**ERA CoBioTech** (ERA-Net Cofund on Biotechnologies)

ACHEMA2018

# Kick-off session: "Biotechnology for a sustainable bioeconomy"

## Project name: Enzyme platform for the synthesis of chiral amino alcohols

Project acronym: TRALAMINOL

Name: Wolf-Dieter Fessner

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant 722361

Frankfurt am Main, 13.06.2018

# Project partners

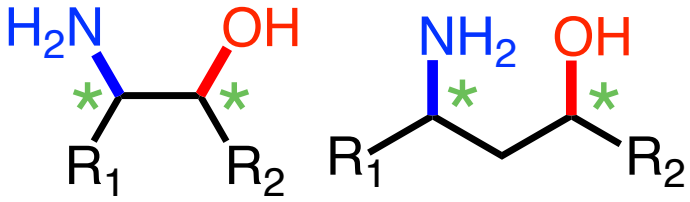
- Wolf-Dieter **Fessner**, Technische Universität Darmstadt, Germany
  Pere **Clapés**, CSIC-IQAC, Barcelona, Spain
  Laurence **Hecquet**, Université Clermont Auvergne, Aubiere, France
  John **Ward**, University College London, U.K.
  Simon **Charnock**, Prozomix Ltd., Haltwhistle, U.K.
  Michael **Breuer**, BASF SE, Ludwigshafen, Germany

- Total project budget: 2.885.000 €

- Project start: 01. April 2018

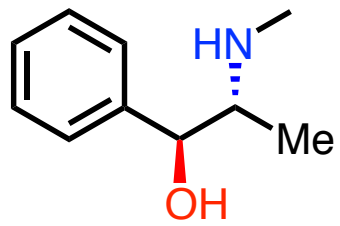
# Introduction

- Amino alcohols comprise highly diverse classes of natural products
  - great importance due to their bioactivity
  - chiral building blocks for pharmaceuticals and agrochemicals
- chemical synthesis of stereo-pure amino alcohols difficult
  - typically requires uneconomical protective group manipulations
  - typical chemical syntheses in industry …
    - … use hazardous substances
    - … consume large amounts of energy
    - … generate toxic waste

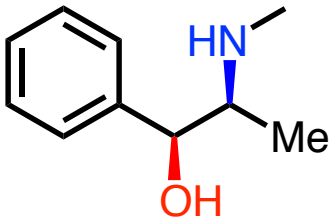



- Tralaminol will develop innovative biotechnological processes for the sustainable synthesis of amino alcohols
  - regenerable metabolic intermediates as starting materials
  - mild reaction conditions and high selectivity levels

