Food Safety and Anti-Microbial Effect of Packaging Materials Containing Chitin Nanofibrils

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Nofima – Processing Technology

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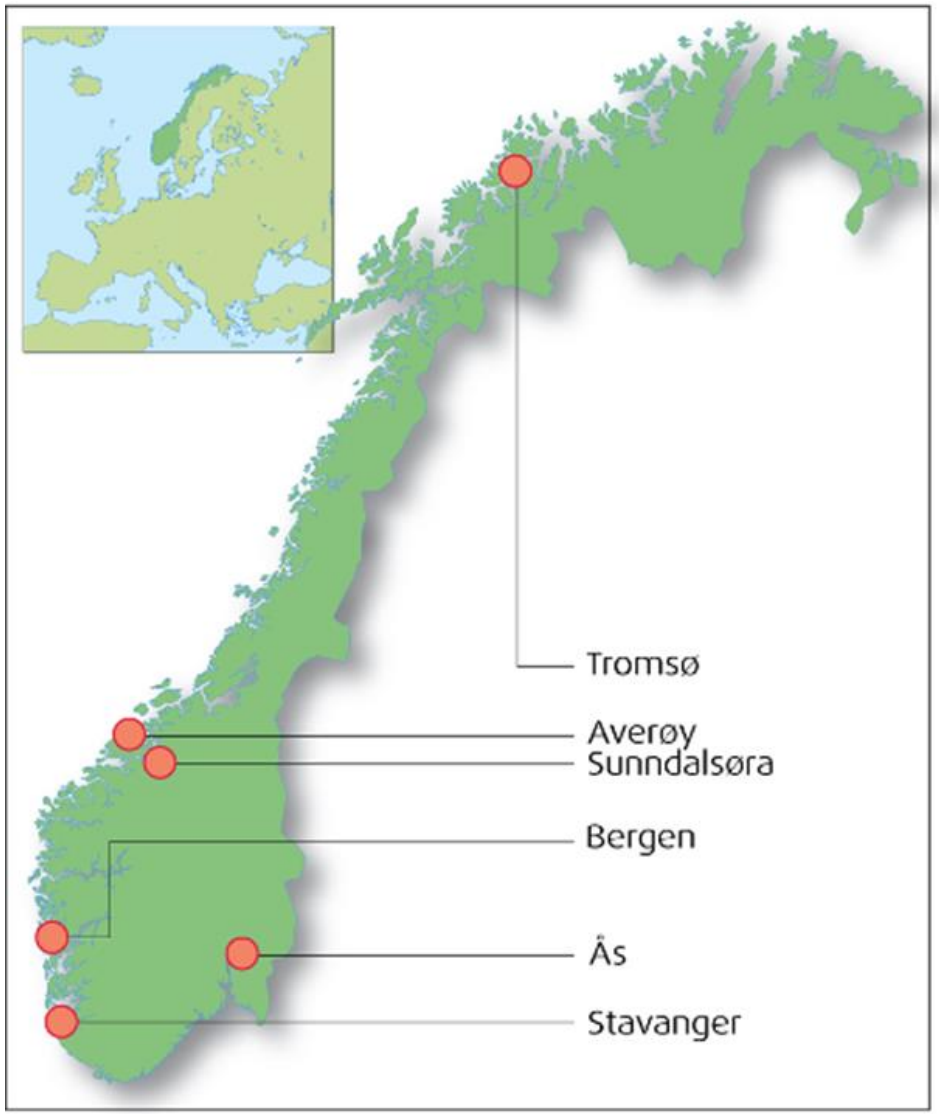
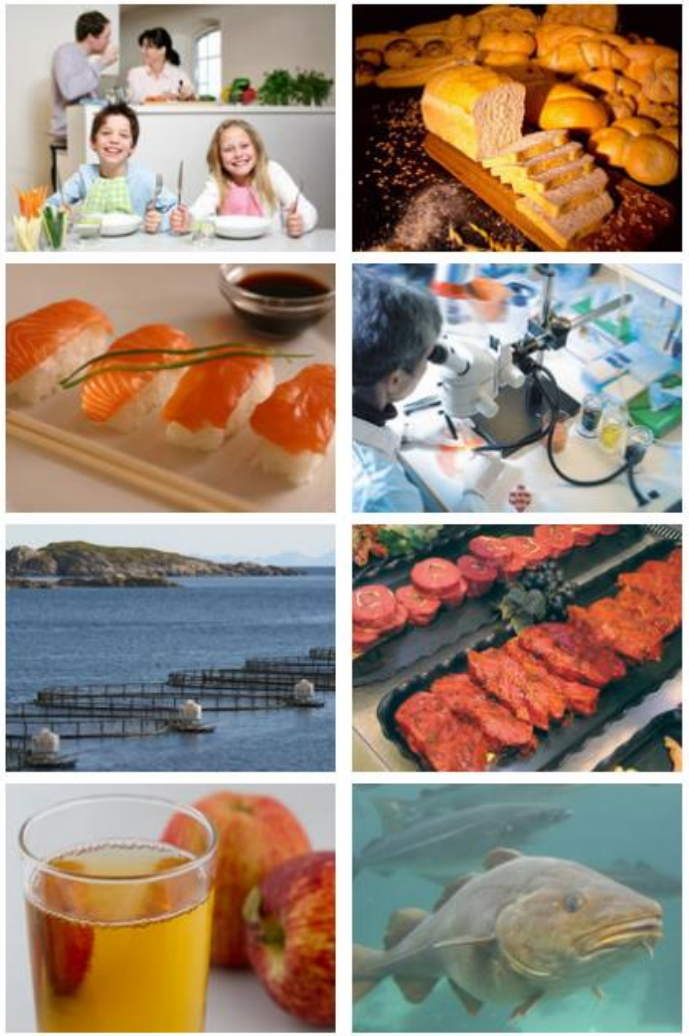
Facts about Nofima

