BREAD4PLA

Guidelines for future environment actions- **'Green Paper'**

BREAD4PLA PROJECT

Demonstration plant project to produce Poly-Lactic Acid (PLA) biopolymer from waste products of bakery industry

Reducing plastic waste through the obtaining of 100% biodegradable and compostable plastic packaging for bakery sector.

[2011-2014]

Associated Beneficiaries

ATB Leibniz-Institut für Agrartechnik Potsdam-Bornim e.V.

BC

cetece CENTRO TECNOLÓGICO

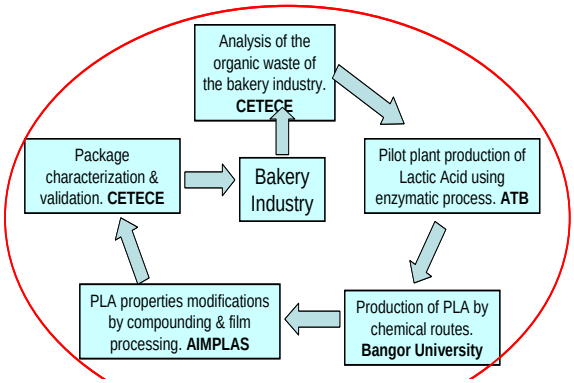
Coordinating Beneficiary

AIMPLAS INSTITUTO TECNOLÓGICO DEL PLÁSTICO

Duration: 36 months · Budget: 1,116,526 € (50% EC contribution) · LIFE10/ENV/ES/479

Agroalimentary waste management overview information

In accordance with the new EC regulations and decisions adopted within the new funding frameworks until 2020[a] and the current 7th Environment Action Programme (EAP) and others*, the research and industrial community have been working hard to impulse the use of feedstock, biowaste and agroalimentary waste to obtain added-value new products. Converting the carbon from these waste streams into added-value products would increase the otherwise low profitability and improve the environmental benefits of the **biorefinery industry, far away from the standard ethanol (or similar biofuels) production**[b]. By developing commercially attractive processes for efficient conversion the new material can be used as a starting point for bio-based polymers including **biodegradable polymers, and in consequence** to produce new plastic products.



From bakery waste to recyclable and compostable package for bakery products: Cradle to Cradle Management.

Figure 1. BREAD4PLA Cradle to Cradle management cycle and Beneficiaries

BREAD4PLA project fits in this approach, offering a new compostable PLA packaging, fully comparable to a commercial PLA able to replace conventional plastics from fossil sources (PP or PE) in several packaging applications for the bakery industry.

BREAD4PLA has positively contributed to what it is not just a fashion, but a proven society necessity.

Current trends on the agroalimentary waste reduction

Bakery solid waste includes stale bakery products, dropped raw materials (e.g., dough), and packaging. The most simple and common way is to directly transport these to landfill or incineration. Landfill can cause the waste to decompose, which eventually leads to production of methane (a greenhouse gas) and groundwater pollution (organic compounds and heavy metals). Incineration of bakery waste can also release nitrogen oxide gases.

Reclamation of the bakery waste can play an important role in its management. The waste consists primarily of stale bread, bread rolls, and cookies. Their main application is animals fed, such as swine and cattle in combination with other fed components (proteins, fibres, vitamins, fat…) with higher nutrient value. In despite of this represent an environmental friendly recycling way for this waste, economically represent a very low added-value option.

[a] Such as new Horizon 2020 and LIFE Programme 2014-2020

[b] There is an example of industrial plant that will produce ethanol for transport fuel, using feedstocks such as biowaste and process residue from **local bakeries and bread from shops** that is past its sell-by date. The plant currently under construction will have an annual production capacity of 5 million liters of bioethanol. The production will start up in early 2015. St1 Biofuels Oy will deliver an Etanolix® plant producing waste-based bioethanol to North European Oil Trade Oy in Gothenburg, Sweden

* Waste Framework Directive (WFD) 2008/98/EC; European Parliament and Council Directive 94/62/EC of 20 December 1994 on packaging and packaging waste; Brussels, 2.7.2014 COM (2014) 397 final 2014/0201 (COD), Proposal for a Directive on Waste.

BREAD4PLA partners have actively been involved in the promotion and valorization of a bio-waste alternative (**bread waste)** with a potential great impact in regard to industrial viability and environmental issues such as reduction of waste, less pollution and less greenhouse gas emissions.

BREAD4PLA project has been developed in a European framework more and more concerned about the correct procedure on food waste management and its potential environmental impacts in the latest years.

