

EXCORNSEED EU Project: Separation, Fractionation and Isolation of Biologically Active Natural Substances from Corn Oil and Other Side Streams to Be Used in Food, Specialty Chemicals and Cosmetic Markets

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Bulletin UASVM Food Science and Technology 77(1)/2020
ISSN-L 2344-2344; Print ISSN 2344-2344; Electronic ISSN 2344-5300
DOI: 10.15835/buasvmcn-fst: 2020.0017

Abstract

The EXCornsEED project combines science, chemistry, biology, engineering and biotechnology tools and knowledge, to develop and validate an integrated process of innovative and highly sustainable extraction/purification and concentration technologies being integrated in bio-refineries' side streams in order to recover, characterise and prepare proteins and other bio-active compounds (i.e. peptides, polyphenols, amino acids, fibres, lipid compounds) as ingredients for food, specialty chemicals and cosmetic market. The approach will be upscaled from lab level (few grams, TRL3) up to industrial pilot level (1t/d capacity, TRL5) considering EU strategies for a bio-based economy to transform traditional bioethanol production into future biorefinery concept as well as circular economy, in order to maximize the utilization of industrial by-products.

Keywords: bio-actives, by-products, valorisation, proteins

Introduction

The EU- project EXCornsEED addresses the BBI.2017.R4 topic, which comprises "Proteins and other bioactive ingredients from side streams and residues" (CORDIS, EC (1), achieving specifically the separation/extraction as well as the purification of the proteins, respectively the bioactive ingredients always taken into account market requirements and regulations. The project relates to the Work Programme "Sustainable and competitive bio-based industries and supporting the development of a European bio-economy" (CORDIS, EC (2)). Most biotechnological production plants are currently producing without realizing their full potential, since the

value of the biomass through the production and/or commercialisation of valuable by-products, e.g. in biorefineries, is not taken into account (Bergeron et.al, 2012,). In biorefinery, almost all types of biomass feedstocks can be converted into useful outcomes for a row of markets by applying diverse technologies (Cherubini, 2010; Dietrich et al., 2016; Trif et al., 2016). This includes for example the European protein market which is steadily growing since the last decades. Thus, Europe is currently representing the largest protein market worldwide. The market for protein ingredients, in terms of value, is projected to grow up to USD 70.7 Bln by 2025 at a CAGR of 6.0% from 2019, referring, amongst others, to an

increased request of (innovative) proteins with functional background as well as the expanding consumer knowledge about nutrition and health (MarketsandMarkets, 2019). The obtained ingredients within EXCornsEED project will be integrated/ tested in the market fields of food & beverages as well as cosmetics & personal care, in order to evaluate the applicability in marketable products.

The achievement of the projects' goal is supported by 19 partners from 7 European countries (EXCornsEED EU project). Among them, research institutions, large industries as well as SME's.

Throughout the 48 months' duration of the project, EXCornsEEDs' overall objective is to unlock the full potential of proteins and other bio-active compounds from side streams of important biotech processes, with high market potential. Therefore, an integrated process of innovative and highly sustainable extraction/ purification/ concentration technologies to be applied to bio-refineries side streams will be developed and validated (i.e. corn oil/ thin stillage from bio-ethanol as well as rapeseed meal from biodiesel production) in order to recover the expected proteins and several other bio-active compounds (peptides, polyphenols, amino acids, fibres, lipid compounds, alkaloids and tannins, etc.). The obtained ingredients will be further characterised, purified and prepared as ingredients for food market, cosmetic market and the personal care sector, thus promoting the realization of near-zero waste biorefineries in Europe. Furthermore, environmental sustainability, technical performance, cost-benefits of the technological solutions and final products as well as the preindustrial feasibility will be assessed. Finally, business potential of the project approach will be analysed as basis for exploitation of the projects's results (EXCornsEED EU project).

Materials and methods

A three- step approach will upscale the EXCornsEED process from lab level (few grams, TRL3) up to industrial pilot (1t/d capacity, TRL5) by extracting, purifying and concentrating high valuable products for the recovery of proteins and several other bio-active compounds (i.e. polyphenols, amino acids, fibres, lipid compounds, alkaloids and tannins, etc.).

The methodology starts with an overall raw material/ side stream (corn oil, thin stillage, rapeseed meal) characterisation in order to find the best valorisation strategy, followed by processing, fractionation and isolation of the desired proteins and other bio- active compounds. In close exchange with industrial partners from the different applicable markets, the ingredients will be further modified with regard to technological functionality and/ or sensory. Followed by these results, pilot scale applications as well as new products from the different applied markets will be designed/ developed. A synergistic approach will be used, in order to define a self- sustainable system and have an outcome that is in accordance with the principles of the circular economy.

Results and discussions

The concurrent presence of biotech producer, technology experts and product companies will guarantee the commitment towards a real market-driven project. Thus, proteins, and different bioactive ingredients will be obtained by extraction methods from industrial bio-refinery by-products and characterised within the markets of food, cosmetics and specialty chemicals. The potential market application of proteins and other bio- active compounds as food supplements for elderly being one of the applications. The food supplement market was globally accounted to nearly USD 123 Bln in the year 2019. Furthermore, a CAGR of 8.2% is expected between 2020- 2027 (Grand View Research, 2020). Besides, elderly EU population is expected to double between 2016 and 2050. This results in approx. 51 million EU citizens (EUROSTAT, 2016) with high prevalence being affected by diseases like dysphagia and malnutrition. Dysphagia patients are usually not able to eat regular food, as they need soft, mostly pureed, food, which can lead to malnutrition due to lower energy consumption (Rusu *et al.*, 2020). Within EXCornsEED project, the protein supplements developed, will be specifically designed to enrich texture modified food products (smoothfood) for elderly. Thus, two interests can be enhanced at the same time. Malnutrition, owed to protein deficiency as well as appealing food, throughout texture modified food applications. Furthermore, feasibility of protein enriched 3D printed food will be evaluated accordingly. The 3D food printing market is expected to grow at

a CAGR of nearly 20% by 2020- 2025 (Mordor Intelligence, 2019). 3D food printing technology is providing innovative technology to personalize food for the elderly, easy to chew and swallow and rich in specific nutrients (Forstner et al., 2015). Within the ingredients' evaluation, functional properties, as well as sensorial properties will be analysed accordingly, always being in contact with the ingredients producer to directly modify the obtained products.

Conclusions

EXCornsEED project will transform traditional bioethanol production in a future biorefinery concept, fully in line with EU strategies for a bio-based economy. The EXCornsEED project aims to exploit the convergence between science, chemistry, biology, engineering and biotechnology for the creation of new knowledge and innovative applications to develop and validate an integrated process of innovative and highly sustainable extraction, purification and concentration technologies to be applied to biorefineries side streams. The high-valuable compounds, developed within the project will have strong impression to the future dietary supplement market.

Acknowledgement. The research leading to these results has received funding from the Bio Based Industries Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreement No. 792054 (EXCornsEED).

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