- National food research institute, established on January 1, 2008
- Comprises the former Akvaforsk, Fiskeriforskning, Matforsk and Norconserv
- Target markets: Food industry and aquaculture and fisheries industry
- Employees: approx. 380
- Turnover annually: NOK 530 mill
- Head office: Tromsø
- Owners:
  - State (Ministry of Trade, Industry and Fisheries): 56.8%
  - The Agricultural Food Research Foundation: 33.2%
  - Akvainvest Møre og Romsdal: 10 %



Research areas

- Aquaculture
  - Breeding and Genetics
  - Nutrition and Feed Technology
  - Fish Health
  - Production Biology
  - BioLab
- Fisheries, Industry and Market
  - Consumer and Marketing Research
  - Industrial Economics and Strategic Management
  - Seafood Industry
  - Processing Technology
  - Marine Biotechnology
- Food Science
  - Food and Health
  - Raw Materials and Process Optimisation
  - Consumer and Sensory Science
  - Food Safety and Quality



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Processing Technology

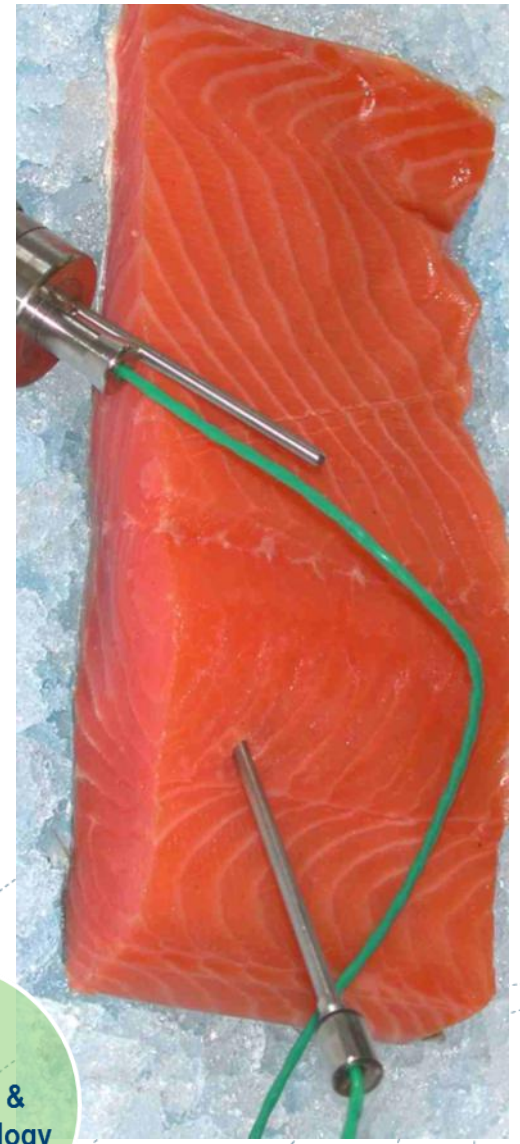
Gentle processes for optimal quality, food safety and increased shelf life

