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

Reporting

Project Information

N-CHITOPACK
Grant agreement ID: 315233

Closed project

Funded under
FP7-SME

Overall budget
€ 1 190 241

EU contribution
€ 901 096,90

Coordinated by
MAVI SUD SRL
Italy

Start date
1 November 2012
End date
31 October 2014

This project is featured in...
Final Report Summary - N-CHITOPACK (Sustainable technologies for the production of biodegradable materials based on natural chitin-nanofibrils derived by waste of fish industry, to produce food grade packaging)

Executive Summary:
The food sector (including beverage industry) accounts for approximately two thirds of global packaging and about 50% of these packages are made of plastics. Plastic food packaging materials currently in use are generally non-biodegradable causing ecological imbalance and aesthetic deterioration of nature. At the same time being a petro-chemical based product, plastics rely on a depleting and increasingly costly natural resource with relatively low LCA performance (high CO2 footprint). Food packaging which is predominantly produced by SMEs is crucial as physical and barrier protection keeping foodstuffs clean, fresh, and safe for consumers while increasing shelf life.

Bio-based plastics offer a highly promising alternative and new biological materials are emerging as potential feedstock, such as chitin waste material from the fishing industry, mostly used in cosmetics applications due to their inherent bacteriostatic properties.

Chitin waste exceeds 250 billion tons/year, and is considered hazardous due to its high perishability and polluting effect, both on land and sea. For this reason re-use and up cycling of chitin to higher value applications establish an important step forwards towards resource efficiency, providing a relevant innovation for the SME packaging industry that is under pressure to reduce cost and respond to environmental concerns.

By using chitin for obtaining bio-based polymer, the n-CHITOPACK project has leveraged on the inherent superior properties of chitin nano-fibrils for the development of new food packaging materials and achieving the following results:

- Realization of materials, which are bacteriostatic, 100% bio-degradable, to be used in food packaging;
- Increasing the competitiveness of the European packaging SMEs;
- Increasing reuse and recyclability of hazardous waste such as chitin and contributing to address the environmental challenges of the waste management;

Project Context and Objectives:
In the development of food engineering, one of the many challenges is to employ modern tools and
knowledge, such as computational materials science and nanotechnology, to develop new products and processes.

Simultaneously, improving quality, safety, and security remain critical issues in food engineering studies. New packaging materials and techniques are being developed to provide more protection to foods, and novel preservation technologies are emerging. One of these developments is related to films for packaging of food products with a short shelf life period. Although the use of conventional films for food packaging such as plastics and their derivatives is effective for food preservation, they create serious environmental problems that continue to present the food industry as a source of pollution and social concerns. This requires that both industrial and scientific stakeholders seek alternative (bio) degradable materials for food packaging. The use of biopolymers however is limited, due to poor mechanical and barrier performance which can be increased by adding compounds such as fillers and fibers. Natural fibers have a low environmental impact because they can be obtained from renewable sources using little energy. They can be animal, vegetable or mineral and the reinforcing performance of natural fibers depends on the nature and crystallinity of the fibers. Nanofibrils from chitin have been a very interesting candidate since they combine their reinforcing function with bacteriostatic (stops bacteria from reproducing) and optical (transparent) properties.

The focus of the n-CHITOPACK project was on the industrial use of waste derived natural Chitin Nanocrystals (known as Chitin-Nanofibrils CN) for producing films and rigid packaging to be used in food industry; the project aimed at found material having the following features:
- bacteriostatic,
- 100% bio-degradable,
- owning mechanical properties comparable with the existing packaging materials
- can be used by European packaging SMEs,
- contribute to increase the SMEs competitiveness in the market and to solve environmental challenges.

The main objective of the project was carrying on researches exploring the possibilities to use CN for new bio-based and improved existing materials used in food packaging, achieving the following key project results:
- Realize a new biodegradable bio-based product completely or predominantly made of waste materials: the n-CHITOPACK process used sea food waste to produce new completely biodegradable films made of Chitosan and CN.
- Optimization of existing biodegradable materials: n-CHITOPACK improved the performance of existing packaging composites using CN. Both flexible and rigid food packaging have been realized.
- Improved production process for the realization of Chitosan/CN based materials:
  1) Increasing production of CN currently used for cosmetic applications, with multiple additional application prospects, patented by MAVI;
  2) setting-up a novel pilot installation to test the feasibility of continuous chitin food-film production
  3) Evaluating multiple exploitation routes and potential market growth towards the field of packaging;
- Alternative bio-based packaging products: the results obtained have made the participants able to pilot novel bio-based functional polymers and adapted processes for the production of both flexible and rigid packaging in the food industry market, as a more competitive alternative to existing bio-derived packaging;
- Environmental Benefit: n-CHITOPACK results support environment:
  1. reducing the pressure on primary non-renewable raw materials
2. reducing pollution caused by non-biodegradable materials,
3. using a potential feedstock base of 2.5 MT of shell fish waste material every year to produce useful goods.

