Overview of activities in NovelQ focused on:
Development and Demonstration of Novel Food Processing Technologies

Ariette Matser, Lilia Ahrné
Wageningen UR, A&F; DIK

NovelQ FOOD QUALITY AND SAFETY

Objective

To develop and successfully demonstrate - eco-friendly - novel processing technologies (HPP, PEF, plasma, microwave, radio frequency, ohmic heating and novel packaging materials) for improved quality food and new products (fresh-like character, extended shelf-life) and to enrich the European Cuisine

NovelQ

Contract No. 015710 funded by EC

FOOD QUALITY AND SAFETY

The NovelQ team

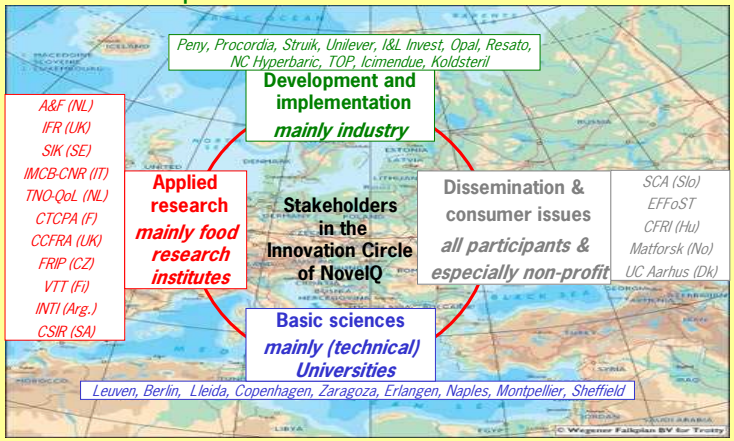
- 6th Framework Program of the European Commission
- NovelQ unites 36 partners + >70 industry members
- EC contribution: 11.3 M€
- Duration: 1 March 2006 – 1 March 2011

Contract No. 015710 funded by EC

European Commission Science community Industry Consumer

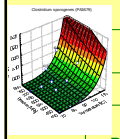
NovelQ FOOD QUALITY AND SAFETY

Consortium partners



NovelQ FOOD QUALITY AND SAFETY

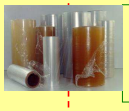
NovelQ approach: basic science & innovation parallel



SP6: *Management*

SP1: *Basic food science*, kinetics, mechanisms & sensors

SP4,7: *Development and demonstration* of NP techniques



SP2: *Material science and packaging*

SP3: *Consumer perception*

SP5: *Dissemination, Technology Transfer, Training and Career Development*

NovelQ FOOD QUALITY AND SAFETY

Subproject 4

Development and Demonstration of Novel Food Processing Technologies

SP leaders: Ariette Matser (WUR), Lilia Ahrné (SIK)

Objective:
To facilitate and speed up industrial exploration of NP via:

- Applied research for successful implementation
- Facilitating pre-industrial applications
- Extensive demonstration projects

NovelQ FOOD QUALITY AND SAFETY

Partners active in SP 4

- SIK (S)
- Agrotechnology & Food Innovations (NL)
- TUBerlin (D)
- KULeuven (B)
- IFR (UK)
- CTCPA (F)
- Campden BRI (UK)
- TNO-QoL(NL)
- FRIP (CZ)
- University of Sheffield (UK)
- Resato (NL)
- I&L Invest (B)
- Unilever (NL)
- Struik Foods (NL)
- Procordia Food (S)
- OPAL (F)
- CGPA PENY (F)

NovelQ FOOD QUALITY AND SAFETY

Focus in SP4

- Processing technologies:
  - HP & HPT
  - PEF
  - Cold plasma
  - Advanced heating: microwave, ohmic, radio frequency
- Processes scaled up to industrial implementation
- Real products and menu of food ingredients
- Chain approach
- Incremental innovations starting at year 1

Overview of activities and results: highlights

NovelQ FOOD QUALITY AND SAFETY

Strategies and structure of SP4

1. Elimination of research hurdles:
   - Hygienic design
   - Process integration
2. Focus on equipment
   - Scaling up of equipment
   - Characterisation of small scale equipment
3. Facilitation of implementation:
   - Environmental efficient processing
   - Predictive modelling
   - Decision support system
4. Demonstration
   - Overall demonstration of product improvement by NP
   - Specific demonstrations with industry