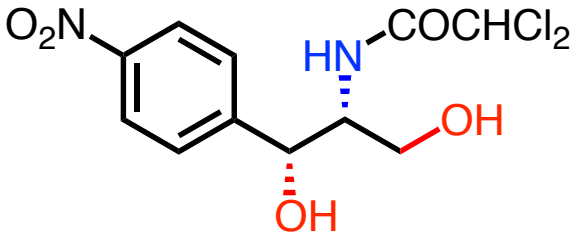
# Important amino alcohols



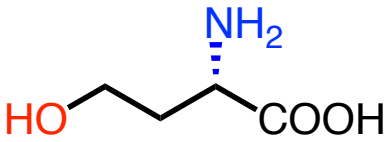
D-ephedrin



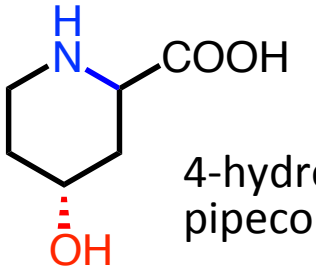
*pseudo*-ephedrin



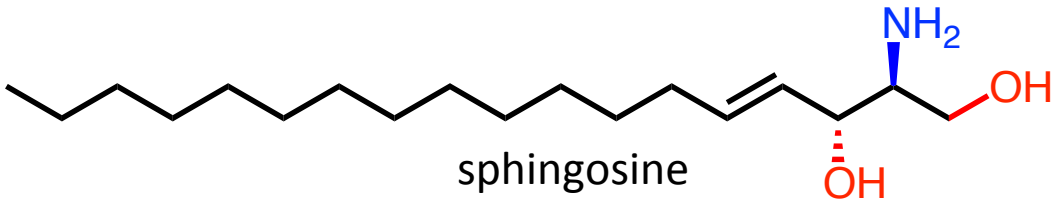
chloramphenicol



homoserine



