ECOBIOCAP
Ecoefficient Biodegradable Composite Advanced Packaging

Newsletter

ISSUE III SEPTEMBER 2013

HIGHLIGHTS:

- From lab to large pilot plant scale
- New insights and understanding into the structural and physico-chemical stability of PHBV-based biocomposites
- Assessing the environmental impact of the new biodegradable materials
- Agenda : related events in 2013

EcoBioCAP: latest steps

The annual EcoBioCAP meeting was held from 17 to 19 April 2013 in Budapest and was greatly organized by the local partner CBHU. The meeting provided an opportunity to share new results from all partners and to discuss progresses and roadmap for the next years to come.

Incorporating the environmental impacts of packaging technology is the next step of INRA and SIK efforts to complete the development of the decision support system as a tool to make the EcoBioCAP requirements driven approach accessible to the whole food packaging chain.

Huge achievements of pilot plant production of biopolyesters (PHBV) from liquid effluent of food industry and of composite trays made of PHBV and solid by-products (wheat straw fibres) were successfully demonstrated by IBET, UniRoma, Fuerstplast and INRA partners.

The next important challenge of Fraunhofer, UMinho, CSIC and INRA partners is to develop flexible films by finding a suitable plasticizing route of PHBV and by exploring further multilayers technology.

Environmental impacts, stability and safety assessment as well as demonstration are efficiently progressing thanks to SIK, INRA, Fraunhofer, UNIBO, Novamont, UCC and UMinho partners efforts.

All these aspects and many others were fruitfully discussed with SAB members in dedicated sessions. Looking forward to see you all very soon, probably in Lisbon where the European Symposium on BioPolymer will host a dedicated EcoBioCAP workshop on October 9th 2013, I wish you a very nice end of summer.

Prof. Nathalie Gontard
EcoBioCAP Coordinator

From lab to large pilot plant scale

Dr. A. Vicente is Associate Professor at the Universidade do Minho, Portugal. He is in charge of the upscaling demonstration activity.

One of the activities of EcoBioCAP aims to **show the industrial applicability of the food packaging solutions developed in the other workpackages of EcoBioCAP**. This objective is achieved in a stepwise approach, where the upscaling process is applied to the production of constituents of the packaging materials (i.e., their main ingredients) and to the production of the packaging materials themselves.

In a first step, selected constituents of packaging materials will be produced at a small pilot plant scale. These constituents will then be used to produce packaging materials and packages (e.g. trays and films), which in turn shall be used to package selected food products and test their performance throughout shelf-life. The best packaging materials will be selected and will set the basis for the work in the subsequent step.

In a second step, large pilot scale production of selected packaging materials will be conducted, together with the assessment of their efficiency against benchmark packaging systems in terms of food quality and safety throughout the distribution chain. The packaging materials produced here will be tested for their efficiency in preserving food quality and safety in real conditions (real foods, storage and distribution conditions).

Dr. Antonio Vicente (UMinho)

New insights and understanding into the structural and physico-chemical stability of PHBV-based biocomposites

Dr. H. Coussy from University of Montpellier 2 is specialized in composite materials and processing structure and leads the EcoBioCAP work related to "Assessment of packaging physical-chemical stability and chemical safety support system"

Aims and background

The general objective of our work is to investigate **the suitability of PHBV-based packaging materials developed in WP3 as food contact materials**. The structural and physical-chemical stability of packaging materials as well as their microbiological stability under the whole life cycle of packaging materials are the first keys to ensure their functional properties and subsequently their ability to preserve food quality and safety within defined limits and recommended usage conditions. If moisture, temperature and mechanical stress are well-known parameters, other ones such as food acidity or fat content are also able to have an influence on biodegradable materials' properties.

PHBV, a biopolymer synthesized by bacteria

In this context, **we aim at establishing the relationships between the chemical safety of PHBV-based packaging materials and their structural and physico-chemical stability in usage conditions**, by studying the influence of severe yet realistic conditions of storage and food contact. So far, some efforts have been put to provide new insights and understanding into the structural, physico-chemical and microbial stability basis of the composite biodegradable materials developed in the project, with a first deliverable (4.1.) that will be delivered in August 2013.