Hygienic equipment performance for NP

Partners: Campden BRI, SIK

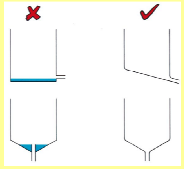
Objectives:

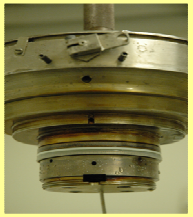
- Develop methods to assess hygienic performance of materials and equipment
- Provide guidance on approval of materials and equipment
- Develop suitable protocols for NP equipment cleaning

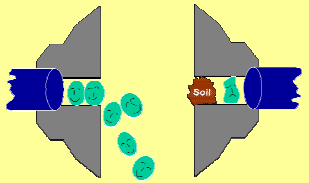
Hygienic equipment performance for NP

- Inherent hygienic design
- Processing performance
- For HP and PEF hazards indentified:
  - Contact materials: no new surfaces and fabrications used
  - Hygienic design of equipment:
    - HP: pressurizing fluid: potential for contamination
    - PEF: hygienic design of coupling etc: standard hygienic design can be sufficient

Hygienic equipment performance for NP







Hygienic design features HP

- Pressure fluid system poor
- Piston closure arrangements

Hygienic equipment performance for NP

SIK PEF test rigs

Hygienic design features PEF

- Hygienic design of tubes etc
- Potential of cracks were micro-organisms can survice

Treatment chamber and surfaces

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Hygienic equipment performance for NP

- Potential post-process problems with both HPP and PEF (though no different to any other thermal process)
  - Aseptic packaging needed for PEF
  - Post contamination possible after HP if there are leakages
- Potential solutions and control options will be developed

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Process integration

The University Of Sheffield.

Sik

ctcpa

Partners: SIK, CTCPA, University of Sheffield

Objectives:

- Integration of process and packaging for handling of liquid foods
- Develop automated technologies and control system for hygienic handling of solid foods

NovelQ FOOD QUALITY AND SAFETY

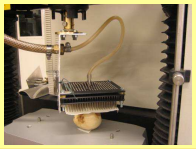
Process integration

Automatic handling of products:

- Minimisation of recontamination of product after processing
- Integration with cleaning
- Integration with sorting and positioning
- Preservation of quality

Results achieved

- Robot handling system developed
- Different gripper systems designed



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Process integration

Evaluation of aseptic packaging:

- Necessary after several (novel) processing methods: PEF, ohmic heating
- Presence of particles (e.g. soups, or vegetable mixes) makes it very complicated
- Research is being done to evaluate sterility and product quality of aseptic packaging of products with particles after ohmic heating.

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Process integration

- Evaluation of aseptic filling after ohmic heating
- Vegetable mixes, meals: large particles

- Direct and fast heating: improvement of quality
- Aseptic packaging successful: shelf life

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Strategies and structure of SP4

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Scaling up of equipment

Partners: SIK, A&F, Resato, I&L, Unilever

Objectives:

- Inventory made of bottlenecks for scaling up and implementation
- Actions differ for each technology

Microwave, ohmic heating:

- Technology and equipment is available
- Lot of progress made in recent year
- Need for success stories and dissemination of these
- Presentations in workshops done
- Dedicated workshop will be organised

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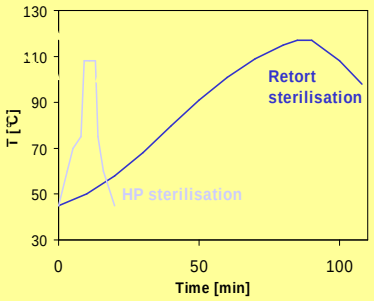
Scaling up of equipment

High pressure:

- HP pasteurisation equipment is available
- Focus on HP sterilisation

Preheating of sample

Use adiabatic compression for fast heating



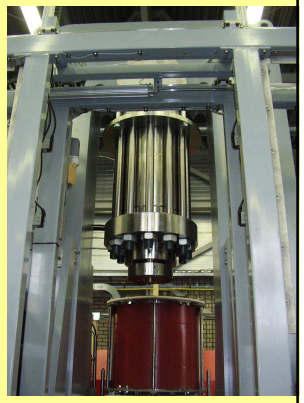
Fast T reduction at pressure release

Prevent heat loss

Short treatment time and smaller heat impact

Goals for HP sterilisation equipment

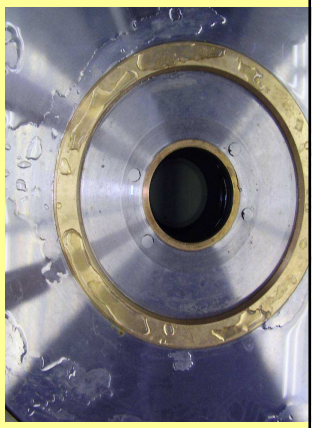
- High temperature, high pressure
- Equipment has to deal with these conditions:
  - Seals
  - Reliability
- Control of temperature
  - Prevention of T loss
  - Homogeneity of T
- Economy



High P, high T: equipment

- Different materials of vessel, lid and seals
- Dilatation due to T changes
- Coefficients different for the materials used
- High P can result in extrusion of seals
- Diameter of vessel

Research topics in NovelQ

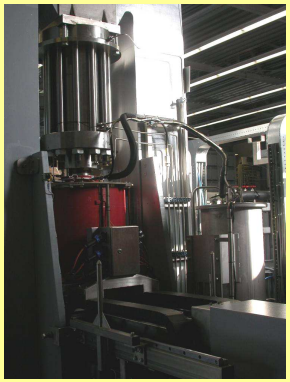


Economy of equipment

- HP equipment is expensive
- High throughput rate necessary
- Vessel volume <-> l/hours
- Rapid loading and unloading
- Fast pressure build up
- % vessel filled with product
- Reliability of system, maintenance
- Current estimation: 0.10-0.20 €/kg

Research topics in NovelQ

Pilot unit:



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- Film

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Scaling up of equipment

Cold plasma:

- Need for better understanding of process
- Mechanism of inactivation of micro-organisms
- Life time and transport of cold plasma
- Composition of cold plasma
- Small scale equipment developed
- With OMVE The Netherlands

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Characterisation of small scale equipment

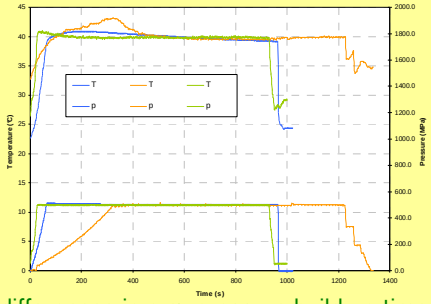
Partners: FRIP, CTCPA, KULeuven, A&F

- Observation at start of NovelQ:
  - Large differences in performances of NP units
  - Can influence comparison of research results
- Inventory made of equipment available at NovelQ partners: database acessible of partners
- Comparison of different equipment

NovelQ FOOD QUALITY AND SAFETY

Characterisation of small scale equipment

- Comparison of HP different equipment



- Large differences in e.g. pressure build up time
- Results in considerable differences in T

Strategies and structure of SP4

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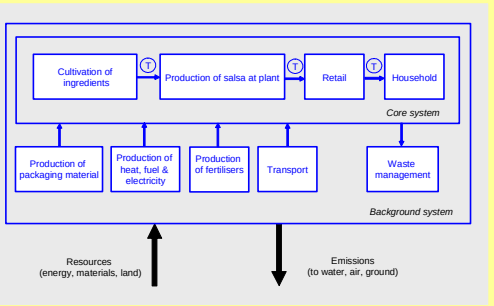
Environmental efficient processing

Partners: IFR, SIK

- Reduction of waste streams: potential of using NP
- Life cycle analysis: what is advantage of NP?
  - Method developed for LCA of HP and PEF
  - Specific data collected for these processes: difficult as less data is available and scale is sometimes different from conventional