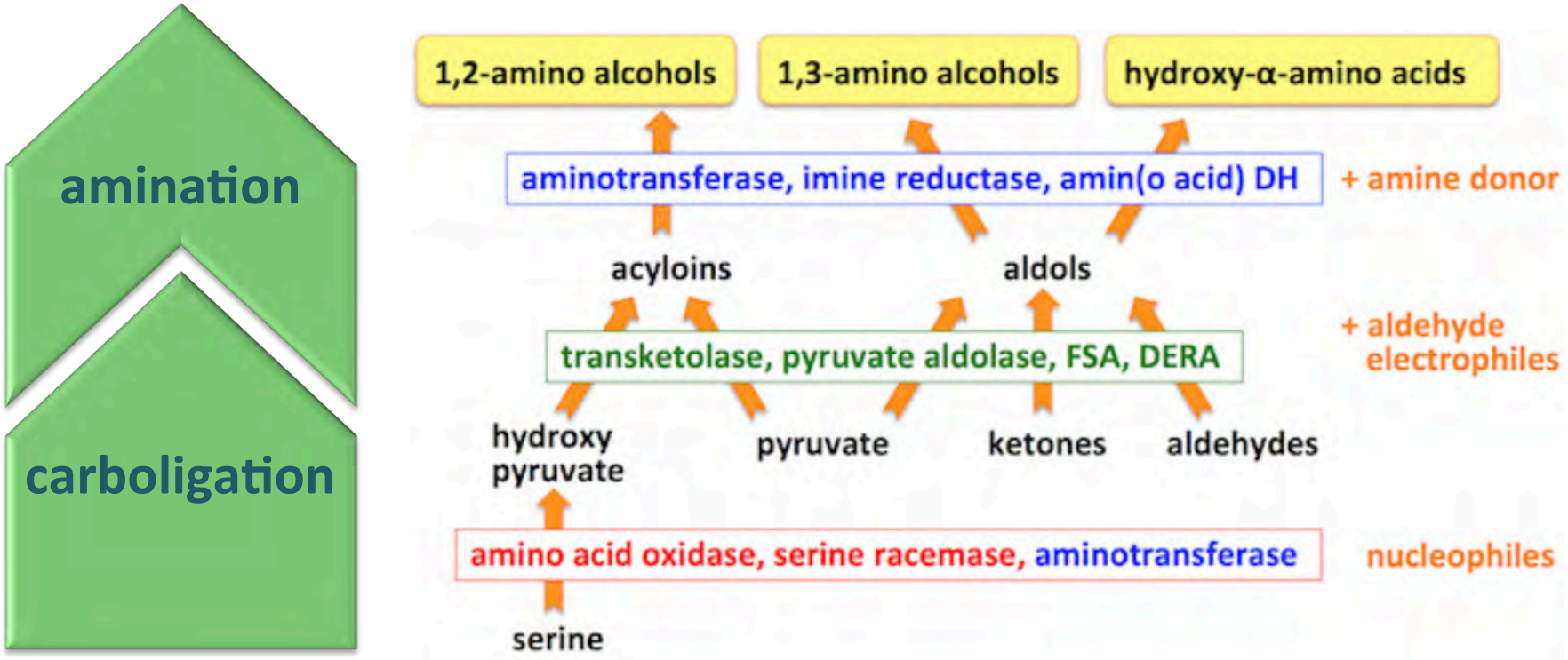
4-hydroxy-
pipecolic acid



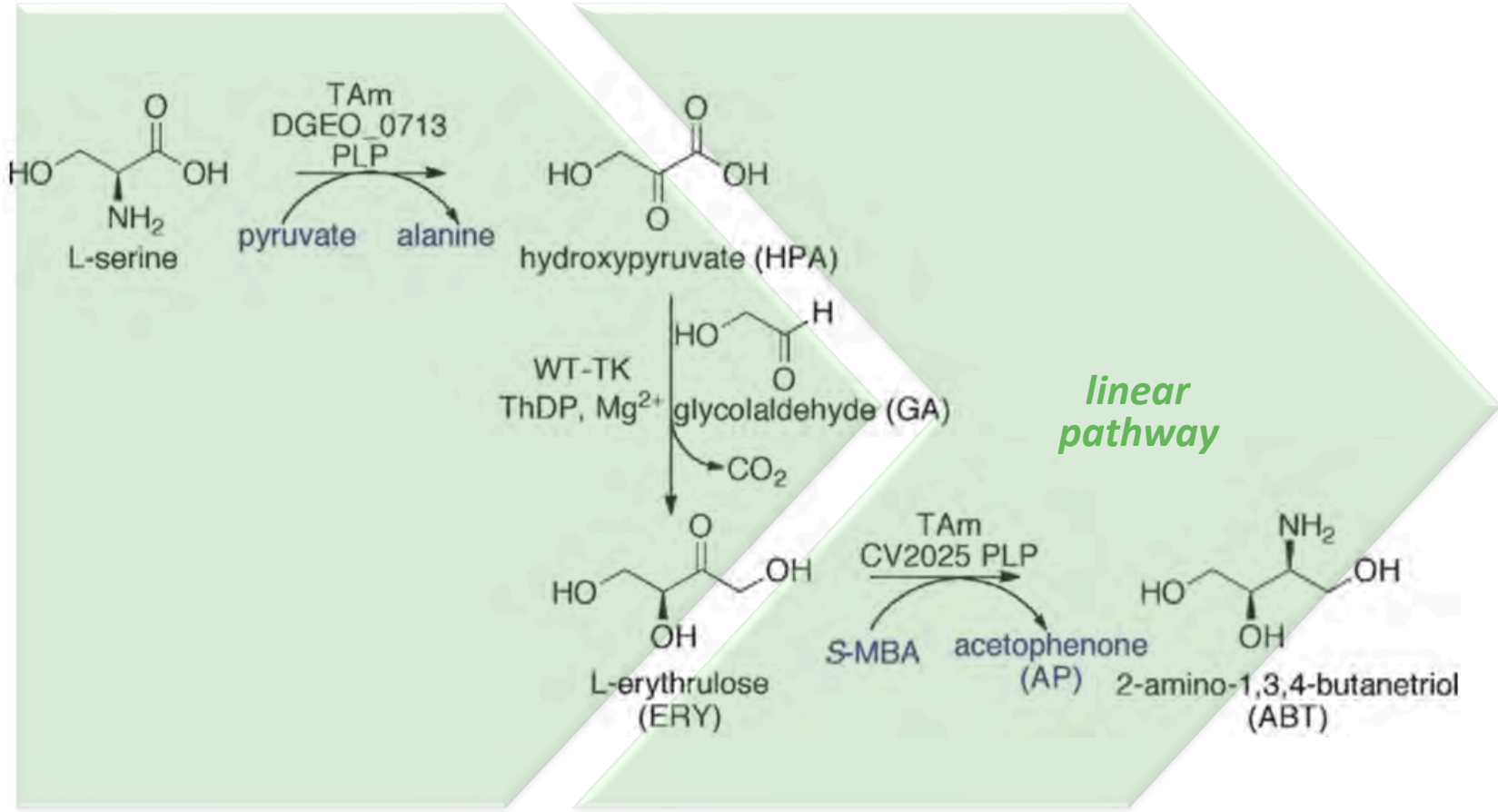
sphingosine

**sympathomimetics**
**antibiotics**
**anti-diabetics**
**special amino acids**
**complex lipids**
**etc.