ERA CoBioTech

BioTech Research & Innovation Hack

2021

ERA CoBioTech Funded Projects at A Glance: SUSTAINABLE CO-PRODUCTION

Tobacco as sustainable production platform of the natural biopolymer cyanophycin as co-product to oil and protein

PART OF EUROPEAN BIOTECH WEEK

INNOVATION IS IN OUR GENES

SUSTAINABLE CO-PRODUCTION

Introducing tobacco as a sustainable production platform of the natural biopolymer cyanophycin as a co-product to oil and protein

This project combines plant and industrial biotechnology with the aim to support the sustainable production of biopolymers to substitute fossil fuels in tobacco.

Project coordinator:

Martin Salinas
Indear, Argentina

Consortium:

Indear, (Argentina)

Sunchem, (The Netherlands)

University of Rostock, (Germany)

Wageningen University & Research, (The Netherlands)

Leuphana University of Lüneburg, (Germany)

Project duration:

1 June 2018 - 31 May 2022

Total budget: 1.7 €M

Tobacco as sustainable production platform of cyanophycin

Plant and industrial biotechnology is combined with the aim to support a sustainable pathway for alternative use of tobacco as production platform in order to reduce the usage of fossil oil and chemicals, to ensure farmers existence, to support the local economy and introduce new market opportunities for tobacco producers and to unlock the opportunity for plant-based and economically viable products. A reduction of tobacco smoking is to be welcomed from a health policy point of view. Yet, tobacco production also plays an important economic role in producing areas, often providing the only source of income. Therefore, developing an alternative use of seeds and leaves of tobacco for the sustainable production of biobased resources is a promising undertaking. The project aims to increase the value of tobacco, commercially grown for oil production in seeds, with the additional production of cyanophycin (CGP) that can sustainably substitute fossil raw materials and chemically produced non-degradable ingredients. This will establish a new economically feasible and sustainable system of co-production for the biopolymer CGP as a by-product of tobacco without relevant additional costs. It can be adopted by farmers and biotech companies in Argentina. The overall goal is to contribute to ecological, economic and social sustainability by reducing the usage of fossil oils and industrial polymers and by delivering plant-based and economically viable production platforms while supporting the livelihood of local agricultural tobacco regions and small farmers in Argentina and beyond.

A transdisciplinary approach to biotechnology including molecular biology, biochemistry, agriculture, economics and social sciences

In order to deliver economically feasible biotechnological methods for sustainable (by-) productions, this project brings together various methods from different areas of plant and industrial biotechnology and its outcome is applicable in different sectors. To create a tobacco variety that produces both oil and cyanophycin in a sustainable way, different tobacco species were transformed and the offspring with highest production rate and growth selected in four generations in the greenhouse and in three field trials in Argentina. The harvest was used to upscale and optimize the cyanophycin extraction for an efficient industrial production. The project team is interested in developing solutions in a transdisciplinary manner, working with local conditions and tailoring solutions to the needs of tobacco farmers and consumers of future products. Therefore, the needs of the various stakeholders in Argentina, such as tobacco farmers or the local administration, are explored and mapped in more detail with the help of qualitative research methods. Furthermore, the acceptance rates for potential products across different European countries are being investigated in a large-scale quantitative study, to identify market potentials and barriers, and to finally develop an economic model that can be used to estimate the economic success of products made of and with cyanophycin extracted from tobacco plants.

Main results

With the aim of finding new applications for tobacco and reducing global dependence on fossil resources, the project team succeeded in breeding a tobacco plant species that on the one hand produces enough seeds to be cultivated in the long term and on the other hand also produces enough cyanophycin to be economically viable. Another success is finding a method to efficiently extract the cyanophycin from the plants on a large scale.

The cyanophycin obtained can then be used for a variety of applications. For example, it could be used as a bioplastic additive, reducing the use of conventional plastic as a packaging material. Other possible applications can be found in the medical field, in wastewater treatment or in the nutrition of livestock, to name just a few. The team's consumer choice study clearly showed that consumers across Europe are receptive to genetically modified products. As a bonus, the cultivated plant is quite robust and can also be planted here in Europe and thus reduce the dependence on overseas plantations. This would not only strengthen the European economy, but also reduce the ecological footprint for transporting the harvested plants.

This project has received funding from the European Union´s Horizon 2020 research and innovation programme under grant agreement No [722361]

Future prospect

The production of cyanophycin in the tobacco variety bred for high oil production would lead to an expansion of the market opportunities and economic prospects of the crop: given the value of its biopolymers medicinally, nutritionally and as a substitute for fossil-fuel based chemicals. It can be expected that cyanophycin-producing tobacco – if technologically feasible and commercially viable in Argentina – will be transferred to the tobacco-growing areas in Europe (Italy, Spain, Poland, Bulgaria and Greece) and boost accordingly the bioeconomy in these countries and in the European Union as a whole. It will provide Europe with an improved and potentially massive bio-based source for biofuel, biomaterials and food/feed protein, reducing the dependency on overseas crops such as soy, palm, coconut, etc. It also would support the reduction of the European carbon footprint by eliminating the transport of these crops to Europe and by replacing fossil-based fuels and chemicals with bio-based alternatives. In the end, the substitution of fossil fuels and the contribution to the reduction in greenhouse gases emission can be assessed, additional jobs created, and the value added to the bio-based economy in Argentina and Europe.

The project has been included as an example and as a showcase for product invention with biotechnology.

The issue of new plant breeding technologies is being addressed, the current status of the debate within the EU on the rules that should govern the use of new crops is summarized in " EU Regulation of New Plant Breeding Technologies and their Possible Economic Implications for the EU and Beyond" (Wesseler & Purnhagen, 2020). The project is referred to as an example of how current legislation would affect the resulting products and could complicate their use. It is described how the products would need to be labelled and the difficulties that could arise.

The project serves also as an example case for circular economy in the background paper "Opportunities and the Policy Challenges to the Circular Agri-Food System. In EU Bioeconomy Economics and Policies" (Cingiz & Wesseler, 2019)

This paper provides an overview about the relevance of the circular economy concepts in current policy debates with a focus on the agri-food system. More scientific papers are being written about the results of the consumer choice study in Europe, the Stakeholder Analysis.

Figure 1: CGP-Tobacco in the greenhouse.

© https://www.sustainable-co-production.com/

Website: https://www.sustainable-co-production.com/
Twitter: @suscopro
Facebook: https://www.facebook.com/sustainable.co.production

This project has received funding from the European Union´s Horizon 2020 research and innovation programme under grant agreement No [722361]