

CLUSTER SPRING: NETWORKING ANNUAL EVENT

14 SETTEMBRE 2023



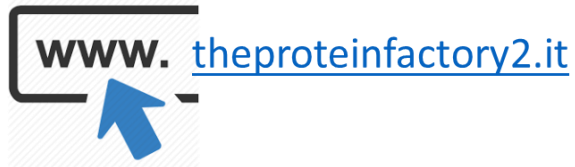
UNIVERSITÀ DEGLI STUDI
DELL'INSUBRIA



DB DIPARTIMENTO
SV DI BIOTECNOLOGIE
E SCIENZE DELLA VITA

Gianluca Molla
 Luciano Piubelli
 Silvia Sacchi
 Elena Rosini
 Laura Caldinelli

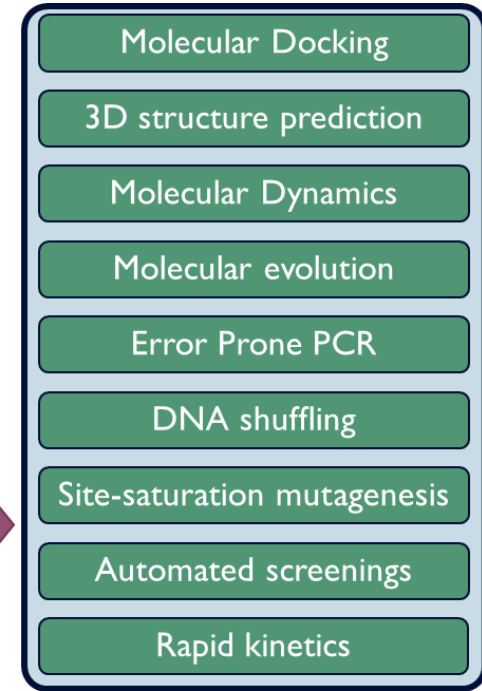
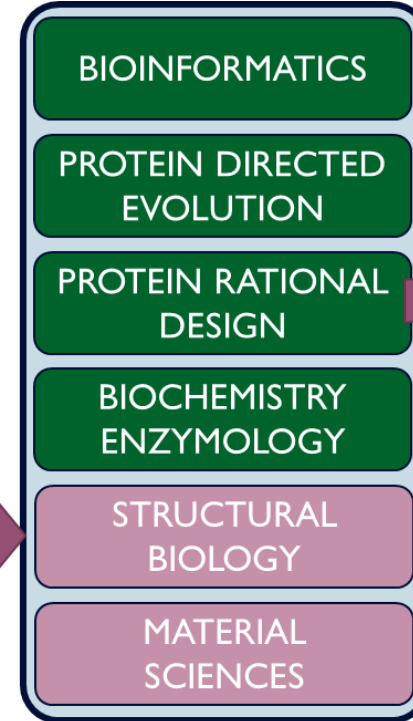
Giulia Murtas
 Valentina Rabattoni
 Valentina Pirillo
 Matteo Miceli
 Erika Zangelmi
 Filippo Molinari
 Elena Zerbini
 Davide Miani
 Caren Battaglia
 Zoraide Motta
 Matteo Crespi
 Elena Mascheroni
 Lorenzo Bonesin



- D-AAAs in serum as biomarkers for AD >
- Regulation of D-amino acids catabolism >
- Serine metabolism in the brain >

- Biocatalytic depolymerization of lignin >
- Systems Biocatalysis >
- Plastic biodegradation >
- Valorization of organic waste >

- Rational design of novel vaccines
- Antimicrobial peptides
- Novel mechanism of antimicrobial resistance
- Protein Factory in CHO cells

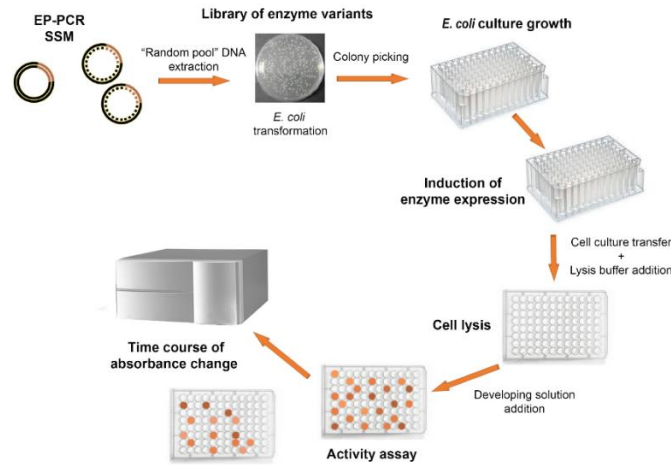


Papers published in the 2017-2022 interval: 87

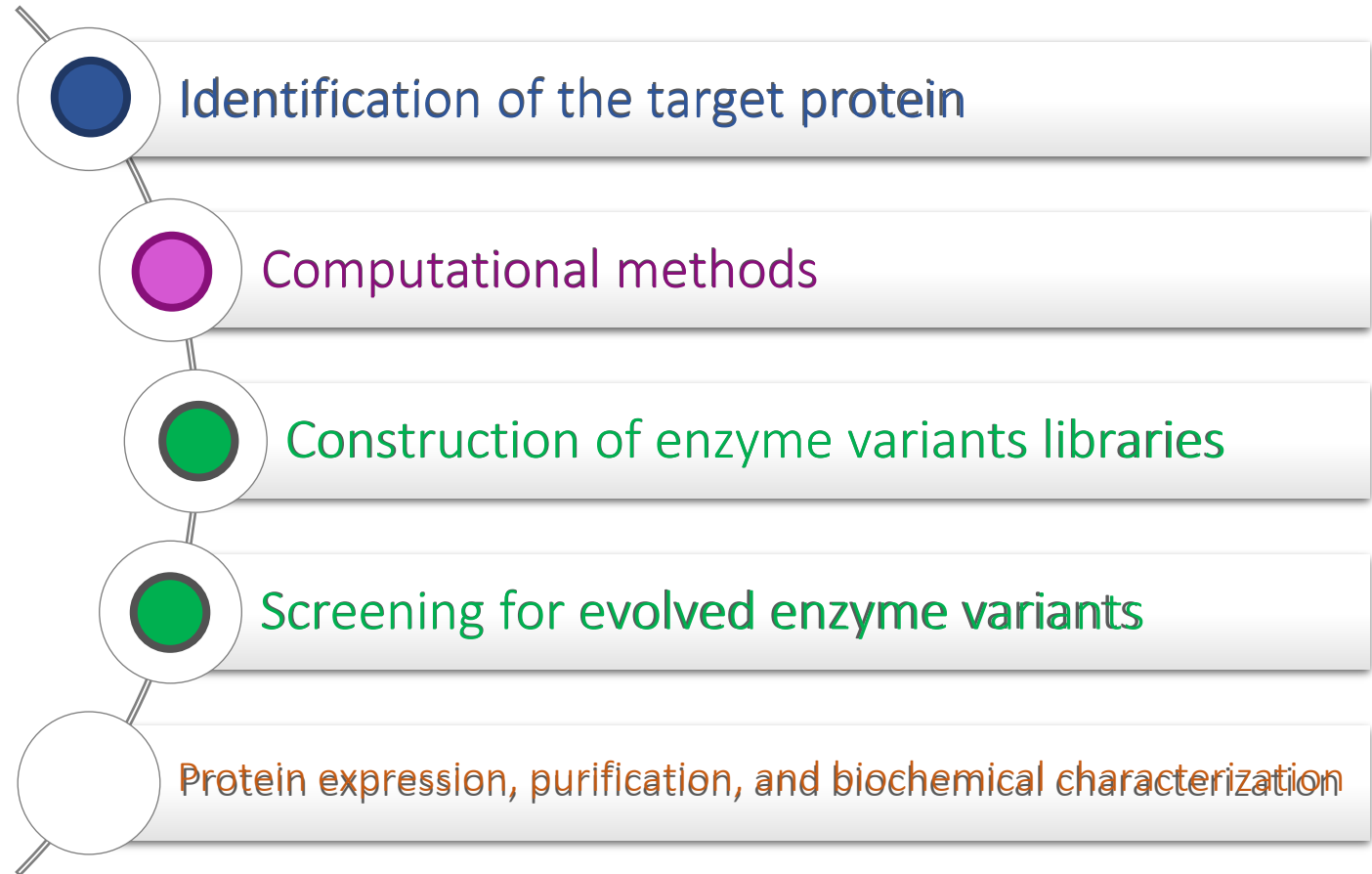
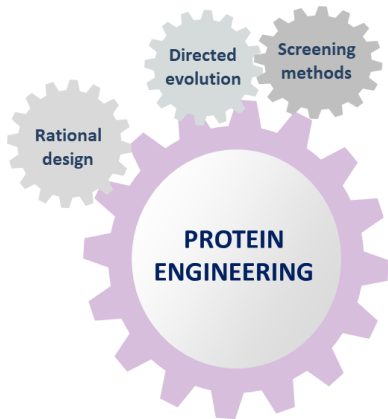
RED biotech	61%
WHITE biotech	31%
Bioinformatics	43%
Recombinant protein expression	69%
Protein engineering	34%