**

# Integrated biocatalytic platform

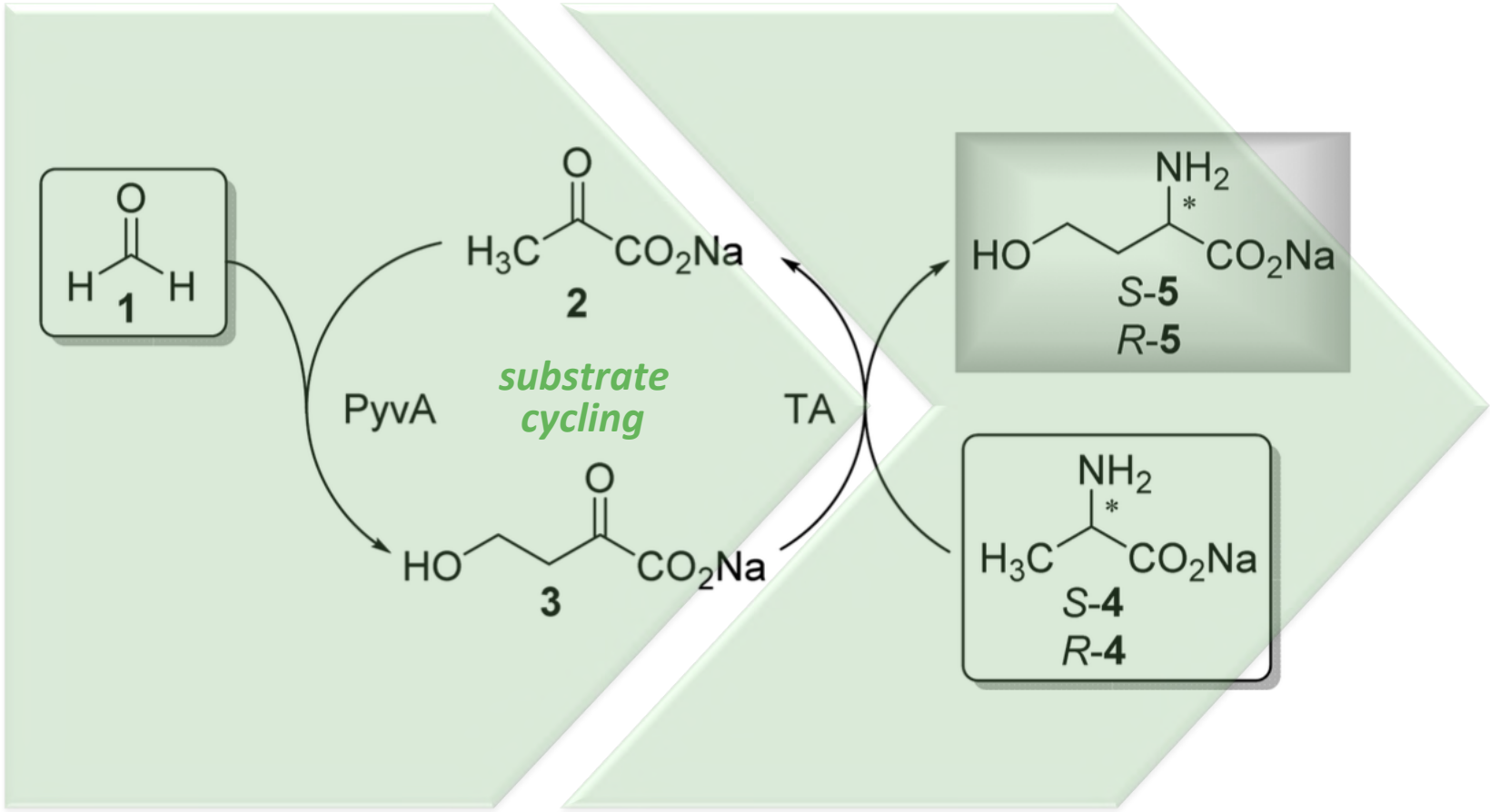


# Exemplary one-pot process (I)




Villegas-Torres et al., *Enzyme Microb. Technol.* **2015**, *81*, 23–30

# Exemplary one-pot process (II)



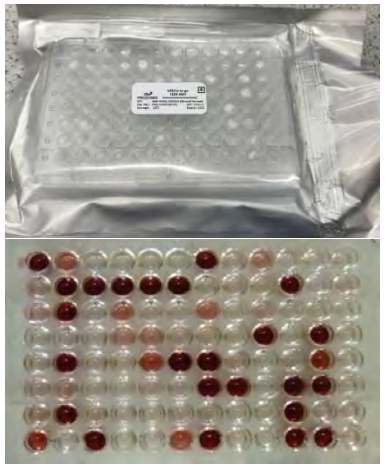

Hernandez et al., *ACS Catal.* **2017**, *7*, 1707–1711

# Project plan

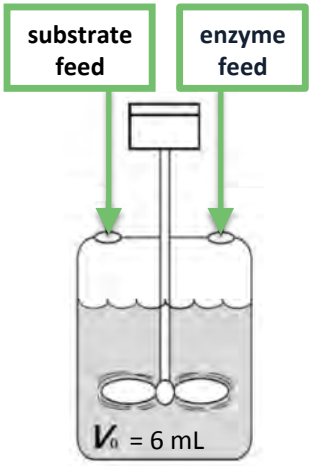
- *enzyme prospecting*
- *protein production*
- *biocatalyst discovery*
- *reaction development*
- *industrial demonstration*
- *technology dissemination*

