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Review Article

PULSED ELECTRIC FIELD PROCESSING OF FOOD TECHNOLOGY

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Synonym

Electropure, High electric field processing, Electro permeabilization treatment, Erlacks process, Elsteril process

History

Initially this technique is used in electroporation of cell membrane in biotechnology for infusion of foreign DNA into the cell (Reversible pore formation) (Zimmerman *et al*., 1974). In food industry 1st used by (Beattie and Lewis, 1925).To pasteurize milk using non- pulsed electric field of 220 volts he found reduction in microbial load.

Introduction

Most advanced food processing methods.Used for high quality products. Use of strong electric fields of very high voltage (10-50 Kv/cm) for short period of time, (1 to 100 µs).

Principle

Dielectric rupture theory (Sale and Hamilton, 1968) of cell membrane by means of electroporation and electropermeabilization.

Mechanism of inactivation

Normally cells have typical transmembrane potential of 10 mV (Charge accumulation on membrane), When an external electric field is applied. There will be further development of transmembrane potential. This causes an electromechanical separation of cell membrane which leads to electroporation and electropermeabilization.

Effect on cell membrane depends on critical electric field strength, when the voltage is very much greater than the critical electric field strength cell gets destroyed (irreversible) permanently (Zimmerman *et. al.,* 1974). When the voltage (or) electric field is less than critical electric field there will be only structural change caused by Hampering of DNA, RNA

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and protein synthesis and is reversible sub-lethal injury (Rogers *et al.,* 1980). When favourable condition occurs repair proteins revert back the organism to virulence.

NOTE: When E = Ev no changes in cell membrane. For most M.O the critical electric field strength is 1-2 kv/cm for plant cells and around 10-14 kv/cm for microbial cells (Zimmerman *et. al.,* 1974).

FACTORS AFFECTING MICROBIAL INACTIVATION:

Table 3: Variability of PEF Treatment

Type of cells	Morphological factors	Growth factors
Bacteria	Stage of cell	Phase of growth
Virus	Diameter (or) Size of the cell	Concentration of cell
Yeast		pH, Temperature, Conductivity of medium

Induced trans-membrane potential is directly correlated with cell-size. Size of yeast cells greater than bacteria because of that yeast possesses somewhat greater resistance than bacteria. During Log phase organisms were susceptible, In stationary phase organisms were resistant. Decrease pH and increase temperature have synergistic effect on microbial inactivation. Agglomeration of microorganisms, Presence of fat globules – affects inactivation of microorganisms which possess dielectric properties similar to microbes (Toepfl *et. al.,* 2004). Presence of air bubbles affects processing and inactivation of microorganisms (Gongora Nieto *et al.,* 2003). Thus food matrix is an important determinant in PEF processing.

Advantages: Novel inactivation technology for high quality products at low temp retains the freshness.

Disadvantages: High cost of initial investment, High energy dissipation.

Commercial status

Food and Drug Administration (FDA) approved the use of PEF in the preservation of liquid eggs in 1996 (Dunn, 1996), while the first commercial PEF application for fruit juice preservation was installed in the United States in 2005 (Clark, 2006).

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