Advanced Heating

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 advanced heating, considers some important issues and serves as a basis for discussion.

What are advanced heating technologies?

Advanced heating technologies include microwaves, ohmic and radio frequency heating.

How do they work?

Molecules in food excited by electromagnetic energy release energy in the form of heat, raising the temperature of the food. Heating is more rapid and more efficient than conventional heat transfer methods (e.g. oven and hob), decreasing environmental impact (e.g. shorter and more efficient heating uses less energy) and increasing product quality. Ohmic heating – also known as electro-, electrical resistance, Joule or electro-conductive heating – passes an alternating current through a food, which acts an electrical resistor, causing to rapid and uniform heating.

What are the problems?

Currently, the use of advanced thermal technologies by the food industry is limited. Whilst the underlying principles are similar, each technology presents different technical problems as well as difficulties with:

- Scaling up pilot-study equipment to large-scale production units
- Incorporating advanced heating technologies with existing or new packaging
- Life Cycle Analysis (LCA) demonstrating environmental impact (carbon-foot print)

Microwaves can be used for heating or drying of foods but shallow penetration caused by dielectric characteristics (e.g. water content) and standing wave patterns arsing from short wavelength (i.e. 1 cm) cause uneven heating. These are easily overcome in the home (e.g. rotating plate and stirring during cooking) but difficult to control in the industrial setting. Current applications include pasteurisation of ready-to-eat meals and dehydration of food products as well as cooking and thawing.

What are the advantages?

Ohmic heating can be used for rapid uniform heating of highly viscous liquids (e.g. soup) and fluids with large particles (e.g. stews). Cool surfaces reduce burning and substantially increase product quality as well as reducing the need for cleaning. Ohmic heating systems have been used for many years in other industries and allow for sterile processing of ready-meals, pre-heating prior to canning, hot-fill pasteurisation and thawing of frozen foods.

Radio frequency heating is used for tempering (controlled heating and cooling to enhance key characteristics) and drying of foods. It is more consistent than microwaves, because the wavelength is too large to form internal standing wave patterns (e.g. 1 metre), and therefore preferable to microwave technologies in an industrial setting.

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