Results and applications

It was demonstrated by CSIC that PHB, PHBV (either PHBV containing 3 or 12% of valerate) and multilayer systems were very stable under **relative humidity** up to 100%RH, except in the case of PHBV3 films plasticized with PEG equilibrated at 100% RH (slightly decrease in the crystallinity and the Young's modulus). It was also demonstrated that a significant increase in the film stiffness and brittleness as well as a loss of stretchability were noted for multilayer systems after 3 **months of ageing**, probably due to the observed increase in crystallinity. However, no very significant change was noticed for the barrier properties of films.

It was shown by INRA that mechanical properties and water vapour permeability of PHBV films were very stable in contact with all food simulant liquids (FSL), except in ethanol 95% where a swelling of the material and a plasticizing effect (decrease of stress at break and Young's modulus, increase in elongation) were observed. In the case of PHBV/wheat straw fibers biocomposites, ultimate properties remained unchanged upon contact with FSL, whereas a significant decrease in the Young's modulus was observed, probably due the decrease in crystallinity highlighted by DSC measurements, and/or to swelling and further debonding of fibers.

Significance and benefits.

These results will be further put in relation with the chemical safety of materials (evaluated through overall and specific migration tests as well as modelling approaches). Strategies will be assessed (e.g. functional stable superficial barrier) to limit materials sensitivity and chemical migration to an acceptable level for consumer safety, especially for materials containing lignocellulosic fibers.

Dr. Hélène Coussy (UM2)

Who are we? Focus on SIK

THE SWEDISH INSTITUTE FOR FOOD AND BIOTECHNOLOGY

The Swedish Institute for Food and Biotechnology AB - Institutet för Livsmedel och Bioteknik AB (SIK) is a private, non-profit, industrial research institute. SIK is a fully owned subsidiary of SP Technical Research Institute of Sweden (SP Sveriges Tekniska Forskningsinstitut). The purpose of the Institute is to strengthen the competitiveness of its member companies. The core competence areas are food processing, food safety, food quality and environmental impact of food production.

SIK has expertises in food science, process engineering, environmental science, and technology transfer. In EcoBioCAP, SIK leads the work on Life Cycle Assessment.

Learn more about SIK...

Assessing the environmental impact of the new biodegradable materials

Dr. K. Nilsson from SIK is a senior consultant at the department of Sustainable Food Production, well experienced in environmental assessments of products and production systems for the food industry.

Dr. L. Ahrne is Director of the Department for Process & Technology Development at SIK and coordinates the work on envirnmental assessment in EcoBioCAP.

Aims and background

The primary purpose of a food packaging is that it shall protect the food and maintain and prolong the food quality during shelf life. The environmental impact of the packaging itself depends on the type of food product. For a meat product, even if the material is of fossil origin, the climate impact from the packaging seldom stands for more than 5 % of the total impact. However the contribution of packaging is more dominant for vegetable products compared to meat products or products of animal origin.

Our overall objective is to contribute to the development of environmental friendly packaging systems by assessing:

- Organic and energy recovery
- Ecotoxicity
- Life cycle analysis (LCA) of the developed materials and packed foods.

So far efforts have focused on giving advice, defining the flow chart of systems to be analysed and starting the data collection for LCA modelling.

Results and applications

The ecoefficiency of the developed material and packaging will be verified by using Life Cycle Assessments (LCA), an ISO standardized method (ISO 14 040-44). It will provide environmental information about the material gathered from all inputs and processing steps of the whole life cycle of the material, from "cradle to grave".

The first assessment will focus on the packaging materials developed in the project:

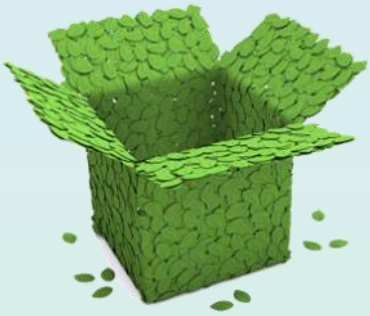
- Production of PHA from Olive oil mill waste and Cheese whey.
- One composite material Wheat straw.

