

# Pulsed Electric Field

*NovelQ is an EU-funded Integrated Project stimulating innovation in novel food processing and packaging (FOOD-CT-2005-015710). Since 2006, 36 research organisations and universities have joined forces to explore novel food processing techniques and understanding more about the public perception new technologies in food manufacturing. Efforts have focussed on high pressure processing (HPP) for sterilisation (e.g. apple juice), the effects of pulsed electrical fields (PEF) on food pathogens, cold plasma as a surface disinfectant and new packaging. Fruits and vegetables (e.g. carrots, tomatoes, strawberries, apples and broccoli) have been used as test foods because they present particular problems with respect to texture, colour and flavour, food safety and potential health benefits. The results, however, are applicable to many food products including whole meals.*

## **Background**

Consumer preferences have shifted towards fresh, healthy, tasty foods, which are readily accessible, easily stored and quickly prepared. Providing such foods in a form suitable for mass production and distribution, which will store as readily at home as in the supermarket, without affecting flavour, texture and colour, is technically difficult and expensive. The majority of European food manufacturers are small companies with few resources and limited expertise to develop and implement new technologies. The advantages and disadvantages as well as the technical problems and potential risks associated with new technologies are often more complicated than first imagines. This business case, describing pulsed electric field (PEF), considers some important issues and serves as a basis for discussion.

## **What is pulsed electric field?**

Pulsed electric field (PEF) used short electric pulses to preserve the food. It is suitable for preserving liquid and semi-liquid foods, removing micro-organisms and producing functional constituents. PEF has not yet been used in Europe on industrial scale although it has been used in the US for orange juice, and it has considerable potential for improving quality and taste of pasteurised foods compared with traditional preservation techniques.

## **How does it work?**

Cellular membranes have pores that control the flow of substances in and out of the cell. Application of a pulsed electric field causes these pores to enlarge and release the contents of the cell or allow substances to enter the cell more easily. Most proteins are unaffected by PEF, and the temperatures reached are lower than thermal pasteurisation, which means flavours are retained.

## **What are the problems?**

Micro-organisms are destroyed by PEF but spores, with their tough protective coats, and dehydrated cells are able to survive, which means refrigeration is required to extend shelf-life. There are gaps in our knowledge about physical rather than chemical preservation methods using PEF. Quantitative studies on food pathogens, real (existing or new) food matrices and the resulting quality of products (positive and negative) as well as life-cycle analysis (carbon foot-print) have not been fully addressed, and proper legislations is still to be put in place.

## **What are the advantages?**

PEF inactivates vegetative micro-organisms including yeasts, spoilage micro-organisms and pathogens, and it can be used to pasteurise fluids such as juices, milk and soups without using additives. This technology can substitute for conventional heat pasteurisation or it can operate at room temperature to retain quality and heat-sensitive vitamins. PEF can be used as continuous process but, after processing, products have to be packaged hygienically and kept cool during storage.

PEF causes the formation of large, permanent pores in cellular tissues, which can be used to improve juice yield, increase concentrations of functional components and enhance the characteristics of dried produce. It can support or replace conventional processing techniques such as enzymatic maceration and mechanical disintegration. However, low electric field strength and/ or pulse number causes reversible cell rupture stimulating a stress reaction in plants or cell cultures and allowing enzymes or proteins with potential health benefits to be harvested.

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