U.V. can give useful extension of storage life of chilled meats.

Apart from this, U.V. radiation of certain intensities can have application in sterilizing thin films of relatively transparent liquids (e.g. water and pickle brine), equipment (e.g. bacon slicers) and air.

EXTENSION OF STORAGE LIFE

In order for the ultraviolet to kill bacteria, rays of certain intensities must strike the organisms. With intensities of 2 micro-watts/cm^2 or more, bacteria and moulds are killed and will not grow on the surface of meat. However, they will still grow in minute cracks and crevices below the surface.

Because U.V. does not penetrate meat surfaces, the effects upon bacteria and moulds on smooth surfaces do not increase when an intensity greater than about 2 micro-watts/cm^2 is used. At levels above 100 micro-watts/cm^2, desiccation of the meat surface will occur. Below 2 micro-watts/cm^2, the effect on bacteria and moulds becomes progressively less.

At 2 micro-watts/cm^2 or more, it was found that it takes about 2 times as long for bacteria to reach spoilage numbers on meat at 37°F and 90% relative humidity and the storage life of the chilled meat is therefore approximately doubled. However, patches of mould growth may appear on the areas shaded from the U.V. light and limit storage life to something less than this. Even at 0.2 micro-watts/cm^2 there is still about 1½ times the normal storage life.

INTENSITY OF U.V.

Optimal U.V. effects are obtained when an intensity of about 2 micro-watts/cm^2 is applied uniformly over the surface of the meat. In practice, lamps should be arranged in the space so that the intensity of U.V. radiation is between 2 and 100 micro-watts/cm^2.

The intensity of U.V. light decreases away from the lamp in proportion to the square of the distance from the lamp. A commercial 24 inch fused silica 25 watt U.V. lamp gives an intensity of 100 micro-watts/cm^2 at about 2 feet distance perpendicular to the lamp and an intensity of 2 micro-watts/cm^2 at about 14 feet distance.

The intensity of U.V. light also falls sharply on the shaded sides of carcases where the U.V. light is mainly only that reflected from the walls. The intensity on the shaded side of a carcase at 6 feet distance from one lamp is only about 0.2 micro watts/cm^2. This figure could be increased by using U.V. reflecting walls of glossy aluminium.

Although polyethylene allows U.V. radiation to pass through without much lowering of intensity, certain films do not (e.g. Saran and Cryovac).