Environmental efficient processing

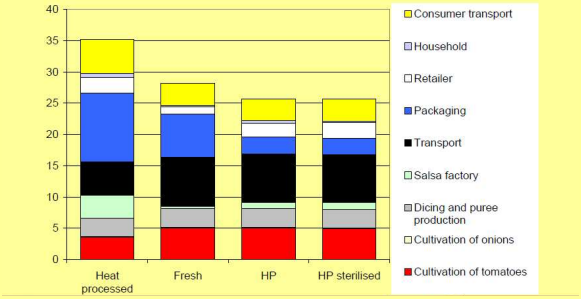
- Example: LCA of tomato salsa



- Influence of processing, but also packaging, transport, storage

Environmental efficient processing

- Example: LCA of tomato salsa



- Influence of processing, but also packaging, transport, storage

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Prediction of shelf-life of NP products

Partners: TNO-QoL, TUBerlin

Objectives:

- Predictive modelling of effects of NP processing on quality and shelf life
- Translation of scientific data towards process conditions and shelf life
- Shelf life: microbial and quality

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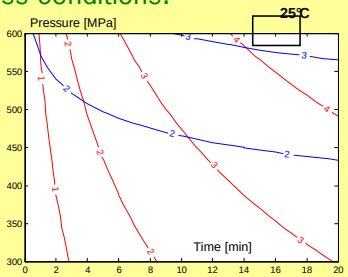
Prediction of shelf-life of NP products

Example: shelf life of orange juice after HP processing

Shelf life in weeks for process conditions:

- red: microbial
- blue: enzymatic



NovelQ FOOD QUALITY AND SAFETY

Decission support system

Partner: A&F

Objective:

- To help potential users to decide if NP is beneficial for their products
- Internet tool
- Questions to select which technology
- Information about NP
- Will be available for IAP members in 2010

Questions:
•Product
•Shelf life
•…..