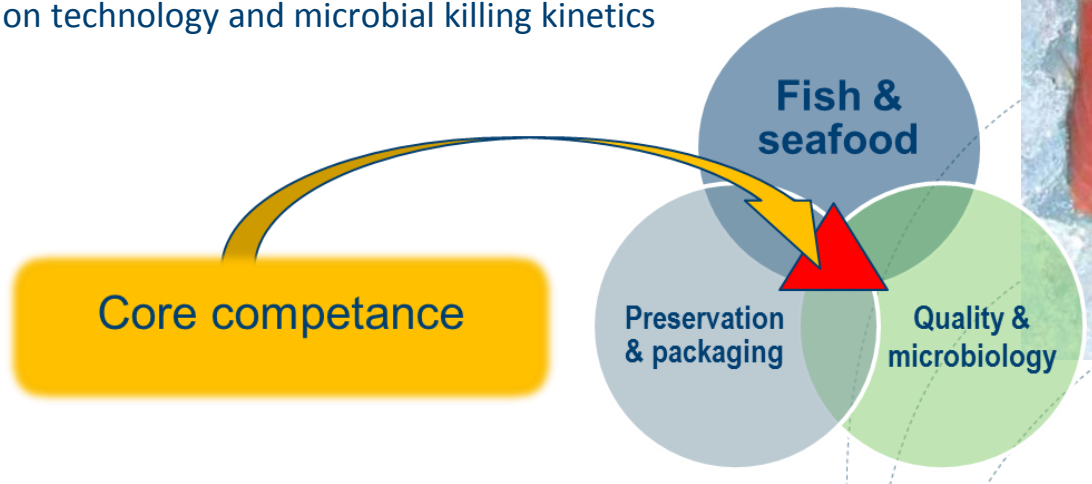
Preserve and increase shelf life

- Raw material quality and welfare
- Packaging and cooling
- Gentle processes using heat and pressure
- Product development and industrial gastronomy

Monitor and safeguard

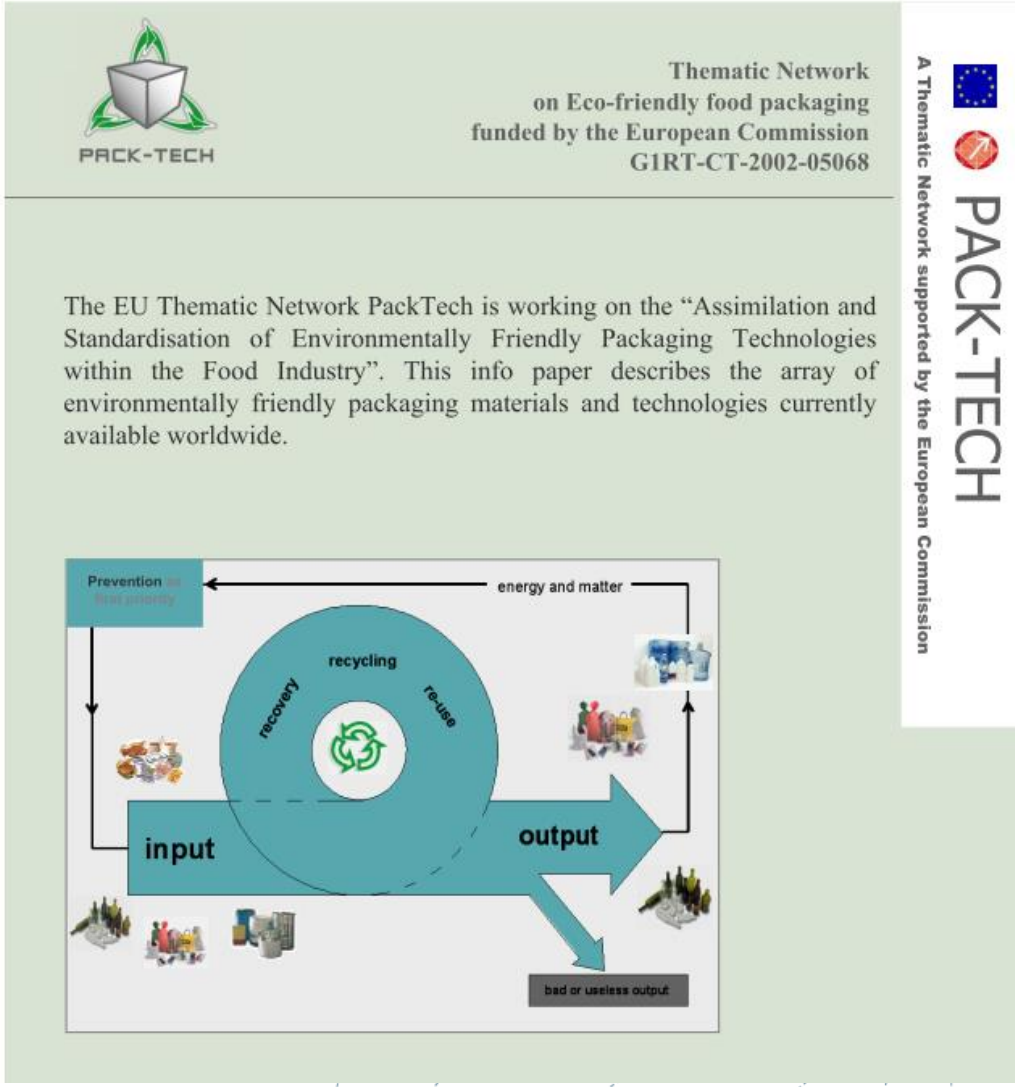
- Hygiene and control of illness-causing bacteria
- Combination technology and microbial killing kinetics





Packtech

- Thematic network (EU-FP5)
- Assimilation and Standardisation of Environmentally Friendly Packaging Technologies within the Food Industry
- 31 partners from 16 countries
- 2002-2005



New Eco-friendly packaging solutions

Bio-based polymers represent a new generation of packaging materials, able to significantly reduce the environmental impact in terms of energy consumption and greenhouse gas emissions, to perform as traditional plastics when used and completely biodegrade within a composting cycle. A lot of research is directed towards the development and improvement of bio-based packaging materials.

