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Hellenic Foundation for  
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**Description of the funded research project**  
**2nd Call for H.F.R.I. Research Projects**  
**to Support Post-Doctoral Researchers**

# Harnessing the potential of Accessory enzymes and their Synergistic relationships in the valorization of Greek lignocellulosic biomass - ARSIS

**Principal Investigator:** Anastasia Zerva

**Reader-friendly title:** Enzymatic synergism in the valorization of Greek lignocellulosic biomass

**Scientific Area:**  
Engineering Sciences & Technology

**Institution and Country:** National Technical University of Athens, Greece

**Host Institution:** National Technical University of Athens

**Collaborating Institution(s):** University of Patras

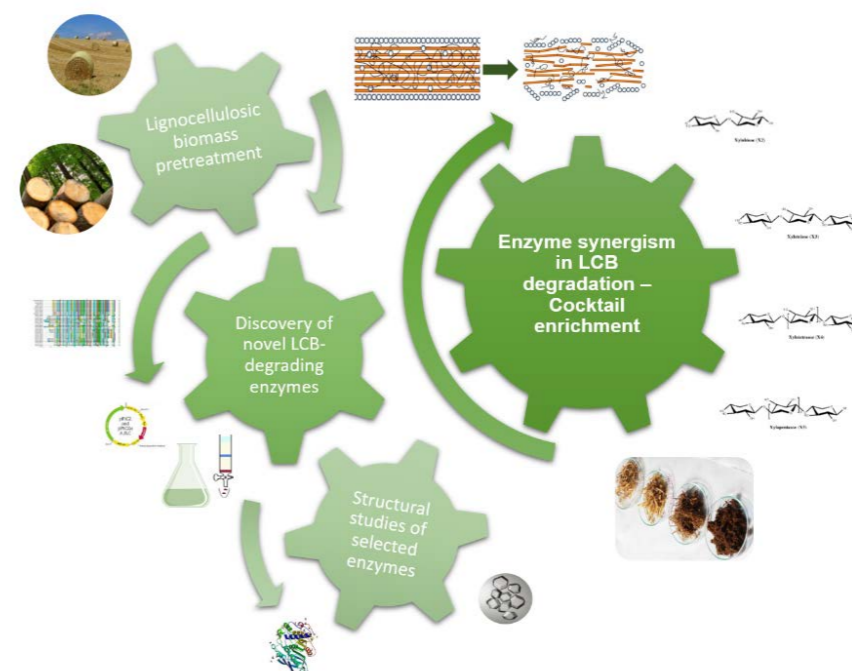
**Project webpage:**

**Linked in**

ARSIS project

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Anastasia Zerva project ARSIS -  
Harnessing the potential of  
AccessoRy enzymes and their  
SynergIStic relationships in the  
valorization of Greek lignocellulosic  
biomass



**Budget:** 197,000.00 €

**Duration:** 36 months

## Research Project Synopsis

***A key factor to efficient saccharification of lignocellulosic biomass (LCB) is the synergism between the main hydrolytic enzyme activities with Accessory Enzyme Families (AEFs). The discovery of such AEFs is crucial to the improvement of LCB hydrolysis, and ultimately to the cost effectiveness of any biomass-based industrial process, through the reduction of the required enzyme load. The aim of ARSIS project is the investigation of AEFs for the optimization of the currently used lignocellulolytic enzyme cocktails. Within the frame of ARSIS, LCB residues representative of Greek agroindustrial byproducts, will be pretreated by different methods, for the construction of a suitable substrate library. Next, enzymes from the main AEFs selected after bioinformatic analysis will be studied in detail, as regards substrate specificity and synergistic activity with the major enzyme families implicated in LCB breakdown (cellulases, hemicellulases, etc.). Novel enzymes with significant potential in LCB breakdown will be fully characterized, biochemically and structurally, to gain insight into their mode of action. Thus, an AEF library will be constructed, and the potential of these enzymes to improve standard lignocellulolytic enzyme cocktails will be evaluated. The project will be implemented by the significant expertise of the Industrial Biotechnology and Biocatalysis group of NTUA in Biocatalysis, together with the collaborating group of Patras University offering their experience in Structural Biology. The construction of a library of lignocellulolytic AEFs will allow the optimization of LCB breakdown in simple sugars, customized to the available starting materials. The adaptation of pretreatment methods and enzymatic cocktails specifically on Greek agroindustrial residues is of utmost importance for the development of a sustainable and circular biomass-based economy in Greece, in line with the global effort to reduce the use of non-renewable fossil-based resources.***

## Project originality

*The innovation of ARSIS, beyond the current state of the art, lies in the following key factors:*

- *Application of customized pretreatment technologies aiming at the efficient lignocellulosic biomass (LCB) pretreatment, to produce digestible materials for subsequent enzymatic hydrolysis.*
- *Construction of a library of novel accessory LCB-degrading enzymes, together with complete characterization data, with significant potential for the degradation of LCB biomass. Within the frame of ARSIS, novel enzymes will be discovered and fully characterized, biochemically and structurally, thus offering new perspectives to the traditional scheme of LCB degradation*
- *Development of tailor-made enzyme cocktails for the efficient hydrolysis of pretreated LCB, focusing not on individual enzyme activities, but on their synergistic interactions*
  - *Mapping of the synergistic relationships between different enzyme players in LCB degradation*
- *Structural determination of novel accessory enzymes, which is a prerequisite for any future attempt to construct improved biocatalysts through protein engineering.*
- *Optimization of saccharification yields on LCB substrates representative of the residues from the Greek agroindustrial sector*

## Expected results & Research Project Impact

***The proposed project aims to achieve scientific goals that will attract considerable economic interest and will have great potential for applications at national and international level. Aside from the sustainable development within the wider agro-industrial sector, the production of microbial biocatalysts with LCB-degrading activity has many attractive features in the context of “Green Chemistry”. Enzymes with such properties have a wide applicability to a variety of industrial and biotechnological processes, such as the detoxification/bioremediation of pollutants or the biocatalytic synthesis of valuable products. The discovery of novel enzymes could be a significant opportunity to transfer this commercial activity to Greek territory. Carbohydrases account for 50% of worldwide enzymes market share, and therefore, the adaptation of the biotechnological knowledge on substrates widely available in the Mediterranean region could significantly boost the industrial development towards greener routes. Further environmental, financial and social implications are as follows:***

- Financial sustainability can be attained through market diversification towards new products, new employment opportunities for young researchers and specialized scientific/technical personnel, and appearance of new fields for capital investments.***
- Environmental sustainability through development of alternative approaches for the valorization of agricultural and agroindustrial wastes and residues, abundant in the Greek agroindustrial sector, which would lead to methodologies and products with less or no environmental impact in relation to those currently in use.***
  - Social sustainability which will be expressed as equal access for all society members to the products and the expertise generated by the implementation of the project.***

## The importance of this funding

*The financing of postdoctoral fellowships through EL.ID.EK. has adopted a pioneering approach, which gives the postdoctoral researcher the freedom to develop his or her own research ideas and approaches, as well as to create his or her own research team. Of course, the most important advantage lies in the realization of a competitive research project in Greece, and the prevention of brain drain. However, my personal opinion is that the benefits that a researcher can obtain from the funding of EL.ID.EK. are multiple, and are related, in addition to independent research and the significant enhancement of his/hers resume, to skills such as research team leading, resource management, collaborating with researchers from other scientific fields, problem-solving skills, and research project management. Personally, I believe that the completion of this project will provide me with more maturity and experience to pursue an independent research career.*



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