Project Results:
The main results achieved during the development of the n-Chitopack project are related to the identification of the materials and the processed to be used for realizing a new biodegradable chitin-based product, therefore using waste materials, to be used for food packaging.

Realize a new biodegradable bio-based product completely or predominantly made of waste materials the n-CHITOPACK process used chitin (sea food) waste to produce new completely biodegradable films made of chitosan and CN. The main objective of such a work was the identification of the process to be used for create material having the needed robustness for practical applications in packaging industry. Moreover, such result is contributing to the further development of an eco-innovative market for innovative bio-based materials.

Optimization of existing biodegradable materials
n-CHITOPACK improved the performance of existing packaging composites using CN. Both flexible and rigid food packaging will be realized. Robustness has been one of the key challenge to be dealt with, in order to be able to use such films in food packaging.

Improved production process for the realization of chitosan/CN based materials
n-CHITOPACK packaging materials has been developed using patented process innovations: 1) production of CN in environmentally friendly and cost-efficient route, currently used for cosmetic applications, with multiple additional application prospects, patented by MAVI; 2) setting-up a novel pilot installation to test the feasibility of continuous chitin food-film production 3) While being validated in food packaging production, the process has had multiple exploitation routes and hence a vast commercial potential towards all the field of packaging;

Alternative bio-based packaging products
The n-CHITOPACK project has enabled the participant SMEs to pilot novel bio-based functional polymers and adapted processes for the production of both flexible and rigid packaging in the food industry market, as a more competitive alternative to existing bio-derived packaging;

Environmental Benefit
n-CHITOPACK has supported the environmental safety not only through the reduction of the pressure on primary nonrenewable raw materials such as petroleum, reducing CO2 footprint of up to 12 MT every years and reducing pollution caused by non-biodegradable materials, but also through the usage of a potential feedstock base of 2.5 MT of shell fish waste material every year to produce useful goods.

Potential Impact:
Impact for the SME participants and competitiveness
Based on the main interest of SMEs project partners the potential area that may be developed are reported below:
• Foreground of materials composition of edible films will be exploited by MAVI
• Foreground of materials composition of flexible films will be exploited by MICROTEC
• Foreground of materials composition of rigid materials will be exploited by AROMA
• Foreground of new packaging machines for the new packaging materials will be exploited by RODAX
• Foreground of market analyses and for exploitation of the final results will be exploited by BIOZOO N

1. Impacts of n-CHITOPACK on MAVI’s competitiveness

The strategy of Mavi for the n-Chitopack project is focused on the development of the possible industrial applications of its patented Raw Material Chitin Nanofibrils (CN) as base product for the preparation of Biodegradable skin friendly packaging. At the present time the CN suspension produced in MAVI are used for internal applications in Cosmetic Products and Medical Devices, partially devoted to the internal market of Cosmetic Companies also. The CN solution produced by MAVI has a solid content of about 2% by weight. This concentration was found to be too low for the preparation of both the master-batches and the films, so that it has been necessary to produce new suspensions of CN, 10 times more concentrated than usually. In order to realise such concentration, MAVI had to adjust its industrial plant, normally used for different purposes, setting up this not easy new preparation, with a consequent reduced productive and efficiency of the adapted industrial machine.

In the aftermath of the start up period, appropriate actions could be adopted by Mavi in order to comply with the future demand of raw material: an industrial plant for the concentration of the CN solution from 2 to 20% solid more suitable with the future request of the market will be necessary, with an estimated investment of approximately 50.000,00€. Considering an approximate selling price of 30,00€/Kg for the 20% CN solution and the present production capacity, the hypothetical monthly turnover would be around 30.000,00€ at the beginning of the activity, with a potential growth up to 300.000,00€.

In the test performed for the preparation of the biodegradable films via casting technology, CN solution was utilized at its original concentration of 2% and concentrated at level of the lab for obtaining a film with a content of CN suspension variable from 15 to 30%.

Also in this case as consequence of the potential capacity owned by Mavi and an approximate selling price of 10€/Kg for the 2% solution, the hypothetical monthly turnover would be around 80.000,00€. All the above scenario represents for Mavi an highly profitable market development, with a remarkable differentiation from its present core business, giving to the company an important tool for managing the difficulties of the actual economic situation in Italy.