- ✓ A good example of this trend on agroalimentary waste reduction, not at European level, but also worldwide, is the recent report released in 2013 by **Food and Agriculture Organization of the United Nations (FAO)** within a project from Natural Resources Management and Environment Department, **'The Food Wastage Footprint model (FWF)**'. Although this report deals with general food waste aspects worldwide, it shows that the BREAD4PLA approach, aiming at reducing the food wastage at regional/national level in Europe, would have substantial positive effect on natural and societal resources. *Food wastage reduction would not only avoid pressure on scarce natural resources but also decrease the need to raise food production by 60 percent in order to meet the 2050 population demand*[c]
- ✓ Another interesting initiative is the inquiry conducted by The House of Lords EU Agriculture, Fisheries, Environment and Energy Sub-Committee into the **EU's contribution to food waste prevention**. The report, '**Counting the Cost of Food Waste: EU Food Waste Prevention'**, was published on 6 April 2014[d].

The work performed under **BREAD4PLA** project shows that some of the specific issues addressed by the Committee during its inquiry were already taken into consideration in the project development relating to bread waste, such as:

- The scale of food bread waste at a national, EU level; **BREAD4PLA** has contributed to this aspect at small level by the definition of a protocol for the preservation of bakery waste from its collection in the bakery industry to the LA production plant. This is part of the necessary logistic that should be implemented if the project results were transferred at industrial scale.
- The challenge of defining and monitoring food waste: It was concluded in the **BREAD4PLA** consortium that the implication of public bodies/management waste authorities/organisms are needed to carry out this monitoring and related protocols at higher levels (not only focused on specific industrial bread waste producers).
- Opportunities for consumers to contribute to food waste reduction: the dissemination activities led by all **BREAD4PLA** partners in several social events and through general media, has highly contributed to increase the society awareness in the bread waste reduction through an environmentally friendly solution, i.e. new bread packaging.
- The need for the European Commission to assess whether there are any aspects of EU regulations on food waste prevention, as well as marketing standards for packaging restrictions and date labelling. The update on the legislation standards has demonstrated that for **BREAD4PLA** new packaging, no specific new regulations would be necessary rather than the ones already existing for the commercial compostable materials and products, as food contact regulations.
- The important strategic role to be played by the EU at worldwide level. The transnational consortium nature of **BREAD4PLA** project has contributed to foster the EU investment on the food waste management benefits and go a step further in the bread waste sector.

[c] http://www.fao.org/docrep/018/i3347e/i3347e.pdf

[d] http://www.parliament.uk/business/committees/committees-a-z/lords-select/eu-environment-and-agriculture-sub-committee-d/inquiries/parliament-2010/food-waste-prevention/

How BREAD4PLA fits into the current market trends?

The latest on the valorization of industry food waste & specifically bread waste

During the previous years[e], there was the general tendency of valorizating agricultural waste by using it as reinforcement in biopolymers. Then, research was a step further by transforming the agricultural/food waste in biopolymers themshelves.

BREAD4PLA project is one of the market approaches that currently are based on obtaining biopolymer formulations for food packaging from natural waste using natural additives to be 100% biodegradable.

There are some studies carried out in the last year that support the high relevance of the proposed **BREAD4PLA food valorization** in the current industry applications.

For example, in a review article it was stated that *bread, fresh pastry goods and cakes* is among the seven most important food products in terms of production capacities in EU-27[f], and clearly supports that *'food waste valorization is a trend topic in the research community'*. Thus, the impact of BREAD4PLA in how significant this renewable resource (specifically bread waste) could become for chemical and material is objectively demonstrated.

It was checked that still the major part of the valorization effort of food waste industry is addressed to convert such food waste to biogas, hydrogen, ethanol and biodiesel as final products. That is, using food waste fermentation technologies for renewable energy generation[g h i].

There is also a recent increased in projects and initiatives that similarly to BREAD4PLA, go beyond the energy valorization, to get added-value products: from packaging products, through non-food packaging to non-packaging applications; by using so many different types of food waste, such as waste water from juice).

In the specific case of the bread waste valorisation, there are scientific articles which review the literature concerning bread waste utilization and potential process systems. For example, bread residues can be converted into lactic acid by alkaline hydrothermal treatments [j], or for other type of chemical components such as succinic acid production.[k]

However, the **excellence of BREAD4PLA** lies in that the biopolymer produced is currently high demanded, with really good acceptance at commercial level: PLA. **BREAD4PLA project has successfully manufactured PLA packaging (film & thermoformed trays), with mechanical & barrier properties which are even better than the commercial PLA in some cases.**

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[e] http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3982572/pdf/fchem-02-00006.pdf

[f] Valorization of industrial waste and by-product streams via fermentation for the production of chemicals and biopolymers Apostolis A. Koutinas,†a Anestis Vlysidis,†a Daniel Pleissner,b Nikolaos Kopsahelis,a Isabel Lopez Garcia,c Ioannis K. Kookos,d Seraphim Papanikolaou,a Tsz Him Kwanb and Carol Sze Ki Lin*b

