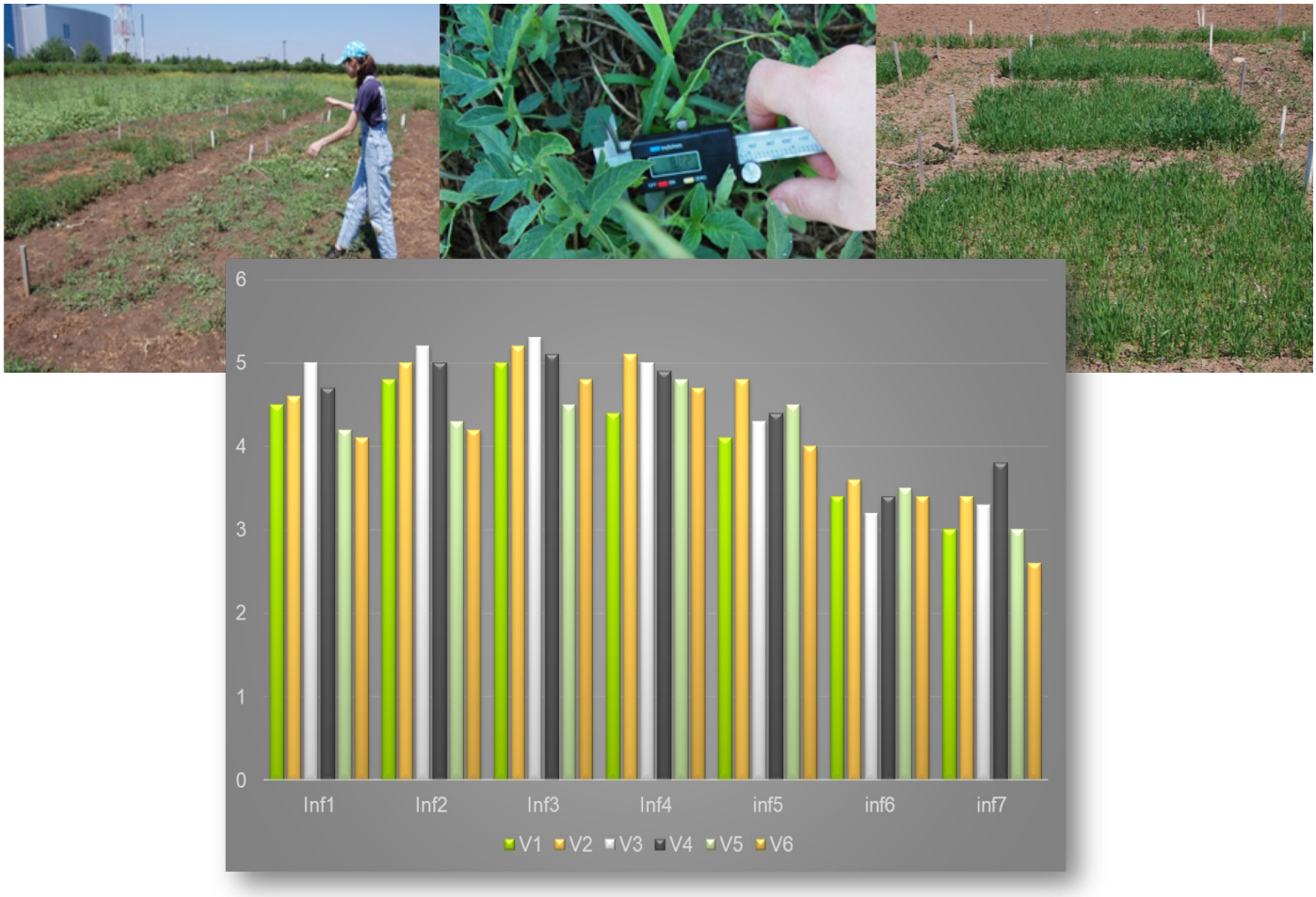
DEBUT

PRODUCTION OF FERULIC ACID, 2,3 BUTANEDIOLE AND MICROBIAL PLANT BIOSTIMULANTS FROM LIGNOCELLULOSIC BIOMASS BY A TWO-STEP CASCADING PROCESS



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Keywords:	Biomass pre-treatment, natural deep eutectic solvents, Feruloyl esterase, ferulic acid, simultaneous saccarification and fermentation (SSF), Trichoderma – Bacillus consortium, 2,3 butanediol
Coordinator:	**Dr. Florin Oancea** (National Institute for Research & Development in Chemistry and Petrochemistry - ICECHIM, Romania) Email: Florin.Oancea@icechim.ro
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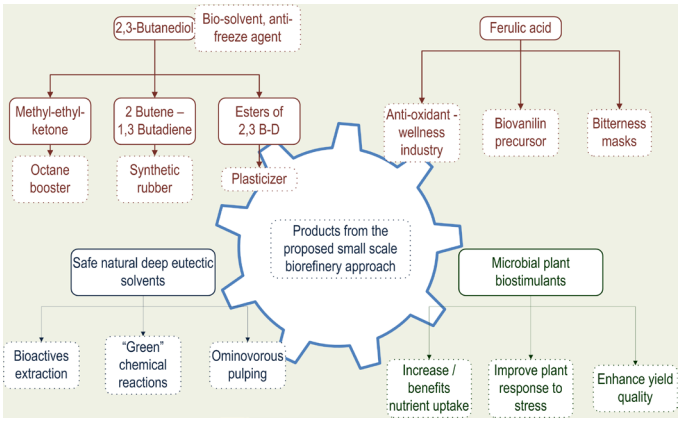
BACKGROUND