2. Description of the main impacts and benefits for AROMA

The product obtained from this European Research project is remarkable, AND aroma has already participated to the European Bioplastic to further promote the development and implementation of this product in the market.

Considering that the development of this coffee capsules will continue as scheduled, AROMA expects to increase the turnover of 3.5% thanks to the knowledge gained from the n-Chitopack bio based material. The customers have already shown interest toward this solution and are ready to invest in such a product should it demonstrate positively its great potential in terms of costs, green factor and product quality. For this reason AROMA is planning to organize meetings to show them the improved properties of the new capsules.
3. Description of the main impacts and benefits for RODAX

RODAX as a manufacturer of packaging equipments has the possibility to enlarge its production technology and design knowledge for the new packaging materials developed in the project. As the new developed materials are available to use by the packaging industry RODAX has the interest in developing packaging equipments with specific characteristics, adapted for the packaging films based on chitin (CN).

RODAX is already using the accumulated experience from n-chitopack project in other research project also aiming to develop packaging materials based on chitosan/chitin (fish, crustaceous waste recovery), ACTIBIOSAFE project, an EEA Grant project (Norway Grant), financed by the EU, pr. nr. 1SEE/2014. RODAX has presented in Romania the results of the project focusing on the capabilities of MAVI to deliver chitin and its research activities in this field (also of the other Italian partners).

RODAX intends to enlarge its number of customers for the packaging equipments, especially attracting those using bio-based materials.

4. Description of the main impacts and benefits for MICROTEC

MICROTEC started the production of biodegradable and compostable formulation from two years ago. Actually two specific products are certified by VINCOTTE with the OK COMPOST certification. These products called Bio Comp BF 3051 and Bio Comp BF 7210.

BioComp® is an innovative family of bio-plastics produced using components of natural origin and biodegradable polymers obtained from both renewable raw materials and fossil fuels. The use of plasticizers of vegetal origin and the addition of organic and inorganic charges (such as plant fiber, cellulose, lignin and talc) maintains its biodegradability and compostability.

BioComp® bio-plastics can be used from agriculture to industry, from long-lasting packaging and disposable packaging, from toys to various kinds and types of objects. BioComp® comes in form of granules and can be processed according to the most common processing technologies in order to obtain fully biodegradable and compostable products, along with physical and mechanical properties comparable to those of traditional plastics. The possibility to obtain different degrees and/or formulations of its various components makes it extremely versatile for the most different customer requirements.

At the present time BioComp formulations are used in several applications as: plastic bags (garbage bags and shoppers), industrial films (mulching film, elastic film, packaging and lamination film, protective covers). The request concerning the use of biodegradable and compostable formulations (for shoppers/bags production) has developed in Italy at the beginning of 2013.

The N-Chitopack project will be very important for MICROTEC seeing that MICROTEC has not a specific formulation for food. The use on chitin in BioComp formulations could enhance the mechanical and the barrier properties of this specific product and also the direct contact with food would be possible. At this time both BioComp BF 3051 and BioComp BF 7210 have not the food contact approval as UE 10/2011 requests. The creation of a specific food-approved biodegradable and compostable formulation would be an innovative product for MICROTEC also considering that at the present time there are not similar products available in the market and no one shows the use of chitin.

As partner of the project, MICROTEC has the possibility for entering in the market with a new and up-to-date product which will distinguish MICROTEC from its competitors.
5. Description of the main impacts and benefits for Biozoon
Within n-CHITOPACK project, BIOZOON has increased its reputation as marketing expert by providing advisory services to the food industry and performing a consumer analysis. During this consumer analysis, consumer attitudes towards packaging attributes have been explored, showing how consumers perceive packaging and how important are these attributes in affecting the purchasing decisions. Beside this, BIOZOON considerably enlarged its knowledge in food packaging. Thereby, as result of the project, BIOZOON’s market share is expected to grow and the developments of the n-CHITOPACK project may give to BIOZOON a significant advance with respect to its competitors.

