High pressure homogenisation of fruit- and vegetable-based products

Identification

Key words
high pressure homogenisation, structure, rheology, bioaccessibility, fruit, vegetable, soup, purée, sauce

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How does it work?

Primary objective
• to disintegrate plant cell structures and wall material
• to create new structural entities
• to include oil into low-fat type of systems
• to produce emulsions with higher or improved stability

Working principle
In high pressure homogenisation, the non-homogenised fruit or vegetable based product enters the valve of the homogeniser at relatively low velocity. The pressure is then generated by a pump and the restriction to flow caused by the passage of the product through a very small gap (see Figure 1). The product flows between the valve and the seat at high velocity. As the velocity increases, the pressure decreases producing an instantaneous pressure drop. The fluid is finally discharged as the homogenised product (7). Phenomena of cavitation, shear and turbulence occur during the homogenisation process (8), leading to the disintegration of cell structures and wall material and the incorporation of oil into fruit- and vegetable-based products.

Images

Additional effects
The rheological characteristics of the product (1,2) as well as the bioaccessibility of micronutrients can be affected by high pressure homogenisation (3-6). The use of very high pressures (up to 350 MPa) leads to a serious increase in product temperature, which in turn results in the inactivation of micro-organisms in the product. (Ultra) high pressure homogenisation can hence also be used as a tool for food preservation (9).

Important process parameters
operating parameters (e.g. flow rate, pressure, number of cycles, temperature) and device parameters (e.g. nozzle geometry and impingement design) (1).

Important product parameters
composition (fat, water, protein, pectin...), viscosity (although of less importance compared to rotor-stators-systems), particle size of solids in the suspension.

What can it be used for?

Products
All kinds of fruit- and vegetable-based dispersions which are sufficiently liquid and thus pumpable: soups, juices, sauces, purées.
Operations

- **Mechanical processing** of fruit and vegetable based food products
- Creation of stable **emulsions** (e.g. oil/vegetable emulsions)
- **Structure engineering** through high pressure homogenisation can be used as a tool to influence carotenoid bioaccessibility in fruit- and vegetable-based food products

Solutions for shortcomings

High pressure homogenisation can be used as a complementary technique to simple blending for the creation of fruit- or vegetable-based dispersions in order to obtain a desired rheological behaviour and/or optimal bioaccessibility of micronutrients.

What can it **NOT** be used for?

**Products**

This technology can not be used for solid food products or products of which the viscosity is very high.

**Operations**

Sterilisation

**Other limitations**

The effect of high pressure homogenization on the structural characteristics of fruit-and vegetable-based products is largely dependent on the matrix type that is considered. For example, a decrease in viscosity with increasing pressure levels has been observed for carrots (6), whereas an increase in viscosity with increasing pressure levels has been observed for tomatoes (2,3,10). This explains why individual studies on different fruit and vegetable matrices are required in order to intelligently apply the technique of high pressure homogenization for the production of fruit- and vegetable-based food products.

**Risks or hazards**

Heating of heat-sensitive products can occur at high pressures, without adequate temperature control.

Implementation

**Maturity**

High pressure homogenisation has already been widely used in the dairy industry (although at lower pressures of 20-60 MPa). Interest towards this technique at pressures up to 350 MPa in the field of fruit- and vegetable processing is currently increasing.

**Modularity /Implementation**

This technology can be inserted in an existing production line, where it complements simple blending. The pressures applied (up to 350 MPa) are higher than for standard homogenization (20-60 MPa).

**Consumer aspects**

The consumer acceptancy of high pressure homogenised products is likely to be high as products with improved rheological characteristics and a high bioaccessibility of micronutrients can be obtained.

**Legal aspects**

No issues expected

**Environmental aspects**

Relatively low efficiency of energy use: in UHPH, 41-63% of the energy is lost as heat (13).

Facilities that might be interesting for you

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<tr>
<th>Title</th>
<th>Institute/company</th>
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<tbody>
<tr>
<td>HP homogenizer GEA KU Leuven</td>
<td>KU Leuven LFT</td>
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<td>UIP1000hd Ultrasonic Processor - TTZ</td>
<td>TTZ</td>
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Further Information

Institutes
KU Leuven LFT, Unilever

Companies
GEA Niro Soavi, OMVE Netherlands, Tetra Pak

References

Source: