Pulsed Electric Field technology offers new potential for New Zealand potato processing and winemaking industries

Sze Ying Leong, Phil Bremer, Pat Silcock and Indrawati Oey (University of Otago)

PEF industry trial at a potato processing plant. Left to right: Katy Bluett (FIET board member), John Jackson (McCain Foods), Gordon Gillies (McCain Foods), Jimmy Kinsella (Elea, Germany), Prof. Indrawati Oey (University of Otago – UO), Chris Claridge (Potatoes New Zealand), Dr. Sze Ying Leong (UO), Zhihao Hu (UO), Ian Ross (UO), Pat Silcock (UO) and Prof. Phil Bremer (UO).

How does Pulsed Electric Field technology (PEF) work?

PEF technology uses brief (microseconds) pulses of high voltage electricity to disrupt the cell membranes of microorganisms, plant material or animal products [1]. It can be used to modify the structural integrity and microstructure of plant and animal tissues, with the goal of improving mass transfer processes [2]; enhancing the extraction yield and quality of pigments or bioactive compounds [3]; reducing cutting force required [4]; and inactivating micro-organisms (vegetative cells) [5] as an alternative to the pasteurisation of bulk liquids, such as fruit juices.

The heterogeneous nature of plant material makes evenly delivering high voltages with very short electric pulses a challenge [6]. Throughout the years, advances in equipment and generator design for PEF technology have improved the feasibility of applying brief electric pulses through solid plant tissue and increased the application of PEF to a very broad range of food products.

The effectiveness of PEF processing to achieve cell electroporation varies depending on the processing parameters applied as well as the physical characteristics of the plant material (e.g. electrical conductivity, particle size, size and type of cells, chemical composition, pH, temperature, etc.) placed between the conducting electrodes [7]. Key PEF processing parameters to achieve specific food applications or to obtain desired quality improvement in the final product include electric field strength, specific energy input, pulse duration or pulse width, number of pulses, treatment time, pulse repetition rate or pulse frequency, pulse shape and pulse polarity [8]. Many of these processing parameters are interdependent; for example, the specific energy input varies according to the applied electric field strength, pulse frequency, pulse width, pulse number and treatment time.

Scope of research

PEF has a wide variety of applications across many food processing industries and has been used as a processing step internationally in potato, sugar beet industries and in winemaking. Research carried out by students, researchers and food companies using pilot plant scale PEF equipment (batch and continuous mode, HVP ELCRACK 5 from German Institute of Food Technologies) in the Food Science