In vitro evolution of novel enzymes



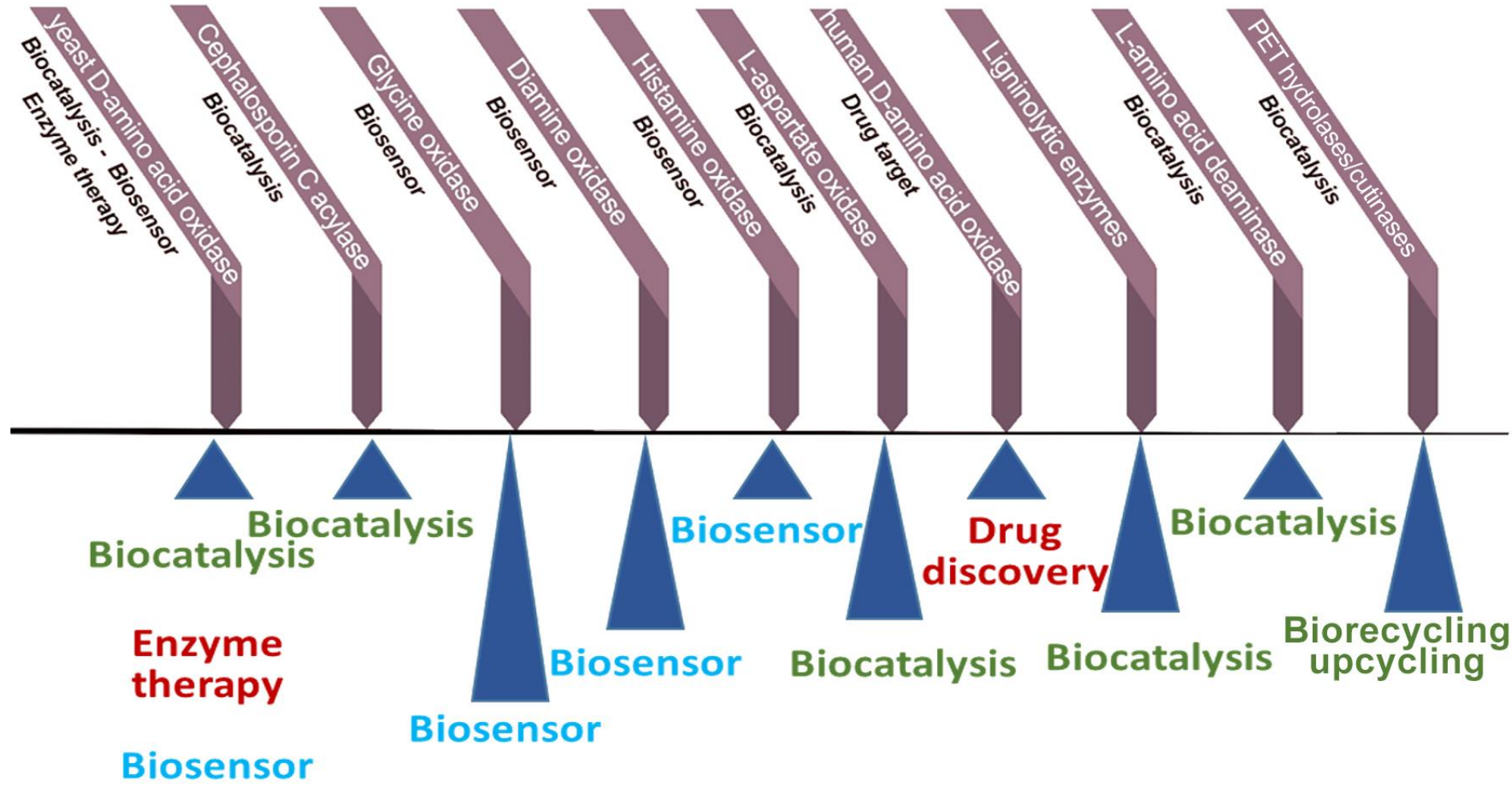
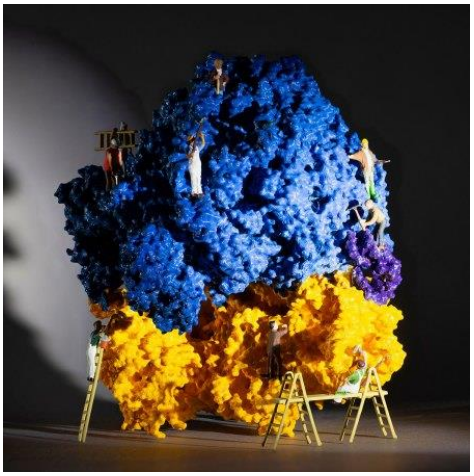
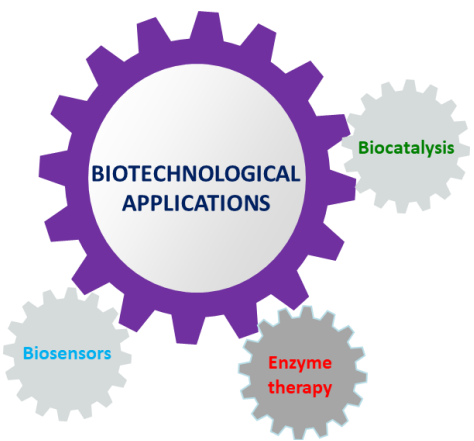
Error-prone PCR
Site-directed mutagenesis
Site-saturation mutagenesis