↓

Ranking of NP

↓

More info

↓

Comparison of costs & benefits

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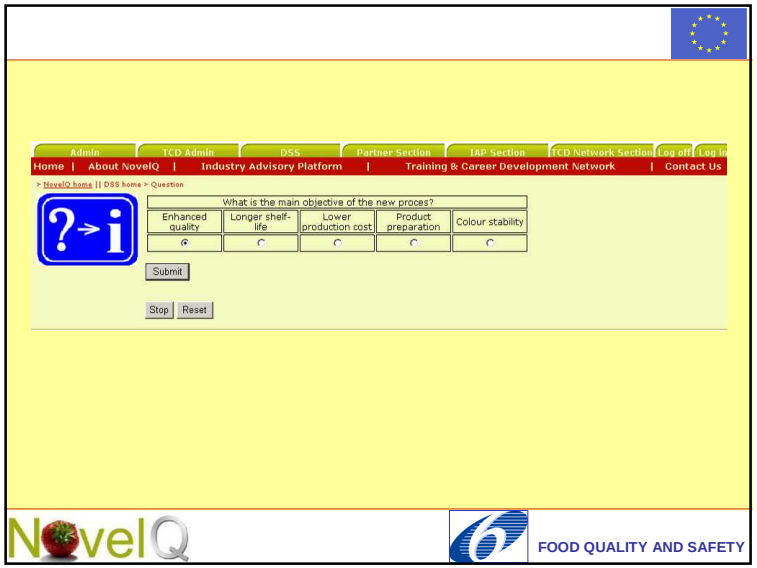
Decision Support System
(Beta Version, only for use within NovelQ)
This decision support system (DSS) helps potential users of novel processing technologies to make a decision whether or not these technologies are beneficial to your business. You will be asked maximum 8 questions about the product category and the intended effects of these technologies. This will result in a first overview relevant novel technologies.
The decision support system is being developed by Agrotechnology & Food Innovations within the European project NovelQ.
This system is currently under construction. At this moment only a limited number of novel technologies (high pressure, pulsed electric fields, cold plasma, microwave and radio frequency heating) and questions are implemented. During NovelQ, extensions and updates will be made with respect to e.g.:
technologies included
information given as outcome (info on technologies, advantages and disadvantages of technologies, scoring matrix, process conditions)
information of lab scale and pilot scale equipment available within NovelQ
access to models
Suggestions and comments are most welcome. Please contact Ariette Matser or Remco Hamoen.
Continue
FOOD QUALITY AND SAFETY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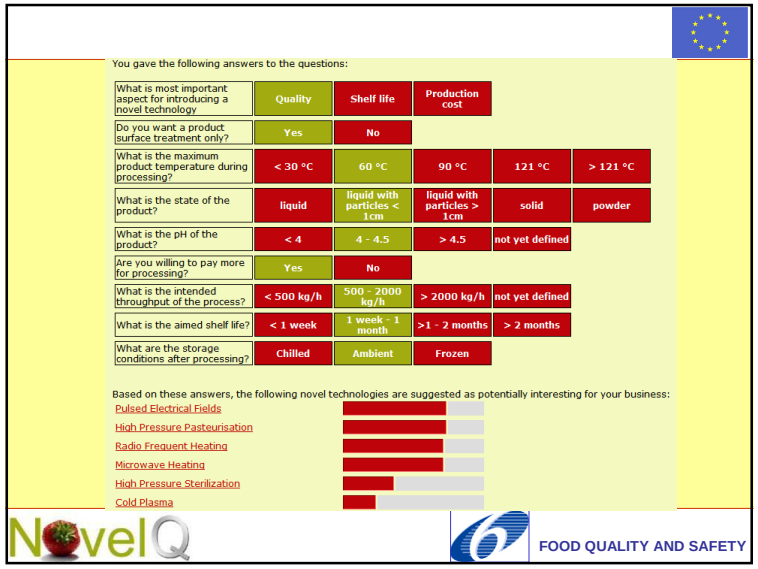
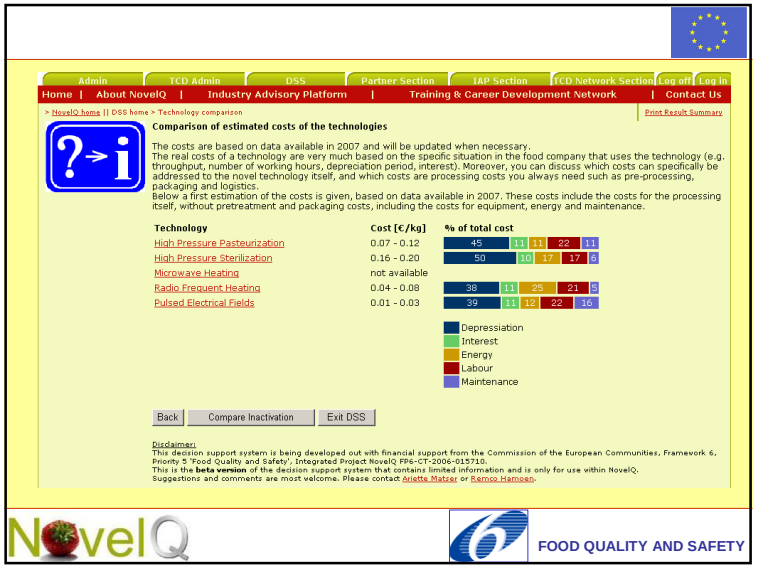
What is the main objective of the new proces?
Enhanced quality
Longer shelf-life
Lower production cost
Product preparation
Colour stability
Submit
Stop
Reset
FOOD QUALITY AND SAFETY