Just because a plastic material is made from renewable sources, such as PHA made from corn, it doesn't have to be more environmentally friendly compared to corresponding conventional plastic of fossil carbon origin. Included in the environmental burden of a corn-based plastic are the resource use for production and use of fertilizer and pesticides in corn cultivation and energy use during biopolymer production. These parameters can be of substantial importance for the final environmental profile of the material. Corn is also a source for animal and human consumption and theses alternative uses of corn should also be considered in an LCA of the renewable plastic material. When it comes to suggested bio sources for EcoBioCap materials these are defined as waste or by products from the food industry but still alternative uses of the material need to be included in the final LCA.

From bibliographical study and meetings between EcoBioCAP partners, some parameters have been identified from a life cycle perspective to be of great importance when it comes to the evaluation the ecoefficiency of a renewable material:

1. Yield production of biopolymer from renewable sources.
2. Access of renewable raw material source.
3. Use of energy and consumables during production of the biopolymer/ biomaterial.
4. Other possible and more favourable uses of the renewable raw material

The present "use" of renewable raw materials proposed to be used in this project needs to be considered. OMW is today used for animal feed or as a waste fraction and have low or none economic value. Cheese whey has several other applications in human food or as animal feed, both directly or after valorisation. In the final LCA, scenarios with present use of these materials, will be included and might influence the result in either a positive or a negative way.



Significance and benefits

These results will contribute to minimize the environmental impact of packaging material developed and packed foods by:

- using waste sources as raw material for the new packaging. Waste source that requires significant amount of energy for upgrading is associated with a heavy environmental burden and will not be used.
- making use of waste streams that do not already have useful markets is beneficial (and, as stated above, not energy intense when upgrading).
- Striving for resource efficiency e.g. identify potential processing fluids in closed loop.
- developing a new packaging minimizing the material used without compromising the function of the packaging in preserving the food product.

Drs. Katarina Nilsson &
Lilia Ahrne (SIK)

Next Related Events in 2013:

16-20 September: 8th International Conference on Predictive Modeling in Food (ICPMF)
Location: Paris, France **Website:** www.icpmf8.org

18-21 September: 7th International Conference on Environmental Engineering and Management ICEEM
Location: Vienna, Austria **Website:** http://iceem07.iceem.eu

7 – 9 October: European Symposium on Biopolymers - ESBP2013

- **9 October: EcoBioCAP** specific public workshop to present first results

  Location: Lisbon, Portugal **Website:** www.esbp2013.org

3-9 November: Polymar, the 1st young researchers platform for Netwsorking in Polymer Science through the Mediterranean
Location: Cruise leaving from Barcelona returning to Barcelona, Spain **More Info:** lagaron@iata.csic.es

Who are we? Focus on INRA & UM2 under IATE unit

The joint unit centre "Ingénierie des Agropolymères et Technologies Emergentes" (IATE) gathers four public institutions (INRA, CIRAD, University Montpellier 2 and Montpellier SupAgro) and is located in the south of France, Montpellier. It is active in the field of agrifood and green chemistry.

The first objective of this unit is to provide integrated knowledge and approaches on combining packaging materials development and food requirements aimed at implementing food-packaging systems into integrated food chain concepts. Beside mechanical protection, the main role of packaging is to control transfers of the main gases (oxygen, carbon dioxide, ethylene etc.) and vapours (moisture, aroma compounds etc.) involved in food degradation (physico-chemical, physiological and microbiological) as well as the migration of potential toxic packaging constituents.

The unit also aims at providing relevant scientific knowledge on mass transfer study and modeling in advanced composite materials based on renewable and biodegradable agropolymers.

The applied objective is to develop next generation of food packaging solutions with direct benefits both for environment and consumers by enabling customisation of the packaging's properties to fit functional, safety, cost and environmental impact requirements of targeted foods.

Learn more about IATE unit...

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The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under the grant agreement n°FP7-265669-EcoBioCAP project