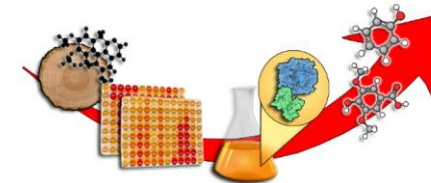
Tailored enzymes



...for innovative uses in different biotechnological fields



Enzymatic tool-box for LIGNIN DEGRADATION



Synthesis of high-value compounds by multi-enzymatic approaches



Lignin-degrading enzymes

Loredano Pollegioni^{1,2}, Fabio Tonin¹ and Elena Rosini^{1,2}

Comparison of different microbial laccases as tools for industrial uses

Fabio Tonin¹, Roberta Melis¹, Arno Cordes², Antonio Sanchez-Amat³, Loredano Pollegioni^{1,4} and Elena Rosini^{1,4}

Catalysis
Science &
Technology



PAPER

View Article Online
View Journal



Cite this: DOI: 10.1039/c6cy01402j

Demethylation of vanillic acid by recombinant LigM in a one-pot cofactor regeneration system†

Elena Rosini,^{ab} Paola D'Arrigo^{bc} and Loredano Pollegioni^{ab*}

Enzyme and Microbial Technology 96 (2017) 143–150

Contents lists available at ScienceDirect

Enzyme and Microbial Technology

journal homepage: www.elsevier.com/locate/emt



A novel, simple screening method for investigating the properties of lignin oxidative activity



Fabio Tonin^{a,b,c}, Elisa Vignali^a, Loredano Pollegioni^{a,b}, Paola D'Arrigo^{b,c}, Elena Rosini^{a,b,*}



A valuable peroxidase activity from the novel species *Nonomuraea gerezanensis* growing on alkali lignin

Carmine Casciello^{a,b,1}, Fabio Tonin^{a,b,1}, Francesca Berini^{a,b,1}, Elisa Fasoli^f, Flavia Marinelli^{a,b,*}, Loredano Pollegioni^{a,b}, Elena Rosini^{a,b}

Research Article
doi.org/10.1002/cssc.202201147

ChemSusChem



www.chemsuschem.org

VIP Very Important Paper



The Laccase-Lig Multienzymatic Multistep System in Lignin Valorization

Elisa Vignali⁺,^a Matteo Gigli⁺,^{b,c} Simone Cailotto,^b Loredano Pollegioni,^{*,a} Elena Rosini,^{*,a} and Claudia Crestini^{*,b,c}

Catalysis
Science &
Technology



PAPER

View Article Online
View Journal | View Issue



Cite this: Catal. Sci. Technol., 2016, 6, 2195

Cascade enzymatic cleavage of the β-O-4 linkage in a lignin model compound†

Elena Rosini,^{*,ab} Chiara Allegretti,^c Roberta Melis,^a Lorenzo Cerioli,^c Gianluca Conti,^a Loredano Pollegioni^{ab} and Paola D'Arrigo^{*,bcd}



Contents lists available at ScienceDirect

Protein Expression and Purification

journal homepage: www.elsevier.com/locate/yprep



Different recombinant forms of polyphenol oxidase A, a laccase from *Marinomonas mediterranea*



Fabio Tonin^a, Elena Rosini^{a,b,*}, Luciano Piubelli^{a,b}, Antonio Sanchez-Amat^c, Loredano Pollegioni^{a,b}

Applied Microbiology and Biotechnology
<https://doi.org/10.1007/s00253-018-8785-z>

ENVIRONMENTAL BIOTECHNOLOGY



Isolation and characterization of a heterologously expressed bacterial laccase from the anaerobe *Geobacter metallireducens*

Francesca Berini^{1,2}, Marko Verce^{3,4}, Luka Ausec^{3,5}, Elena Rosini^{1,2}, Fabio Tonin^{1,2,6}, Loredano Pollegioni^{1,2}, Ines Mandić-Mulec⁷

Applied Microbiology and Biotechnology (2018) 102:10579–10588
<https://doi.org/10.1007/s00253-018-9499-3>

BIOTECHNOLOGICALLY RELEVANT ENZYMES AND PROTEINS



Characterization and use of a bacterial lignin peroxidase with an improved manganese-oxidative activity

Elsa Vignali¹, Fabio Tonin^{1,2}, Loredano Pollegioni¹, Elena Rosini¹

RESEARCH ARTICLE

doi.org/10.1002/adsc.202100849

Advanced
Synthesis &
Catalysis

Multi-Enzymatic Cascade Reactions for the Synthesis of *cis,cis*-Muconic Acid

Elisa Vignali,^a Loredano Pollegioni,^{a,*} Giovanna Di Nardo,^b Francesca Valetti,^b Silvia Gazzola,^c Gianfranco Gilardi,^b and Elena Rosini^{*,a,*}

ACS
Sustainable
Chemistry & Engineering

pubs.acs.org/journal/ascceg



Research Article

Whole-Cell Bioconversion of Renewable Biomasses-Related Aromatics to *cis,cis*-Muconic Acid

Filippo Molinari, Loredano Pollegioni,^{*} and Elena Rosini^{*}

ccMA synthesis project



Lignin



Depolymerization



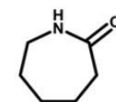
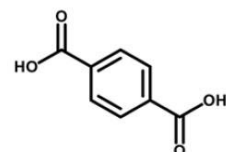
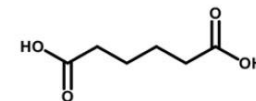
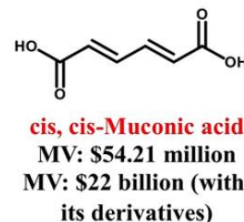
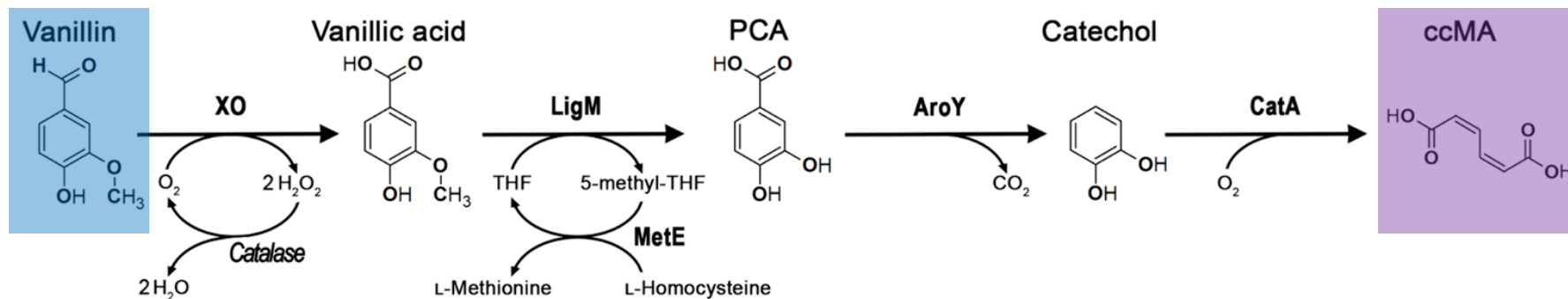
Functionalized Aromatics

