Developing new circular tools for wheat microbiome modulation as an innovative contribution for a sustainable, healthy, and resilient food production system

Circles

World population growth: 10 billion by 2050

- Biodiversity loss
- Hunger & malnutrition
- Resource depletion
- Human impact on the environment

To reduce net emissions of GHGs to zero by 2050, while ensuring the prosperity of the European economy and the well-being of its citizens.

- 20% reduction in the use of agrochemicals for fertilization
- 50% reduction in the use of chemical pesticides
- 50% reduction in nutrient losses
- 50% reduction in the use of antibiotics for farm animals

This policy provides a framework for transforming food systems into resilient systems to ensure that everyone has access to affordable and healthy food.

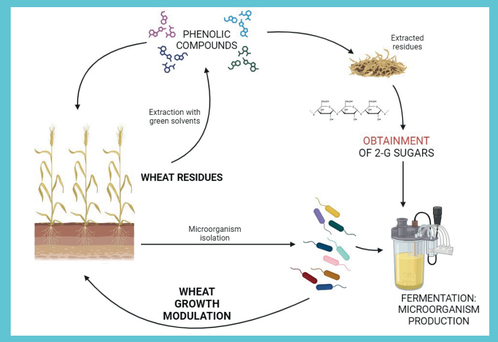
Objectives

The overall objective of the project is to deep the knowledge of the **microbiome of the soil & plant**, studying the variability under different biotic and abiotic stresses, with the aim of carrying out a modelling that will allow further research into new tools for **modulating and improving crop yields**, as well as to improve agricultural production to obtain **advanced, improved & more nutritional food with a direct positive impact** on the **microbiome in both animals & humans**. In this work, we aim to isolate potential microorganisms for wheat crop modulation from wheat residues and soil samples and to develop and optimise bioconversion processes for the production of 2 microorganisms and wheat waste fermented media as modulators.

Conclusions and Next Steps

The work presented here shows that we are on the right way of gathering best practices related to microbiomes in food production systems. Next steps are related to:

- Conditioning and integration of obtained products with fertilizers for validation in pot trials and in field.
- Develop and optimise extraction processes with high efficiency for the production of 2 phenolic extracts from wheat residues and/or other botanical extracts.



Methodology and Results

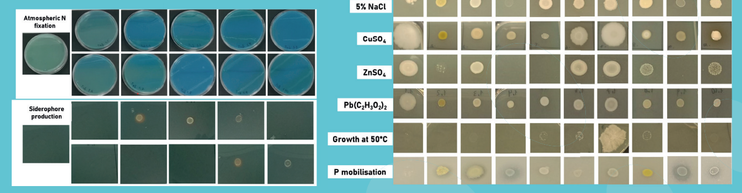
Circularity and sustainable practices

- Isolation of specific microorganisms with PGP activity as wheat modulators
- Enzymatic hydrolysis of wheat residues to release 2G sugars
- Use of wheat hydrolysates as fermentation medium for the microbial modulators. Process development and scaling-up

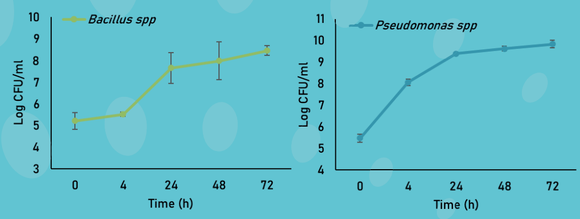
Microbial isolation & evaluation of Plant Growth Promoting (PGP) activities

From the 154 isolates, 122 were selected to screen PGP activities according to their biosafety (BSL1)

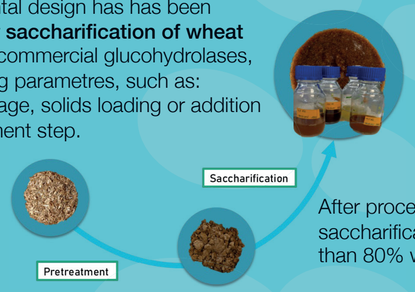
- Nitrogen fixation: 77 %
- Phosphorous mobilisation: 63 %
- Siderophores production: 63 %



2 PGP microorganisms have been selected for optimisation of microbial culture: Pseudomonas sp and Bacillus sp. Both microorganisms show high cell viability in growth-kinetic studies when cultured in LB medium:



An experimental design has has been performed for **saccharification of wheat straw**, using commercial glucohydrolases, and optimizing parametres, such as: enzymes dosage, solids loading or addition of a pretreatment step.



After process optimization, saccharification yields higher than 80% were reached.

Ongoing experimental sets:

- Evaluation of additional PGP properties: indol, organic acid and plant hormones production, as well as ACC deaminase activity.
- Optimisation of microbial growth conditions from 2G-sugars derived from wheat residues at lab scale.
- Scaling-up of the selected bioprocesses, obtaining the required amounts of modulators for conditioning and validation.

TRIBIOME

Advanced tools for integration and synergistic inTeRconnectIon of microBIOMEs in resilient food systems

This project received funding from the Horizon Europe research and innovation programme under grant agreement N° 101084485

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