*metagenomic libraries*

*600 x 2 L production line*

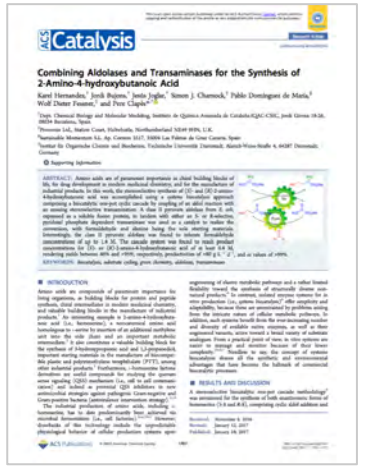


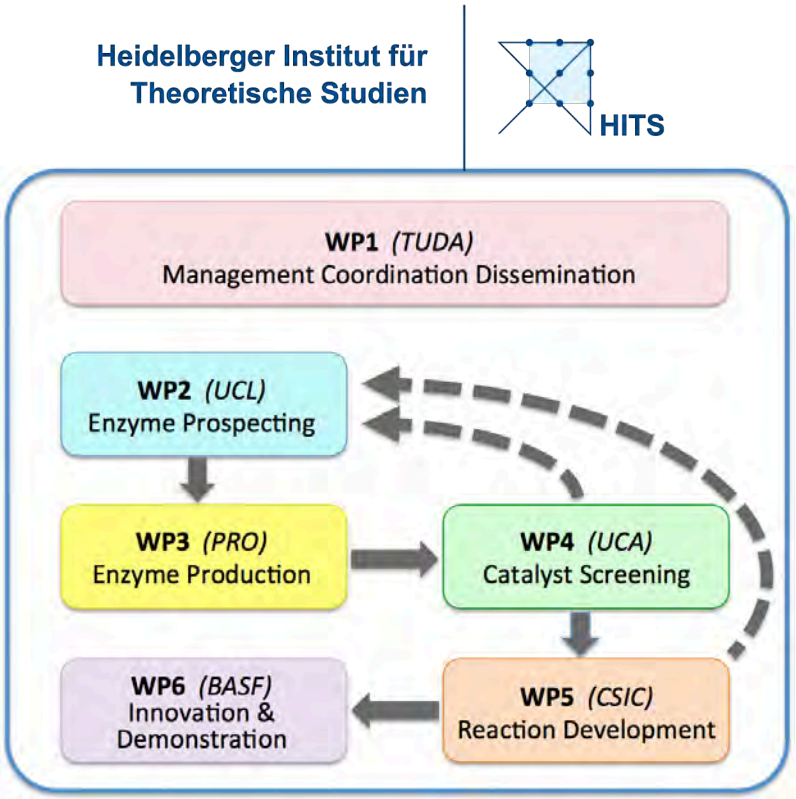
*Colorimetric assay plates*

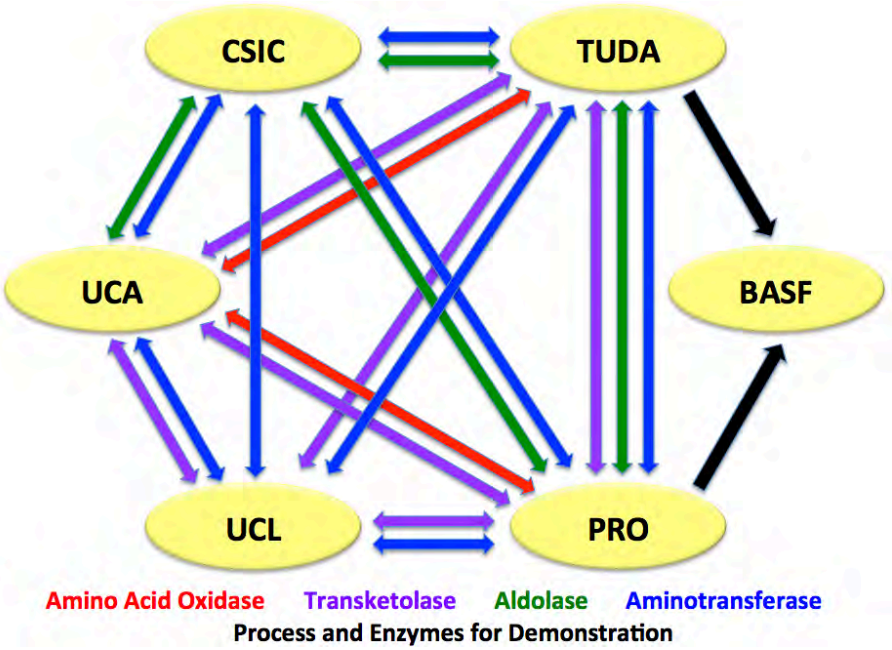



*lab scale reactions*

*750 L pilot lab demonstration*






Overview on work package structure and project interaction matrix

# Project timeline


Existing enzyme panels available from partners allow instantaneous joint start without waiting delays — all instrumentation and technologies in place — Consortium Agreement signed — recruiting of new personnel in progress

# Expected outcomes

- **Enzyme superfamily portfolios** *designed for maximum genetic diversity for various reaction types (1000s of enzymes for carboligation, amination, etc.) will become available for future exploitation*
- **Robust biocatalysts** *characterized for industrial processes*
- *Novel* **one-pot, multi-step processes** *for stereospecific syntheses*
- **Integrated reaction platform for the sustainable manufacture** *of multifunctional chiral building blocks*
- *Significant potential for* **environmental impact** *by replacing multi-step energy and resource-intensive conventional chemical processes*
- *Strengthening the* **global competitiveness** *of the European chemical and pharmaceutical industries*
- *Accelerated transition from fossil raw materials toward a sustainable* **bio-based economy**

# Summary

***Tralaminol* will create a unique enzyme platform for the sustainable synthesis of chiral amino alcohols, fully exploiting the synergy between synthetic biology and biocatalysis**

- Toolbox of robust carboligation enzymes (aldolases, transketolases)
- Toolbox of robust amination enzymes (transaminases, imine reductases)
- Flexible strategy for synthesis of various positional isomers
- Selective access to complementary diastereomers
- Small bio-based metabolites as sustainable starting materials
- Economically interesting, highly integrated one-pot processes operating under mild reaction conditions
- Novel biosynthetic routes to bio-active (non-)natural products *("artificial metabolic pathways"* for *"Systems Biocatalysis")*
- Product molecules with high added value *(diverse pharma market segments, including drugs related to treatment of cancer, circulatory disease, diabetes, microbial infection and others)*

# Contact details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