KRAFT LIGNIN
≈ 130 million tons / year

THERMO-CHEMICAL TREATMENT

≈ 10% w/w yield

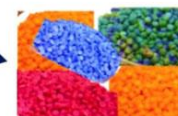
Multi-enzymatic cascade process



NYLON
MV: \$1.9 billion



PLASTICS
MV: \$97.2 billion



RESINS
MV: \$6.6 billion



LUBRICANTS
MV: \$150 billion

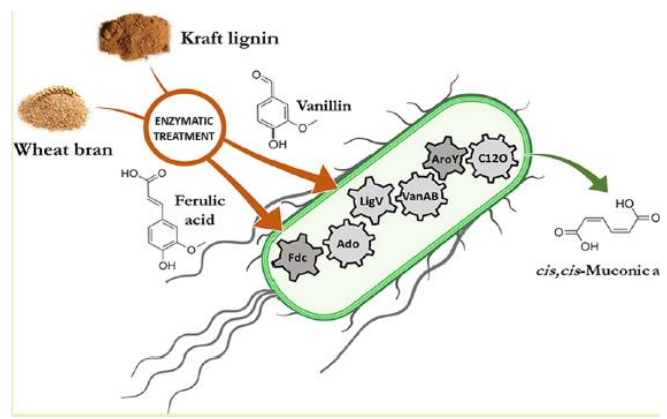
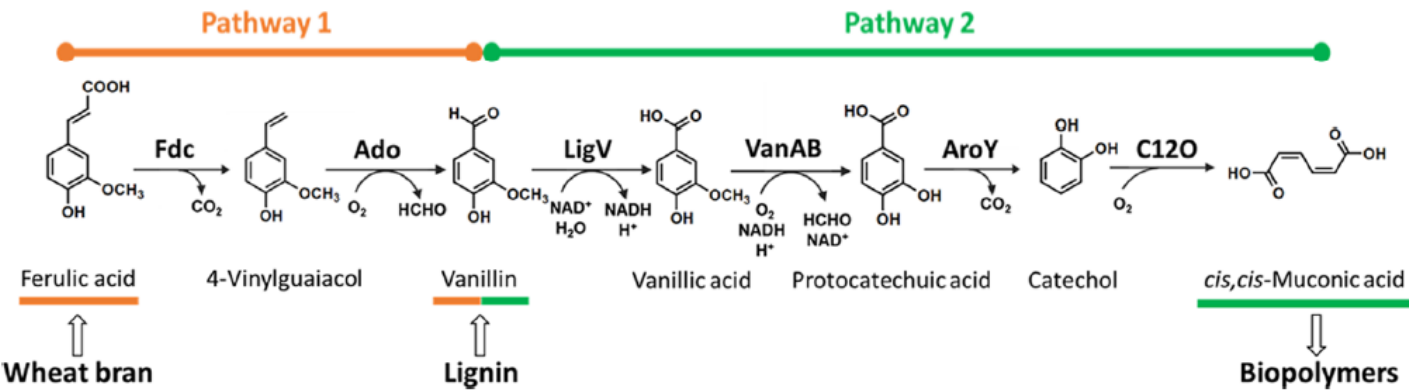
RESEARCH ARTICLE doi.org/10.1002/adsc.202100849



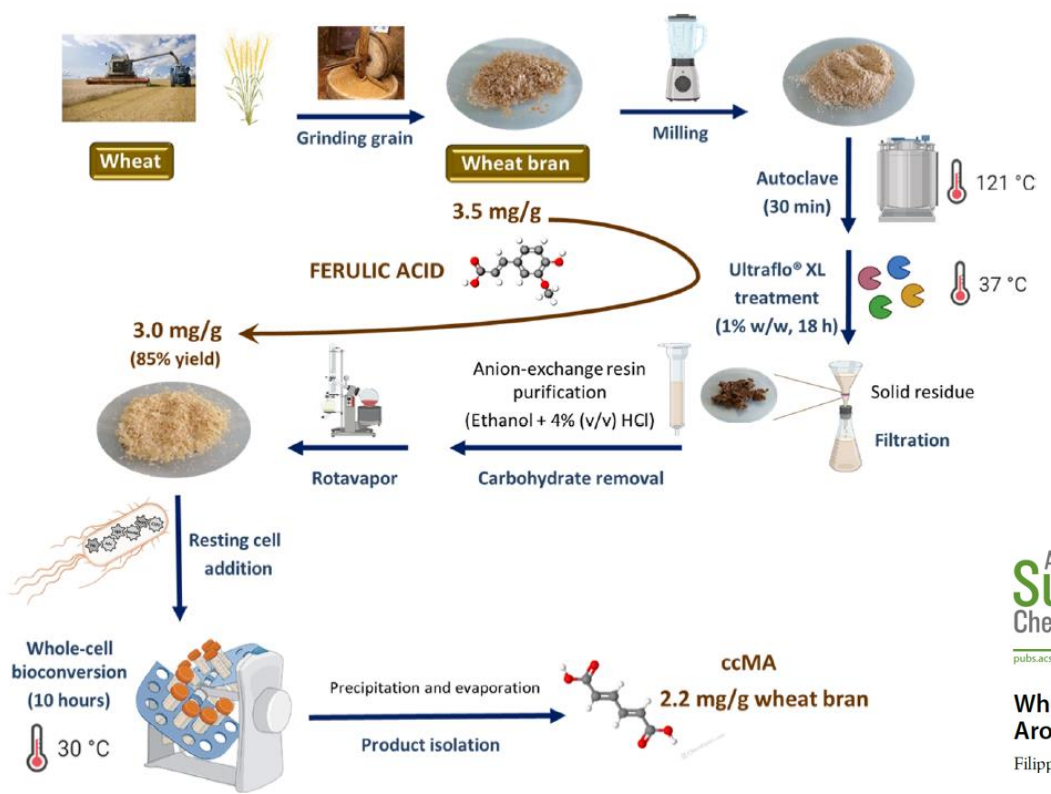
Multi-Enzymatic Cascade Reactions for the Synthesis of *cis,cis*-Muconic Acid

