

Pulsed Electric Field (PEF)

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An emerging technology

Pulsed electric field (PEF) treatment involves applying a short burst of high voltage to foods between two electrodes, and can be carried out at ambient or at refrigeration temperatures. It is thought that pulsed high-voltage (40 kV/cm) stimulation ruptures microbial cell membranes, and decontamination of liquid or semi-solid foods such as juices, milk and potato dextrose agar have been successful, achieving reductions of up to 6 log (Zhang *et al.*, 1994).

PEF is typically applied for short period of time. During this treatment, little heat is generated, thus maintaining 'fresh' appearance, nutritional composition of foods and extending their shelf life (Castro *et al.*, 1993, Kozempel *et al.*, 1998). However, PEF has limited applicability on solid foods such as meat and meat products. This is due to low conductivity and high protein and fat contents. Bolton *et al.* (2002) reported that PEF was ineffective at controlling *E. coli* O157:H7 on beef trimmings or in beef burgers. However, application of PEF has been trialled in a meat injection solution (Rojas *et al.*, 2007). Approximately 2-log reduction of *E. coli* K12 was observed but electrical field strength of ≥ 7 kV/cm was required and higher field strengths resulted in arching. Saif *et al.* (2006) also achieved 8-log reductions in *E. coli* O157:H7 using a pulsed DC square wave signal on goat meat immersed in a brine solution. This was despite that a treatment time of 32 minutes was required. Furthermore, Houghton *et al.* (2012) concluded that PEF may not be suitable as a food safety intervention measure for the control of microbial contaminants on broilers during processing, although it may have potential to reduce contamination of process water.

Further work on the design and construction of a PEF treatment vessel and the format of the product needs to be considered before this technology could be applied to larger cuts of meat and products, although, it may be possible to treat other meat products, such as extruded meat paste for example. Use of this technology in any scaled-up application will need to consider the safety of the equipment because of the high voltages involved.

Electrical stimulation has long been in use in the meat industry to improve the texture of meat, and some research has been carried out to explore potential antimicrobial effects, as electrically stimulated carcasses seem to exhibit a slower onset of microbial spoilage than those that are not stimulated (Bawcom *et al.*, 1995). Artificially inoculated beef steaks were successfully decontaminated using direct application of electrodes to each end of the steak, and reductions in microbial count were improved if the steaks were wetted prior to treatment.

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