

Electromagnetic Radiation

FOOD SAFETY TECHNOLOGY SUMMARY	
Status	Currently Available
Location	Post-Packaging
Intervention type	Exposure to radiant energy
Treatment time	Few seconds to several minutes
Regulations	No specific restrictions Widely used for cooked products
Effectiveness	No consensus in the literature
Likely Cost	Not known although microwave technology used in other industries is expensive due to the protective shielding necessary
Value for money	Difficult to ascertain
Plant or process changes	Protective shielding to avoid radiation exposure will need space allocation. However, if used as a thawing process, may be able to reduce holding areas or better utilise space
Environmental impact	Utilises energy
OH&S	Radiant energy leaks must be prevented and controlled
Advantages	Can be used on packaged product Radiofrequency heating is more uniform and more precise control of the process Microwave heating can reduce thawing time from hours to minutes
Disadvantages or Limitations	Microwave causes uneven heating and product discolouration

Electromagnetic Radiation

Electromagnetic radiation is widely accepted as a method of heating foods prior to consumption, and can cause destruction of bacteria, probably due to heating. Microwave treatment of cooked product can be an acceptable decontamination intervention, but on fresh product, it tends to give uneven heating, and discoloured, partially cooked areas appear. Alternatives include dielectric and infra-red heating.

Dielectric or radiofrequency

Dielectric heating is based on the fact that the oscillation of water molecules produces friction and consequently heat is generated. The word “dielectric” can be used in all the electromagnetic frequencies, including those of the infra-red spectrum, but it is generally accepted that the term “dielectric” is developed at frequencies between 1 and 100 MHz (Hugas *et al.* 2002).

The radiofrequency waves are generated through a device called a magnetron applicator, and essentially the interaction with the food material caused the food molecules to heat themselves – it is not a method of directly applied heat. Therefore, it is important to control the leaks of radiation to avoid interference with radiofrequencies and more importantly for human safety.

Advantages of dielectric heating is that it is more uniform, very precise control of the heating process and less likely to have surface overheating effects causing protein denaturation.

Microwave radiation

Microwaves rely on the same heating principle as radiofrequency but it uses higher frequencies between 300 MHz and 300 GHz. The food safety effects in foods as a result of microwave treatment are probably due to heating effects within the food (Fung and Cunningham 1980). At 915 MHz, the penetration depth of microwaves into red meat reduces as the temperature rises, but at 2450 MHz, the penetration, although much less, is not affected by changes in temperature within the range 5-120°C, and 120 seconds of microwaving will destroy *Salmonellae* (Teotia and Miller 1975), although treatment times of greater than 30 seconds will cause colour changes and partial cooking.

Microwave treatment has been reported to reduce the microbial load in vacuum-packaged beef, when applied to the intact packs for 5-20 seconds (Fung and Kastner 1982; Paterson *et al.* 1995), but other authors have found no significant effects (Kenney *et al.* 1995). The main problems encountered seem to have been uneven heating of the product, and partial cooking of the



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produce, but research is underway in an attempt to limit the cooking and penetration of the microwaves.

This technology can be used in thawing, heating, cooking, drying and frying of foods. In thawing and/or heating there are significant advantages over the conventional methods as the shortening of the thawing time from hours to minutes, the reduction of the plant space devoted to thawing and the elimination of thawing chambers, an increase in the hygienic conditions and a decrease in the microbial load of the thawed product (Hugas *et al.* 2002).

Infra-red

Unitherm Food Systems manufactures an infra-red pasteuriser for pre-package surface pasteurisation for the control of *Listeria* in RTE products such as roast beef and corned beef. The radiant oven provides a quick surface treatment (45 – 60 seconds) prior to packaging. Published research using this system indicated a 2.15-2.45 log reduction in *Listeria monocytogenes* (Gande and Muriana 2003). The manufacturers recommend using this system in combination with a postpackage pasteurisation system.

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