Bio-based polymers origin

Extracted directly from natural materials

(e.g. starch-based polymers)

Produced by traditional chemical synthesis from renewable bio-derived monomers

(e.g. lactic acid monomers)

Produced by micro-organisms or genetically transformed bacteria (e.g. bacterial cellulose)

The picture prevails that important environmental benefits are obtained by using biopolymers. However, more efforts need to be made in this area:

bio-based materials are still 4 to 6 times more expensive than conventional ones. In general, the technologies are still in their infancy and material properties are not fully competitive with the conventional materials.

Sustainable packaging: **Forbioplast**

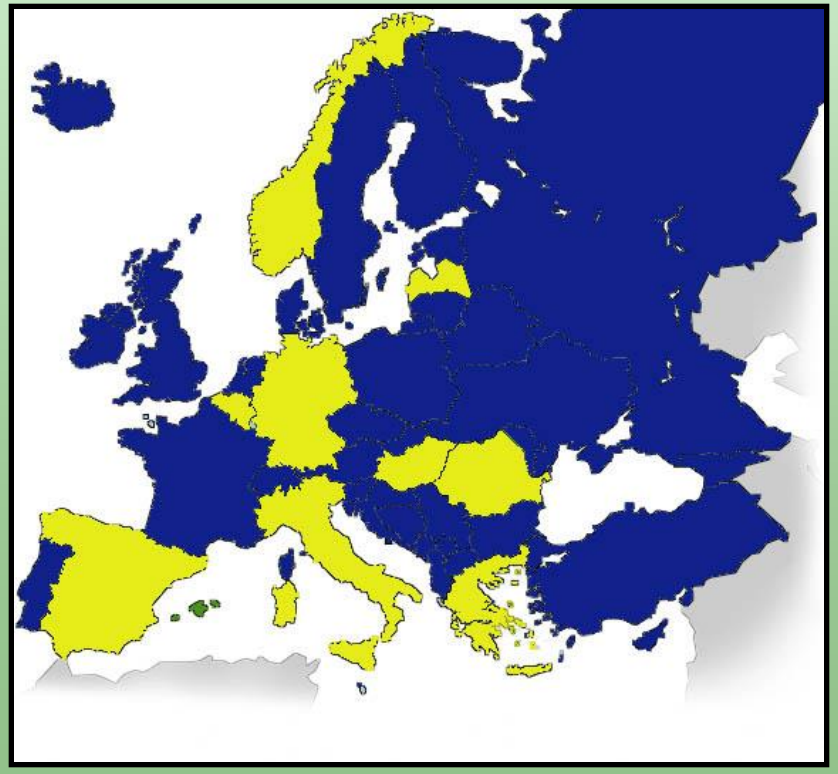
"Forest Resource Sustainability through Bio-Based-Composite Development" is a collaborative Large-scale European Project in the 7th Framework Programme. 2008-2012

GOALS

- **Valorisation of forest resources** for the production of biobased products.
- Identification of the best ways for **industrial exploitation of forest biomass** at the European scale.
- Development of **improved** technologies with regard to the present **industrial synthesis of polyurethane** and target of an industrial scale up of the process.
- Replacement of **glass fibres and mineral fillers with wood derived fibres** in automotive interior and exterior parts.
- Development **of biodegradable polymer/wood derived fibre composites** for application in the packaging and agriculture sector.
- Production of polyurethane from materials based on forest resources.

Participants

The FORBIOPLAST consortium:
16 partners.
cooperation among research centres, small-medium enterprises and industrial partners



Researchers

- University of Pisa (Italy): coordinator, nanotechnology, material processing
- University of Budapest (Hungary): fibres modification
- Latvian State Institute of Wood Chemistry (Latvia): PU expert
- University of Almería (Spain): biovalorisation, biodegradation
- Fundacion CARTIF (Spain): forest material expert
- University of Agronomic Sciences and Veterinary Medicine, Bucharest (Romania): agriculture, toxicity
- Organic Waste Systems (Belgium): composting, LCA
- Nofima A.S. (Norway): packaging tests

Producers

- PEMŰ Plastic Processing Co. (Hungary): car components, packaging
- RODAX (Romania): equipment
- Ritols Ltd. (Latvia): PU foams
- Incerplast (Romania): packaging

End users

- FIAT Research Center (Italy): vehicle prototypes, LCA on car components
- Neochimiki L.V. Lavrentiadis S.A. (Greece): users and tests on packaging
- Cosmetic (Greece): users and tests on packaging