Elisa Vignali,^a Loredano Pollegioni,^{a*} Giovanna Di Nardo,^b Francesca Valetti,^b Silvia Gazzola,^c Gianfranco Gilardi,^b and Elena Rosini^{b*}

ccMA synthesis project...whole-cell system



0.73 g ccMA/g ferulic acid

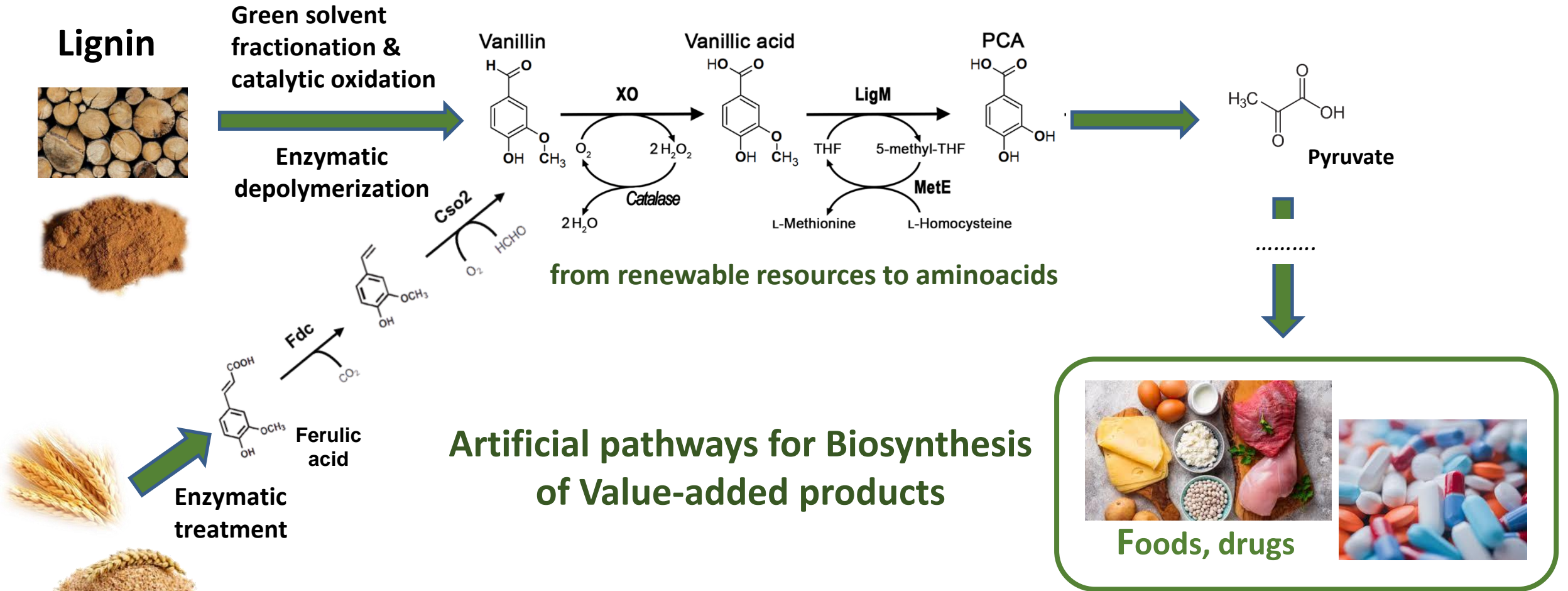


Recovery and purification of ferulic acid from wheat bran

↓

bioconversion into ccMA

MEAT-from-WOOD project (from renewable resources to)



Wheat bran



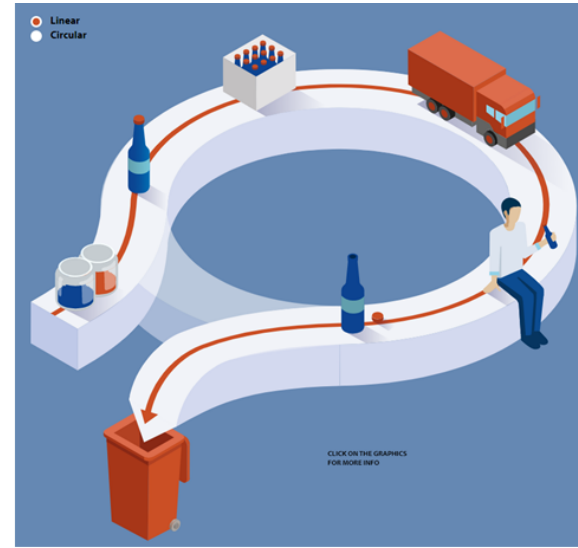
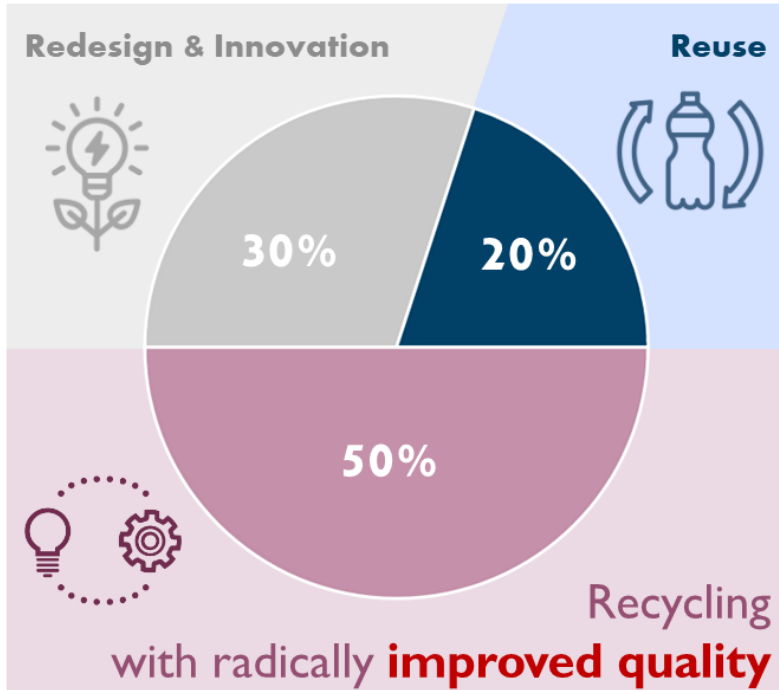
Gianluca Molla, Elena Rosini, Loredano Poliegoni

Toward a PET circular economy

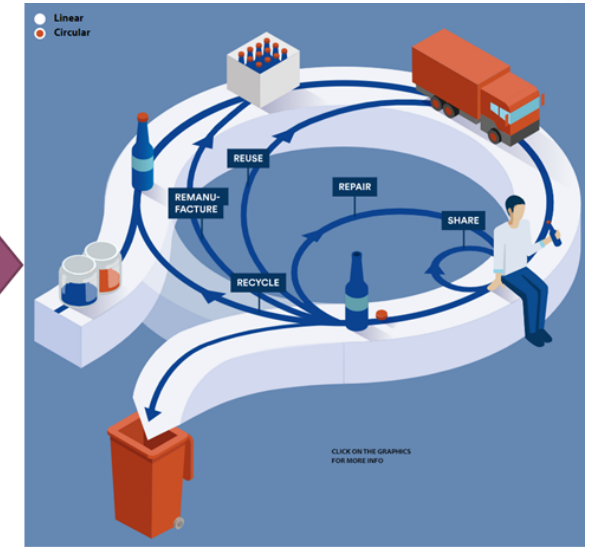
The plastics pollution problem is a general failure of the whole **plastic value chain**

- product design & industrial production
- Marketing & behavior of consumers
- disposal processes