You gave the following answers to the questions:
What is most important aspect for introducing a novel technology: Quality | Shelf life | Production cost
Do you want a product surface treatment only: Yes | No
What is the maximum product temperature during processing: < 30 °C | 60 °C | 90 °C | 121 °C | > 121 °C
What is the state of the product: liquid | liquid with particles < 1cm | liquid with particles > 1cm | solid | powder
What is the pH of the product: < 4 | 4 - 4.5 | > 4.5 | not yet defined
Are you willing to pay more for processing: Yes | No
What is the intended throughput of the process: < 500 kg/h | 500 - 2000 kg/h | > 2000 kg/h | not yet defined
What is the aimed shelf life: < 1 week | 1 week - 1 month | >1 - 2 months | > 2 months
What are the storage conditions after processing: Chilled | Ambient | Frozen
Based on these answers, the following novel technologies are suggested as potentially interesting for your business:
Pulsed Electrical Fields
High Pressure Pasteurisation
Radio Frequent Heating
Microwave Heating
High Pressure Sterilization
Cold Plasma
FOOD QUALITY AND SAFETY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> NovelQ home || DSS home > Technology comparison
Print Result Summary
Comparison of estimated costs of the technologies
The costs are based on data available in 2007 and will be updated when necessary.
The real costs of a technology are very much based on the specific situation in the food company that uses the technology (e.g. throughput, number of working hours, depreciation period, interest). Moreover, you can discuss which costs can specifically be addressed to the novel technology itself, and which costs are processing costs you always need such as pre-processing, packaging and logistics.
Below a first estimation of the costs is given, based on data available in 2007. These costs include the costs for the processing itself, without pretreatment and packaging costs, including the costs for equipment, energy and maintenance.
Technology | Cost [€/kg] | % of total cost
High Pressure Pasteurization | 0.07 - 0.12 | 45 11 11 22 11
High Pressure Sterilization | 0.16 - 0.20 | 50 10 17 17 6
Microwave Heating | not available
Radio Frequent Heating | 0.04 - 0.08 | 38 11 25 21 5
Pulsed Electrical Fields | 0.01 - 0.03 | 39 11 12 22 16
Depressiation
Interest
Energy
Labour
Maintenance
Back
Compare Inactivation
Exit DSS
Disclaimer:
This decision support system is being developed out with financial support from the Commission of the European Communities, Framework 6, Priority 5 'Food Quality and Safety', Integrated Project NovelQ FP6-CT-2006-015710.
This is the beta version of the decision support system that contains limited information and is only for use within NovelQ.
Suggestions and comments are most welcome. Please contact Ariette Matser or Remco Hamoen.
FOOD QUALITY AND SAFETY

Strategies and structure of SP4

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NovelQ FOOD QUALITY AND SAFETY

Integral demonstration

Partners: all

Comparison of NP technologies
Use of knowledge generated in NovelQ
Analysis in SP1, SP3
Production etc in SP4
Dissemination in SP5

NovelQ FOOD QUALITY AND SAFETY

Integral demonstration

Demonstration on pilot scale possibilities of NP for specific products - in 1-2 day trials caried out at various NovelQ partner organisations.

NP Technologies	Locations	Products
	NovelQ partners	IAP members

1-2 day trial

- Short public reports for dissemination of results will be available 2010/2011

NovelQ FOOD QUALITY AND SAFETY

Demo project: Radio-frequency heating

Partners: Struik Foods (NL), A&F

Objective:

Demonstration of radiofrequency as volumetric heating method for sterilisation of food products

Achievements

- Development of lab scale and pilot scale system
- Measurement of temperature profiles
- Evaluation of effects on product quality

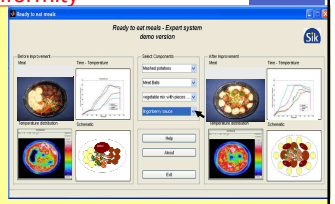
NovelQ FOOD QUALITY AND SAFETY

Demo project: Microwave heating uniformity

Partners: Procordia (S), SIK

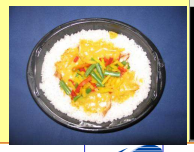
Objective:

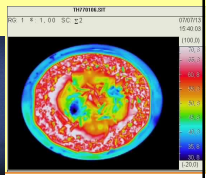
Improving uniformity of microwave heating and thawing



Achievements

- Numerical modelling combined with experience and knowledge in microwave
- Model developed and evaluated





NovelQ FOOD QUALITY AND SAFETY

Demo project: Ohmic heating of pumpable foods

Partners: OPAL (F), Peny (F), CTCPA

Objective:

Demonstration of ohmic heating of pumpable foods

Achievements

- Pilot scale evaluation
- Medium to high viscosity products
- Integration with pretreatment and packaging
- Evaluation of homogeneity
- Effects on product quality

NovelQ ctcpa FOOD QUALITY AND SAFETY

Conclusions

- Focus on HP, PEF, Plasma and advanced heating
- Activities:
  - Elimination of research hurdles
  - Focus on equipment
  - Facilitation of implementation
  - Demonstration
- Strong interaction between partners and activities
- More results will be available in coming years

NovelQ FOOD QUALITY AND SAFETY