Lignocellulose feedstocks have a complex structure, highly recalcitrant, wherein hydrophilic biopolymers, cellulose and hemicellulose, are closely bound to hydrophobic lignin. Feruloylated hemicellulose are key components of this lignocellulose recalcitrance, anchoring the hydrophobic lignin to hydrophilic polysaccharides. Disruption of such complex structure needs aggressive pre-treatment. Ionic liquids (ILs), composed of cations and anions, were proved to be effectives solvents for selective separation of lignocellulose components. However, environmental toxicity and high price reduced the interest for ILs, refocusing it to the close related low transition temperature mixtures, deep eutectic solvents (DES). Such mixtures proved to be: even more effective than ILs on selective dissolution of lignocellulose components. However, the used acidic DESs seem to have a higher ecotoxicity comparing to their corresponding ionic liquid. Our innovative approach is to screen from the very beginning the ecotoxic characteristics of new NADESs and to enhance cellulose accessibility by using FAE. Large scale production of ferulic acid from lignocellulose is limited by the low solubility and low diffusion rate of ferulic acids into aqueous media . The versatility of the selected low toxicity DES should allow them to act both as solvent for lignocellulose components extraction and concentration phase for enzymatically extracted compounds

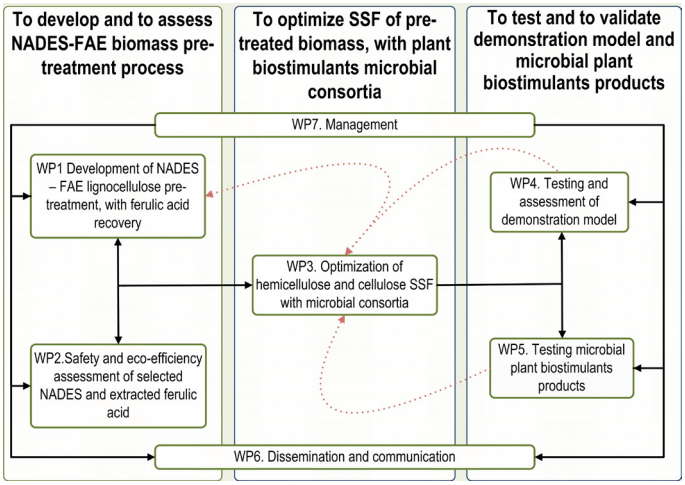
OBJECTIVE

The DEBUT project aims to develop a small scale biorefinery process, which includes two main steps: 1) biomass pre-treatment with natural deep eutectic solvents (NADES) and feruloyl-esterase (FAE); and 2) one pot production of a versatile chemical, 2,3 butanediol (2,3-BD) from NADES-FAE pre-treated lignocellulose biomass, by simultaneous saccarification and fermentation (SSF), performed by a plant biostimulant microbial consortia. The objectives of the DEBUT project are: (i) to develop and to assess NADES-FAE biomass pre-treatment
process; (ii) to optimize SSF of pre-treated biomass with plant biostimulants microbial consortia and (iii) to test in relevant conditionsthe demonstration model and the microbial plant biostimulants product. Objectives are related to the different Technological Readiness Level (TRL). NADES-FAE biomass pre-treatment (1stobjective) allows critical function and/or characteristic analysis and improvement (TRL 3). Components integration (2nd objective) and product testing in relevant conditions (3rd objective) permit technological development to TRL 5.



METHODOLOGY

The DEBUT project is broken down into 7 workpackages: WP1. Development of NADES – FAE lignocellulose pre-treatment, with ferulic acid recovery; WP2. Safety and eco-efficiency assessment of selected NADESs and extracted ferulic acid; WP3. Optimization of hemicellulose and cellulose SSF with microbial consortia; WP4. Testing and assessment of demonstration model; WP5. Testing microbial plant biostimulants products; WP6. Dissemination and communication; WP7. Management.



RESULTS AND KEY FINDINGS

The impact of the DEBUT project results from: (i) the small scale biorefinery cascading process; and (ii) the added value of resulted products. The small scale biorefinery is based on a smart and integrated process design, which avoids high temperatures and pressures. Such a design allows an easier replication on rural areas, because is not capital intensive and do not require very high qualified working force. The process of NADES formation, as a mixture on precise molar ratio, from largely available ingredients, is also a process easy to scale-up and which did not require high temperature or high pressure. The DEBUT project resulted safe and non-expensive NADES will have additional applications as green extractant.. Project aims also to produce microbial plant biostimulants. This plant biostimulants assure sustainable intensification of agricultural production, in face of major challenges: climate change, soil degradation, finite land resources, increased demand for food production and for bio-resources use in bioeconomy value chains.