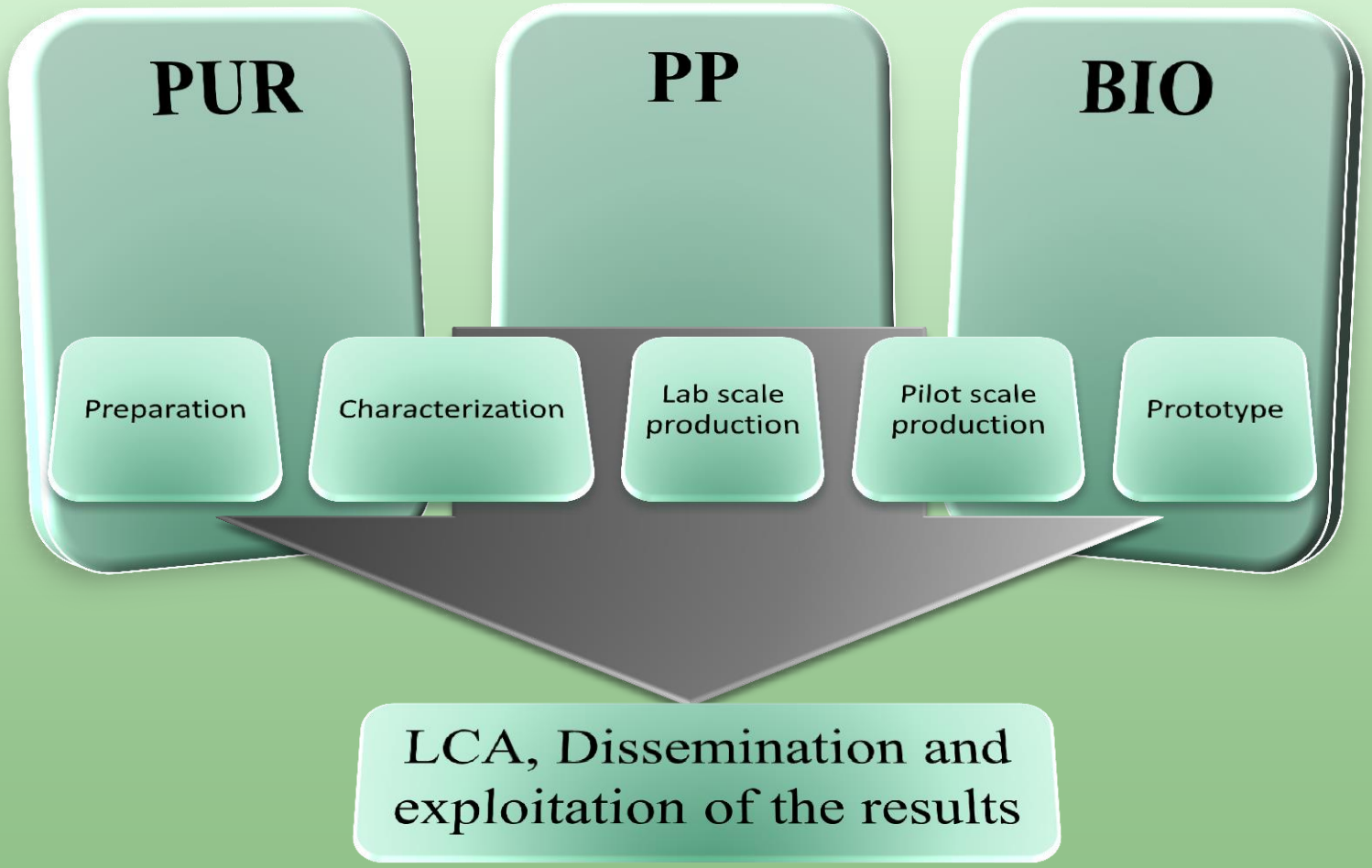
Market expert

- Wiedmann GmbH. (Germany)

Forbioplast 2008-2012

Collection and pre-treatment of forest materials

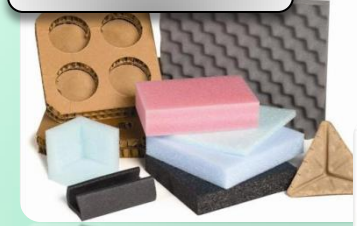
- Market analysis of raw materials
- Characterisation of forest materials
- Forest materials pre-treatment



Applications

Forest resources

Packaging



Automotive

Agriculture

Biomass

Products

- Car seat and spoiler
- Green PUR insulation foam
- Biodegradable plant pot
- Substitute of lightweight expanded clay aggregate
- Tomato clip
- Encapsulated fertilizer
- Packaging (container for cosmetics, chemicals, fish, transport of fish, biological egg)

Conclusions and perspectives

- New knowledge in **forest derived materials**
- **Cooperation** in the framework of the project between partners
- Development of **new biodegradable and environmentally friendly** products
- Substitution of petroleum products with **renewable raw materials** in the production of polymers, and composites
- Utilization of knowledge in **education**

This work is supported by European Community, Grant number: 212239.