[g] http://www.sustainablechemicalprocesses.com/content/1/1/21

[h] https://www.elsevier.com/books/food-industry-wastes/kosseva/978-0-12-391921-2

[i] http://www.sciencedirect.com/science/article/pii/S0016236114005365

[j] http://www.sciencedirect.com/science/article/pii/S1385894714004513

[k] http://pubs.rsc.org/en/content/articlelanding/2012/gc/c2gc36518a#!divAbstract

Bioplastics Market Update: Demonstrated BREAD4PLA opportunities

In general terms, all the findings coincide in stating that the **foreseeable potential market of the bioplastics in food packaging (among the most important ones, PLA) is optimistic.**

According to a report from *Pira International,* the emergence of new materials and major suppliers are set to shake up the global market for bioplastic packaging over the current decade (up to 2020)'. It is foreseen that **packaging market demand gradually shifts from biodegradable and compostable polymers towards biopackaging based on renewable and sustainable materials, which is in line with the BREAD4PLA main environmental objective, as waste bread sources is used.**

European Bioplastics source states that growing demand for more sustainable solutions is reflected in growing production capacities of bioplastics: in 2012 production capacities amounted to approximately 1.4 million tonnes. Market data of European Bioplastics forecasts production capacities will multiply by 2017 – to more than 6 million tonnes[l].

There are sources[m] which assure that the turnover of biopolymers is currently 10% of the plastic market and that in 2020 will reach 25%. Figure 2 shows the trends for the coming years. At the same time, it is pointed that the biodegradable manufacturers will increase from the current 500 companies until more than 5,000 in 2020[n]. **Therefore, the demonstrative industrialization of a biodegradable alternative (polylactic acid-PLA biopolymer) to the current used conventional bakery packaging (PP-polypropylene, PE-polyethylene),** will bring a solution to a growing problem in Europe; i.e. **agricultural / food waste management,** particularly in the case of **industry bread waste**, as addressed by **BREAD4PLA.**

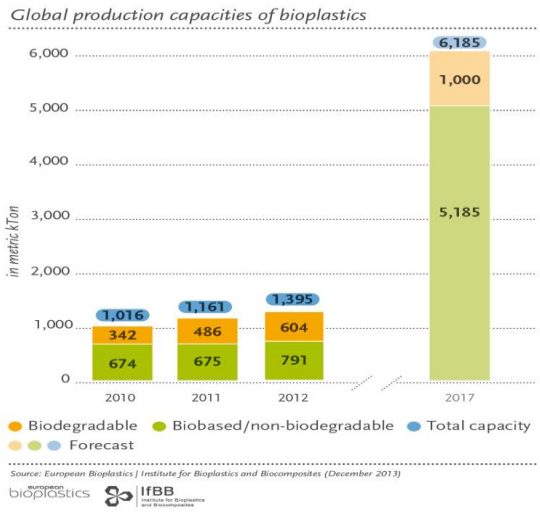

Figure 2. Global Production capacity of Bioplastics (2017)

Conclusions

The project partners are interested in the industrial scale-up of the project developments. Logistic and economic aspects at industrial level continue being evaluated through different partners´ contacts in order to find the chance of transferring BREAD4PLA results. The project stakeholders (Panrico and Grupo Siro) as well as other bakery companies have been in contact with AIMPLAS and CETECE since the project end. Other companies generating different type of food waste in important amounts, like sweet quince or wheat bran, contacted CETECE. ATB and BANGOR are also contacting companies that may perform the LA and PLA production processes at larger scale.

In the light of the information herein contained, this document represents the basis to promote among the industry and society the positive aspects derived from BREAD4PLA demonstrative activity and its potential benefits in the current agroalimentary waste management sector, so that in a foreseeable future the results successfully reach the market (full industrial level), provided that the assumed conditions (mainly suitable investment in bread waste management and in Lactic Acid production) are given in the society.

l http://en.european-bioplastics.org/market/
m http://www.foodproductiondaily.com/Packaging/Major-growth-trends-in-bioplastic-packaging-to-2020, January 2011
n NatureWorks LLC [Homepage of NatureWorks] Retrieved September 9, 2009 from http://natureworks.custhelp.com

BREAD4PLA "Demonstration plant project to produce poly-lactic acid (PLA) biopolymer from waste products of bakery industry" is a LIFE+ project, under the Environment Policy & Governance strand. LIFE10/ENV/ES/479

The project has a total duration of 36 months (from October 2011 to September 2014) and a budget of M€ 1,1 (EU contribution: 50 %)

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