3 main areas



Linear

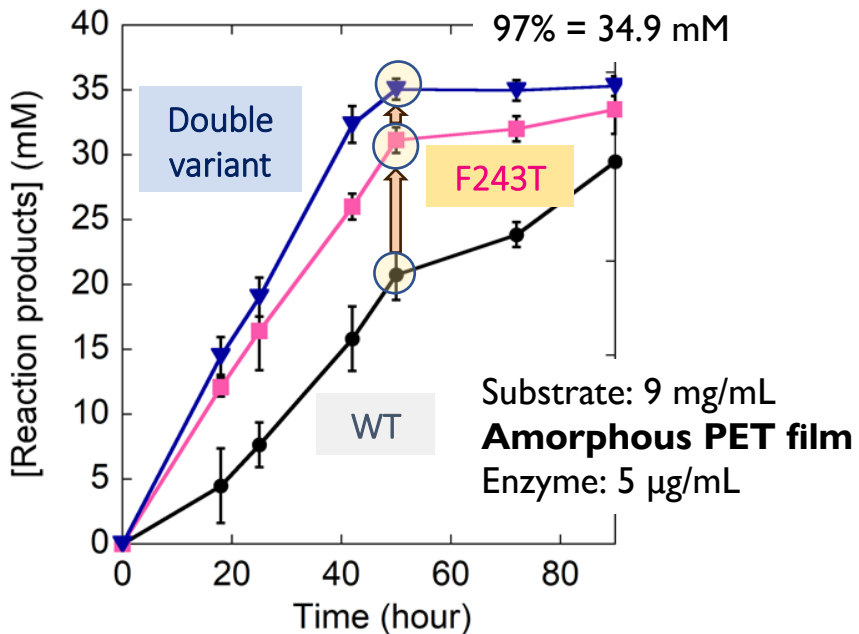
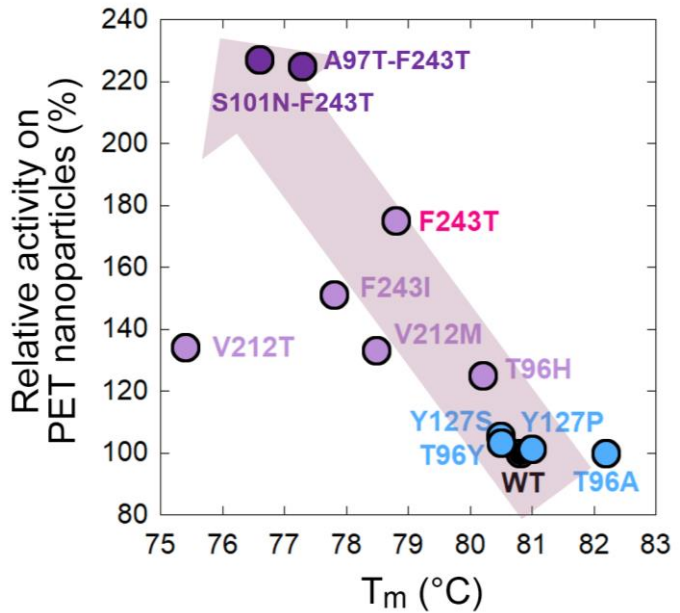


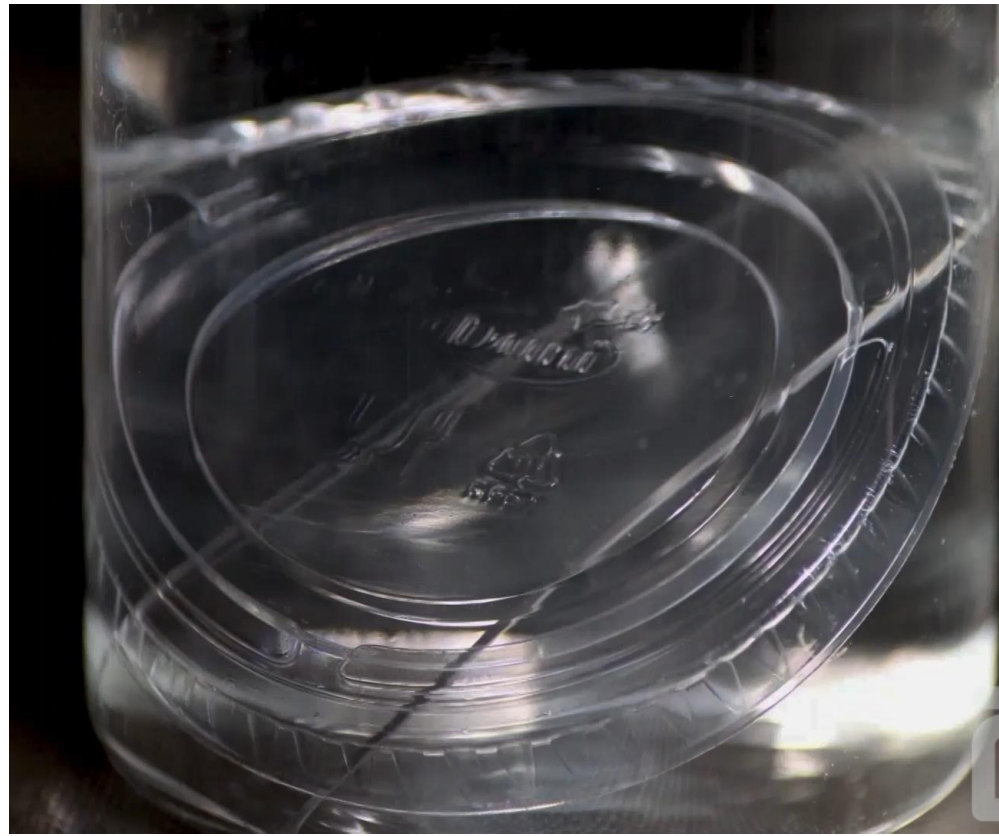
Circular

Only 21% of PET is recycled because the recycled polymer possesses a **lower quality** and a **higher cost** in comparison with the original one