Sustainable technologies for the production of biodegradable materials based on natural chitin-nanofibrils derived by waste of fish industry, to produce food grade packaging.

n-chitopack

SEVENTH FRAMEWORK PROGRAMME

2012-2014

Main Objective

The *n*-CHITOPACK project will focus on the industrial use of waste derived **natural chitin nanocrystals** (known as *chitin-nanofibrils-CN*)

to produce functional *bacteriostatic* films and rigid packaging to be used in the food industry

which are 100% bio-degradable and demonstrate higher mechanical strength as well as increased UV and heat resistance.

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Participants/partners

Italy, Czech republic, Germany, Romania, Norway

Partners

Partner of the project

mavi	MAVI Sud srl V.le Dell'Industria, 1 - 04011 Aprilia (LT) - Italy Official website: www.mavicosmetics.it		***Coordinator***
AROMA	AROMA SYSTEM SRL VIA DEL BATTIRAME 6, BOLOGNA, ITALIA Official website: www.icaspa.it	biozoon food innovations gmbh	BIOZOON GMBH Fischkai, 1, BREMERHAVEN, DEUTSCHLAND Official website www.biozoon.de
macro PRAGUE	USTAV MAKROMOLEKULARNI CHEMIE AV CR, V.V.I. HEYROVSKEHO NAM. 2, PRAHA 6, CESKA Official website: www.imc.cas.cz	INSTM	CONSORZIO INTERUNIVERSITARIO NAZIONALE PER LA SCIENZA E TECNOLOGIA DEI MATERIALI Via Giusti 9, FIRENZE, ITALIA Official website: www.instm.it
MICROTEC SRL Plastics Masterbatch Compound	MICROTEC SRL VIA DELLA CROCE ROSSA 42, PADOVA, ITALIA Official website:www.microtecsrl.com	Nofima	NOFIMA AS MUNINBAKKEN 9-13, TROMSO, NORGE Official website: www.nofima.no
RODAX IMPEX SRL	SC RODAX IMPEX SRL DRUMUL TABEREI, BUCHAREST, ROMANIA Official website: www.rodax-impex.ro		

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S&T Objectives of the project

S&T Objective 1: To develop a sustainable 100% biodegradable chitosan/CN film as well as novel CN based nano-bio-composites to improve bio-degradable packaging materials with bacteriostatic, UV resistance and increased thermo-mechanical properties.

S&T objective 2: Design of adapted and optimized process for the production of chitosan/CN film and (flexible and rigid) CN-bio-composites for food-packaging.

S&T objective 3: Validation of the newly developed technologies in food packaging through <u>interaction with different food matrices and shelf life studies.</u>

S&T objective 4: Validate the environmental benefit of the new material and process, performing a cradle-to-grave Life Cycle Analyses (LCA) and biodegradation test.

Actibiosafe 2014-2017

The Romanian - EEA Research Programme

Improving food safety through the development and implementation of active and biodegradable food packaging systems

Deltagere: Institutul de Chimie Macromoleculara “Petru Poni”, Nofima, Institutul de Cercetari Produse Auxiliare Organice, Rodax Impex S.R.L., Universitatea de Stiinte Agronomice si Medicina Veterinara

IMPROVING FOOD SAFETY THROUGH THE DEVELOPMENT AND IMPLEMENTATION OF ACTIVE AND BIODEGRADABLE FOOD PACKAGING SYSTEMS

ActiBioSafe

Budget (2014 – 2017): 900 000 Eur (85% European funding, 15% Romanian funding)

Introduction

The increasing demand for fresh and high quality packaged food, consumer convenience and manufacturer concern for longer shelf life of the food products are driving the market. Conventional packaging materials represent a huge problem precisely because of their long persistence in environment. This project will contribute to reduce alteration of the food in that it will develop active and biodegradable packaging systems.

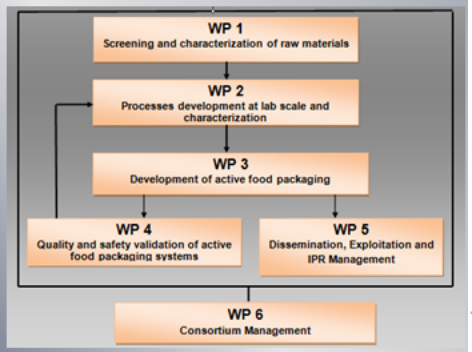
Consortium Structure

- "PETRU PONI" INSTITUTE OF MACROMOLECULAR CHEMISTRY, Iasi, Romania; Project Promotor
- NOFIMA AS, Stavanger, Norway
- SC RODAX SRL, Bucharest, Romania
- RESEARCH INSTITUTE OF ORGANIC AUXILIARY PRODUCTS SA, Medias, Romania
- UNIVERSITY OF AGRONOMIC SCIENCES AND VETERINARY MEDICINE BUCHAREST, Romania

Objectives

- Design and development of new antimicrobial biocomposites based on biodegradable polymers and capsules with active component
- New bioactive packaging materials, patents, scientific papers, conference presentations, master dissertations and doctoral theses

ACTIBIOSAFE Work Plan



Project Outcomes

- Effective knowledge sharing among the research and scientific communities between Romania and Norway
- Reducing food contamination risk and prolong shelf life of food products
- Developing and implementing courses and supporting for individual PhD and MSc student projects
- Obtaining of scientific publications, Master's dissertation and PhD thesis

Acknowledgements:
The research leading to these results has received funding from Romanian - EEA Research Programme operated by MEN under the EEA Financial Mecanism 2009 - 2014 and project contract no. 1SEE/2014.

