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Research Paper :

Application of pulsed electric field in food processing

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ABSTRACT

Among nonthermal treatments, pulsed electric field (PEF) has received special attention on account of its potential use in treating liquid foods and its feasible application in continuous-flow processing. Pulsed electric fields (PEF) is a non-thermal preservation method mainly used in liquid foods to inactivate micro-organisms and enzymes, retaining volatile compounds and nutrients in foods Improving the food quality of milk and dairy products with PEF processing may be a relevant consideration in product development research. It has already been demonstrated that pulsed electric fields (PEF) processing can alternatively be applied to deliver safe and shelf-stable products.

Key words : Pulse electric field, Non-thermal preservation, Electropermeabilization

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 (40kV/cm) stimulation ruptures microbial cell membranes, and decontamination of liquid or semisolid foods such as juices, milk and potato dextrose agar have been successful, achieving reductions of up to 6 log (Zhang *et al.*, 1994).

The treatment is applied for less than one second, so there is little heating of the food, and it maintains its "fresh" appearance, shows little change in nutritional composition and has a satisfactory shelf-life (Castro *et al.*, 1993, Kozempel *et al.*, 1998). Microbial reductions of up to 9 log have been achieved in laboratory scale systems using treatments of 2 seconds to 300 seconds, and good results have been achieved in liquids such as water, milk and juices (Qin *et al.*, 1995).

METHODOLOGY

Application of Pulsed Electric Fields (PEF)

The exposure of biological cells to an external electrical field of sufficient field strength induces the formation of pores in the cell membrane. This phenomenon, termed electropermeabilization, can be utilized for many operations in food- and bioengineering as shown in Fig. 1. First reported in the 1960s for disintegration of plant or animal tissue, research on the applicability of these gentle membrane permeabilization techniques in food processing has concentrated on microbial inactivation in different liquid food products (Zhang *et al.*, 1995, Grahl and Märkl,1996, Wouters and Smelt, 1997, Barbosa-Cánovas *et al.*, 1999 and engineering aspects.(Barbosa-Cánovas *et al.*, 1999, Heinz *et al.*, 2002) In addition, the electropermeabilization of plant cells, (Brodelius *et al.*, 1988; Aibara and Esaki , 1998; Ho *et al.*, 1997, Hodgins *et al.*, 2002) the effects of PEF on food matrices,(Bendicho *et al.*, 2003) inactivation of enzymes and induction of stress reactions and secondary metabolites production(Bendicho *et al.*, 2003) have been investigated. Even if application of PEF will require an additional input of electrical energy, the subsequent sections show selected examples of beneficial effects on total energy consumption of mass transfer processes such as extraction or pressing, as well as increased sustainability.

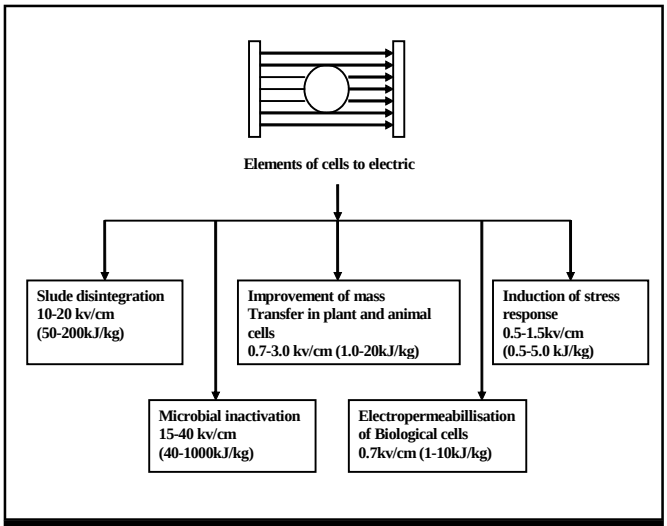

Fig. 1 : Electropermeabilisation of cells after expose to electric field and application in food and waste water processing with typical electric field strength and energy input requirements