← Biotechnological enzymatic processes

Biodegradation of post-consumer PET at 55 °C






1 DAY

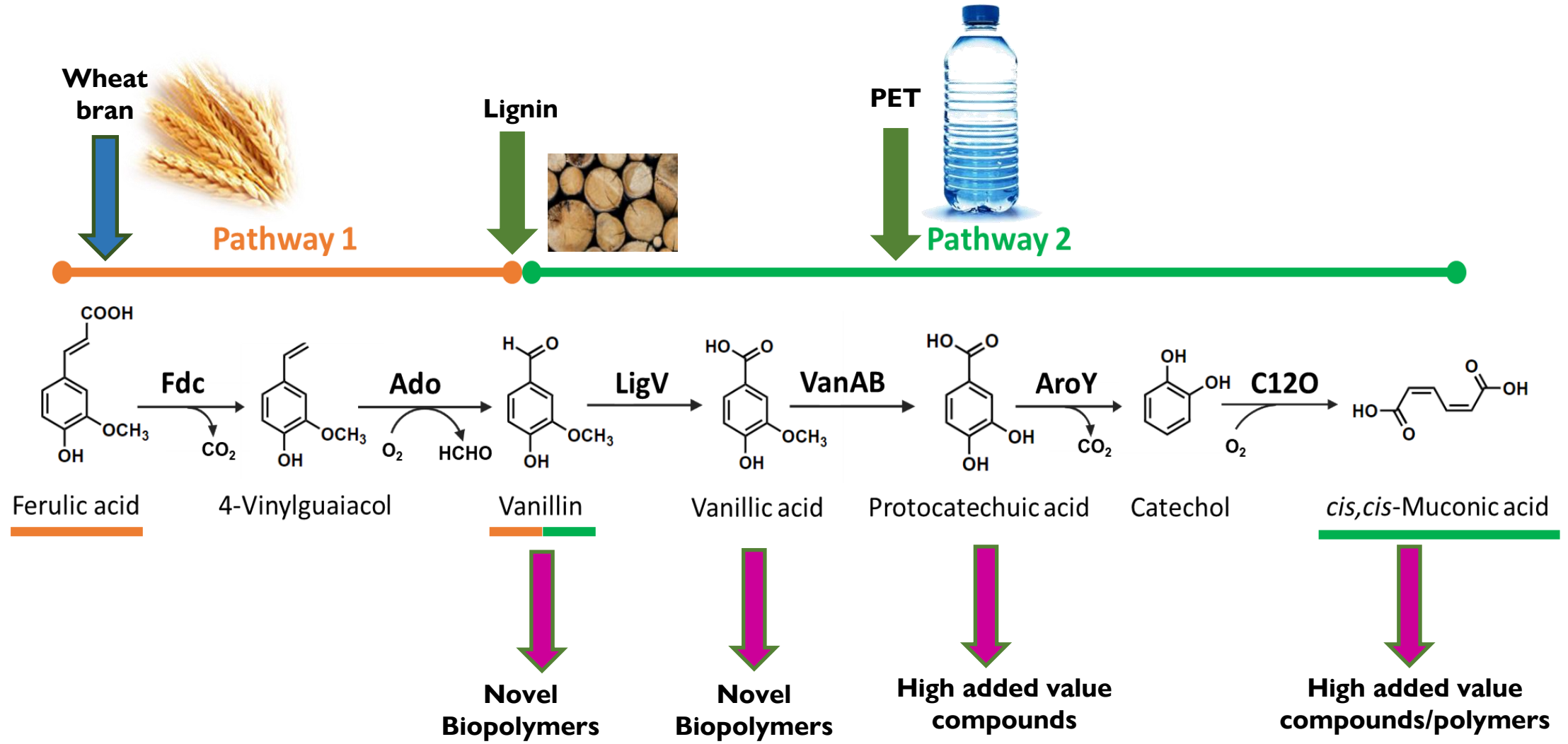
PET -hydrolyzing enzyme at 55 °C (in H₂O)

1.3 g post-consumer PET waste from disposable plastic cup lid

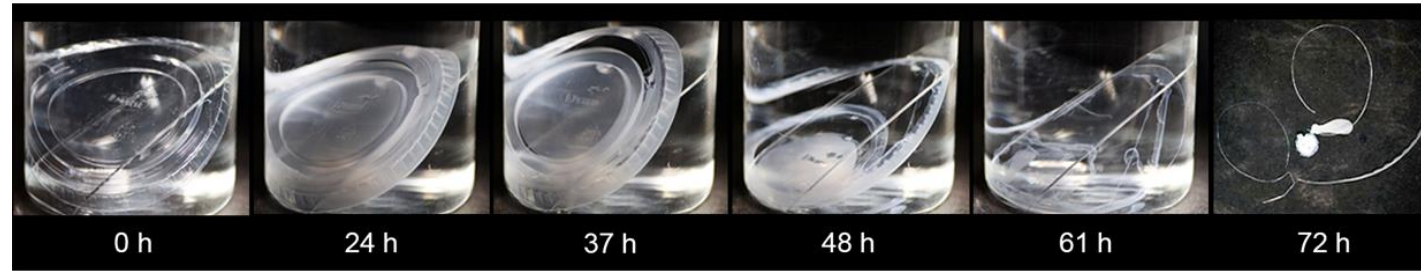
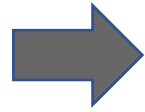
Remaining fragments (0.8%)



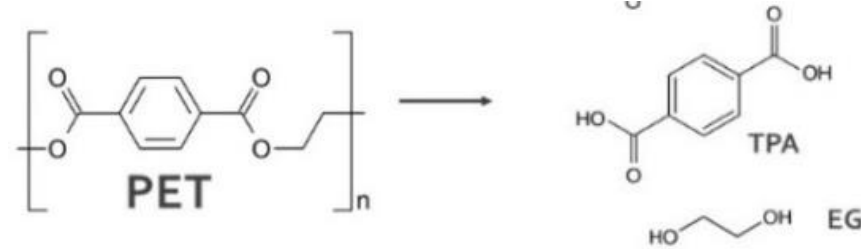
System Biocatalysis → A circular bioeconomy for PET



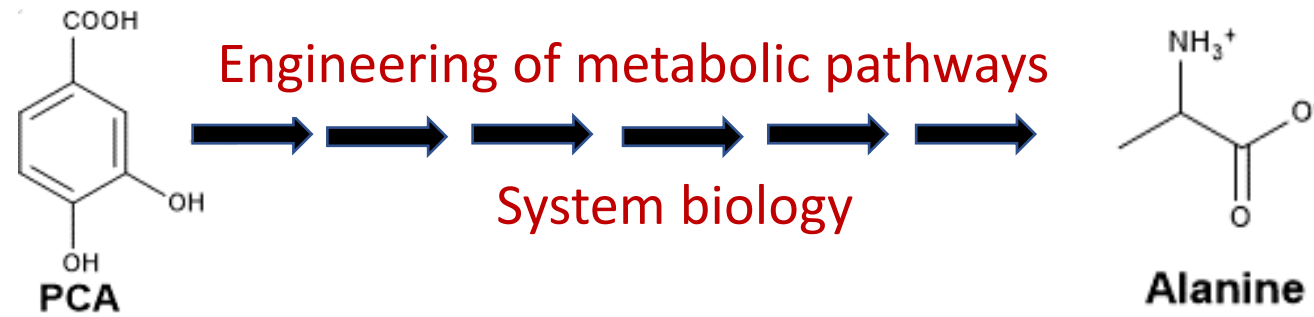
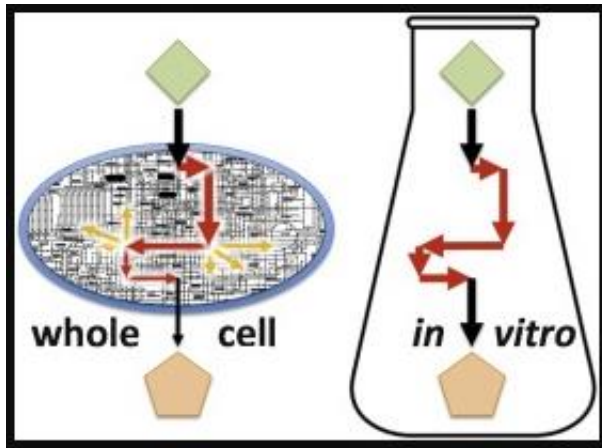
ProPla project: Proteins from plastics