Areas of application
At the end of the project the exploitation opportunities are mainly focused on the industrial community of biomass preparation, production of bio-polymers for food packaging and consumer products. The Bio-based Products Lead Market covers a broad range of intermediate products, product components, and ready-made products, e.g. bio-plastics, bio-lubricants, bio-fibres for textiles, composite materials for construction and automotive, chemical building blocks, enzymes, and amino acids. In particular, the interest for biopolymers is continuously increasing on the market. Today, however, biopolymers have a niche market. A real potential increase of volume is related to their expansion on the consumer goods market such as for example through food-packaging. This will not merely involve replacing conventional plastics in individual application areas (such as traditional food-packaging), but also completely new ones will be developed (i.e. the novel n-CHITOPACK chitin-NF based edible and transparent films for food-wrapping).
Thus, bioplastics are expected to deeply penetrate into new application segments which traditionally use conventional polymers. Prospects for new bio-based products such as n-CHITOPACK materials look promising. If the outcomes of n-CHITOPACK prove successful, it is likely to profit from this emerging eco-innovative market with an estimated market share to 25-30% by 2020.

SMEs will play a crucial role as (potential) suppliers in this emerging market with huge potential taking a value chain approach:
- New Bio-based materials: The project has contributed to the development of an eco-innovative market for the innovative bio-based materials. The n-CHITOPACK process will use shell-fish waste to produce new completely biodegradable materials made of chitosan and chitin fibrils;
- New production process for the realization of chitosan/CN based film. n-CHITOPACK has been developed following an environmentally friendly and cost-efficient route with multiple application prospects. While being validated in food packaging production, the process will have multiple exploitation routes and hence a vast commercial potential towards all the field of packaging

Contribution to policy development
Description of the contribution to the EU policies
The n-Chitopack project fits with the European polices related to the promotion of innovation as key driver for sustainable development and competitiveness and support the environmental challenges related to the reduction, the reuse and the recycling of hazardous waste.
Dissemination activities
To comply with the request of the Dissemination Plan, and in accordance with the tasks of WP8, the following Dissemination activities have been performed:

- Press Release
- 1 Seminar and 1 SMEs training
- 1 Dissemination workshop
- n-Chitopack website
- Interim and Final Plan for the use and Dissemination of the project
- Media communication and Publications
- Presentations at conference and workshop

Press Release
A press release announcing the beginning of the n-Chitopack project was realised in Italian and English languages and published in many newspapers, both technical and general.

Seminar and SMEs training
The seminar and training were performed by the partner INSTM in Terni (Italy) at the University of Perugia Facilities. The target were both academy and companies. The titles of the two activities were:

- Seminar - n-Chitopack : Bionanocomposites from sea food waste as new material
- Training - Chitin Nanofibrils : what opportunities for manufacture innovation?

A leaflet was produced by INSTM with the cooperation of all the partners and distributed after the sessions.

Dissemination workshop
The workshop has taken place the day after the Final Consortium Meeting and was hosted by the partner IMC in Prague. The workshop had the aim of disseminating the project results to an academic audience.

n-Chitopack website
The n-Chitopack website, realised at the very beginning of the project and continuously update in the 2 following years represents the wider and easier method for the Diffusion of the project objectives.

Interim and Final Plan for the use and Dissemination of the project
The aim of the work performed was to set up a general dissemination strategy and to describe the activities realised during the whole period of the project. The strategy and the dissemination activities performed include:

- n-Chitopack website
- A project flyer produced by RODAX in month 3
- Media communication, press release and publications (whole list included in the Deliverables and website)
- Presentations at conferences and workshop (whole list included in the Deliverables and website)

The following conferences were participated and papers presented:
A numerous number of conferences and papers have been presented.

Several presentations to industrial bodies were performed:
Several presentations have been made to industrial odies, relatively to the project results, such as:
Meeting with Morrison Lamotte Inc., on 3 July 2013 at Toronto, Canada (AROMA)
TV clips, prepared on 2 February 2014 and onair on the Romanian Television, (RODAX)

List of Websites:
The project website is available at the address
www.n-chitopack.eu
info@n-chitopack.eu

The Relevant contact details for each organization that took part to the project are:
Partner: MAVI; Mr. Pierfrancesco Moganti; morganti@mavicosmetics.it
Partner: AROMA; Mr Cesare Rapparini; Fin@icaspa.it
Partner: RODAX; Mrs Mirela Becea; mimibecea@yahoo.com
Partner: MICROTEC; Mr Diego Lombardo; lab@microtecsrl.com
Partner: BIOZOON; Mrs Matthias Kück; info@biozoon.de
Partner: IMC; Mr Jan Kouba; kouba@umch.cz
Partner: INSTM; Mrs Claudia Bettaccini; segreteria@instm.it
Partner: NOFIMA; Mrs Anne Risbrathe; anne.risbraathe@nofima.no

Last update: 12 May 2015
Record number: 163251

Permalink: https://cordis.europa.eu/project/id/315233/reporting

© European Union, 2021