MINISTERUL EDUCAȚIEI NAȚIONALE

eea grants

norway grants

www.eeagrants.org

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Sustainable packaging:
Marinepack and fillet-only

Marinepack – Fillet Only

- 1 million tons of salmon
  - 200 million salmon/year
- 50 million Styrofoam (expanded polystyrene) boxes
  - 300 000 tonn wet ice

- Objective
  - HOG (head-on gutted) -> fillets
  - EPS -> Fibre
  - Wet ice -> Superchilled

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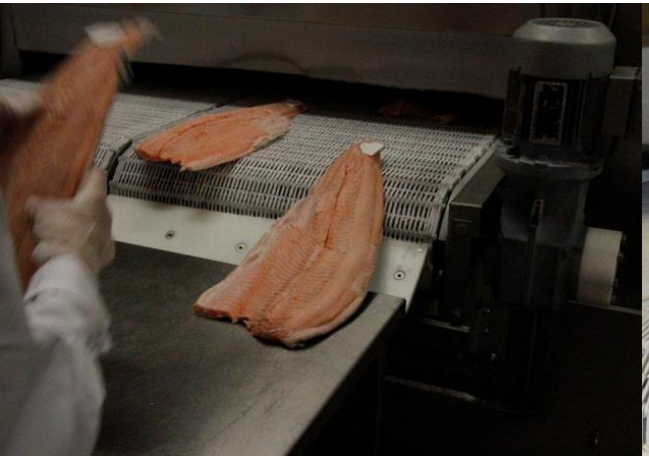
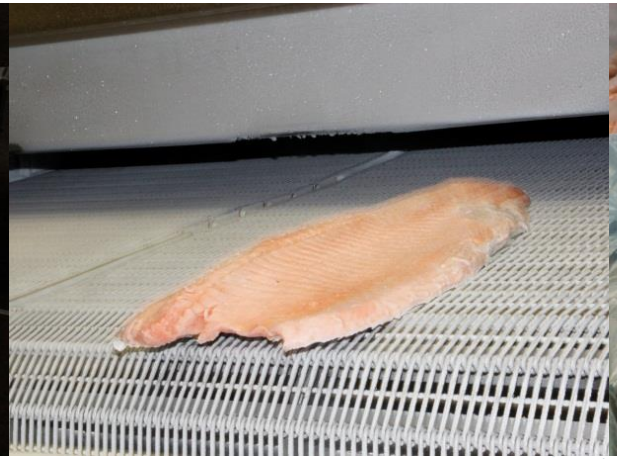
Why not EPS and ICE
superchilling fillets in cardboard boxes

- Better quality keeping
  - Extended shelf-life
  - less shrinkage,
  - less dripploss
- Needs an unbroken chill chain
  - Less insulation, no ice





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Economical and environmental benefits

But why do we need packaging?

- Protect the product against:
  - mechanical stress
  - biological stress
  - climatic stress
- Ease handling in production and distribution:
  - form, fill, seal
  - transport
  - storage
  - retailing
- Promote sale:
  - form
  - package design
  - printing/graphics
  - branding
- Information carrier:
  - product ID (bar codes)
  - labelling
  - consumer information