Step 1: PET enzymatic degradation



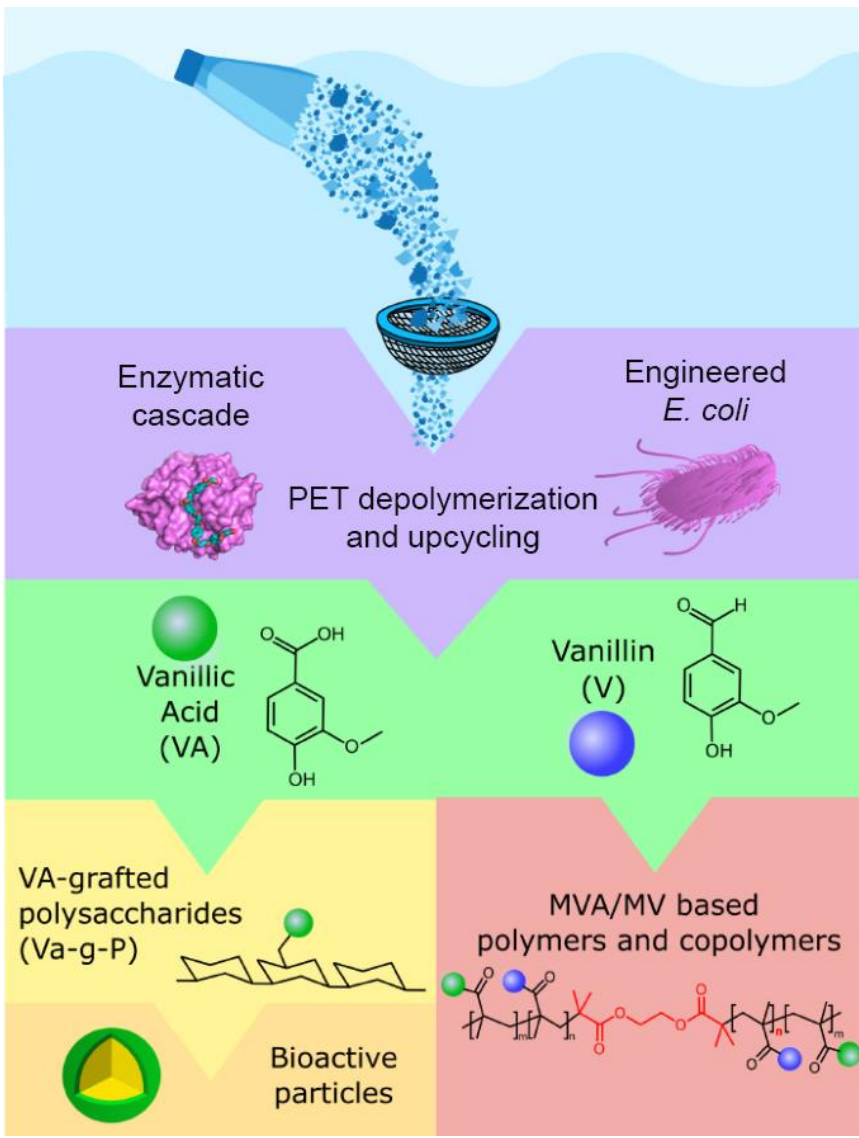
Step 2: TPA enzymatic degradation and valorization into amino acids



Funded



PET2POLY project From PET WASTE to BIOACTIVE POLYMERS: an innovative bioeconomy approach



BUILDING BLOCKS FROM PET

INNOVATIVE BIOACTIVE POLYMERS

Funded



RICH project - Turning Rubbish Into biobased materials: a sustainable CHain for the full valorisation of organic waste



NicePET project - aN InseCt biorEactor for the full valorization of PET

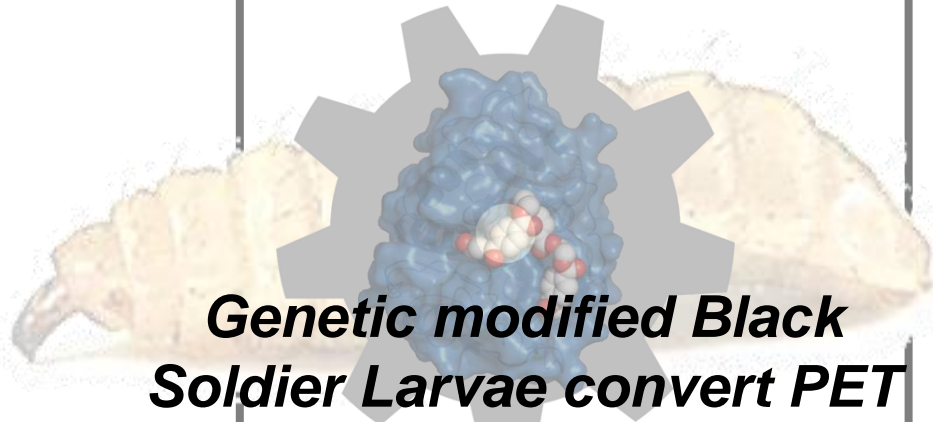


INPUT

Organic wastes contaminated by Poly(ethylene Terephthalate) (PET)



Genetic modified Black Soldier Larvae convert PET into compounds used to grow



OUTPUT

Rearing residues



Organic fertilizer

Proteins & small peptides



Novel materials

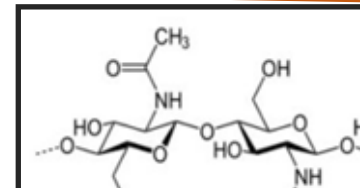
Natural antimicrobials

Lipids



Biodiesel/additives

Chitin and chitosan



Novel materials
Natural antimicrobials

Funded



PETex: a tailored PET bioeconomy for textiles valorization



(A) BLENDED FIBERS DEGRADATION:

(B) FIBER-DERIVING DEGRADATION PRODUCT VALORIZATION:

Submitted
for funding

Fondazione
CARIPLO



Feathers (end of life and scraps)



**WE LOOK FORWARD
TO WELCOMING YOU
TO MILANO 2024**

Mining biochemistry for human health and well-being

48th FEBS

Federation
of European
Biochemical
Societies

CONGRESS

MILANO 29 June - 3 July 2024

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febs2024@aimgroup.eu

Visit <https://2024.febscongress.org/>

Highlights

- **14 Plenary lectures** from worldwide research leaders, including **3 Nobel laureates**
 - **1 Nobel laureate** meets the Young Researchers session

- **31 Symposia** (2 managed by young scientists) grouped within 4 main themes:
 - Biochemistry for Knowledge Advances in Life Sciences
 - Environmental Biotechnology
 - Biochemistry and Human Well-being
 - Biochemistry in Health and Diseases

- **64 Main invited speakers**
- **90 Speakers selected from abstracts**
- **9 Speed talk sessions: 90 selected presenters**

- **Lectures, short talks and speed talks** from the submitted **abstracts**

- **Special Sessions** dedicated to:
 - Young Scientists
 - Biochemical Education
 - Science and Society
 - Women in Science
 - Private and Public Funds in Translational Research

- **Poster presentation sessions**

