

## **COLD EXTRACTION** **by Pulsed Electrical Fields (PEF)** *in brief:*

A cold pressing does not allow a rupture of all plant cells to obtain a high extraction yield. The application of PEF pre-treatment before pressing significantly increases the extraction yield and increases its quality.

PEF can be also used for the recovery of specific substances (proteins, vitamins, antioxidants) from targeted cells without the use of chemical or thermal treatments known to degrade such substances.

**PEF is used to enhance a cold extraction of up to 80% for juices, proteins, nutrients, vitamins and natural colors from**

- roots,
- fruits,
- vegetables,
- grass and leaves ,
- protein rich original products.

**PEF extraction keeps original properties of nutrients unchanged plus can simultaneously sterilize it.**

Prior to the PEF processing natural products have to be converted to a mash unless. This is to assure a uniform flow through a PEF treatment chamber, where having air bubbles or large solid pieces can lead to local electrical breakdowns.

Advantages of PEF systems are just the same as for PEF sterilization systems:

- works on an entire mash flow,,
- **No wearing parts,**
- Keeps the product temperature almost unchanged,
- **No dependence on optical properties,**
- No side effects,
- **Cost-effective because uses the latest advances in pulsed power technology.**

**PEF extracts by stretching bacteria to its disruption by a strong electrical field 10-20 kV/cm**

Its is possible with square wave pulses at pulse duration from 1 to about 50 µsec or longer and steep 100 ns fronts and tails of pulses, as SteriBeam offers.

**Step-by-step PEF extraction:**

- pulse shape: electrical fields from a few kV/cm to 40 kV/cm in a form of short (a few µsec) square pulses are applied to coaxial or parallel electrodes, confining a moving liquid (or mash) media.
- Electrical fields polarize and stretch bacteria cells up to a break-up of its membranes. (bacteria get from 3V to 5V across its length (ca. 1-3 µm), sufficient for this process). -
- resulting rupture of cell walls releases a liquid content of cells.
- the next step must me a cold pressing to take the cell content (juices, proteins whatever) out of mash.

**Bi-Polar pulsing will enhance cells break-up:**

Stretching bacteria in one direction can be immediately followed by its stretching in the opposite direction by a pulse with the same parameters but of the opposite polarity. In such a case a bacterial literally is "thorn" since its wall endures a much higher stress. It is about the same effect as one for wearing mechanical metal parts by alternating load.

Now it is possible to achieve using the latest advances in HV switching technology, which SteriBeam became familiar with (as an option).

**Limitations for PEF process:**

**PEF will not work on a conductive media, neither on a fully insulated media (like in a liquid enclosed in a plastic bag).**

**A small current has to flow through a treated media to allow PEF to work by either of two mechanisms described above.**

PEF sterilization and extraction method is well known since decades yet up to recently it is only used for small scale processes. There are quite a few reasons for this limitation:

- it depends too much on a treated media and
- a problem with an electrode erosion in large systems.

**Advantages of PEF** become more evident with growing restrictions of heat and chemical extractions.

**Details on known applications you can find e.g. in the **FDA Review on PEF basics:****

<http://www.fda.gov/Food/ScienceResearch/ResearchAreas/SafePracticesforFoodProcesses/ucm101662.htm>

SteriBeam offers standard and customized PEF systems, described in our sections: sterilization Systems and Extraction systems.



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