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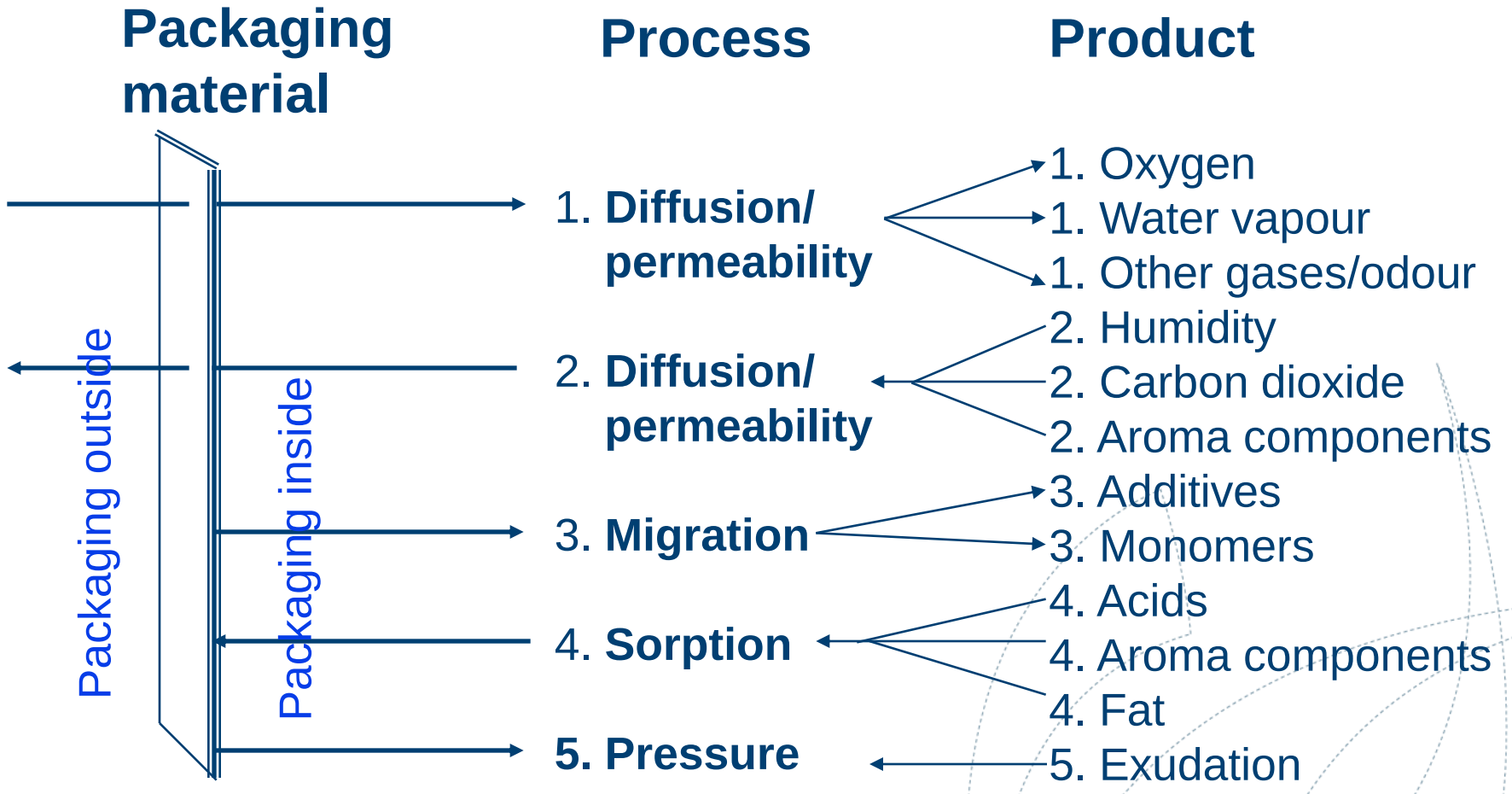
Packaging concept

- Determined by the demands of the consumer on the one hand and the product on the other.
- Optimisation means one must weigh a large variety of product, packaging and environmental aspects within as specific context.

The products demand for the packaging material

- Gas barrier
- Water vapour barrier
- Protection against aroma changes
- Fat resistance
- Light protection
- Chemical resistance
- Impact absorbing
- Cold or heat consistent
- Endure handling during transport and retail

Interactions between package and product



External demands

- Logistics
- Marketing
- Costs
- Environmental
- Convenience
- Legislation
- Consumer safety

Logistics

- Size and dimensions
- Strength
- Compatibility with secondary packaging
- Weight

- Packaging logistics software programmes

Marketing

- Packaging design
- Brand image
- Decoration
- Information

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Costs

- Product & packaging development
- Packaging material
- Indirect costs
  - machinery investments
  - storage
  - transportation
  - energy consumption
  - labour

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Environmental

- Minimisation of packaging material
- Mono-materials
- Reuse or recycled material
- Materials suitable for energy recovery/incineration
- Biodegradable packaging materials

- LCA - life cycle assessments to determine the most environmental friendly packaging

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Convenience

- Package should be convenient to:
  - buy
  - handle
  - carry
  - open
  - use
  - store and re-seal
  - dispose or re-use

Legislation

- Environmental
- Safety
- Labelling
- Storage

Consumer safety

- Safety against food-borne illnesses
- Safety against contaminants from packaging
- Tamper evident

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Materials in contact with foodstuffs

- Framework Regulation (EC) No. 1935/2004 applies to all food contact materials
  - GMP -“under their normal or foreseeable use, not transfer their constituents to foodstuffs in quantities which could:
    - endanger human health
    - bring about an unacceptable change in the composition of the foodstuffs or a deterioration of the organoleptic characteristics thereof”
- Commission Directive 2011/10/EC of 14 January 2011 relating to plastic materials and articles intended to come into contact with foodstuffs:
  - The total amount of substances transferred from plastic articles to foodstuffs must not exceed 60 mg/kg, or 10 mg/dm2 of the surface area of the material or article
  - Specific migration limits for many of the monomers, additives and starting substances on the positive list
- The USER has to ensure the packaging materials is in compliance with the directives

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Environmental friendly food packaging optimisation

- Complex
  - product, market, economical, environmental, legislative & technical demands
- Product and market specific
- The optimal package is often a compromise between the different aspects
  - And more often than not the cost is the most important

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