An Emerging Biosynthetic pathway in Hairy root Culture

Dr. Anna M.K[1] Dr. Vimala. K.S[2] Dr. Raiby P Paul[3] Dr. Priyalatha. B[4] Dr.Priya. S[5]
[1]Final year PG Scholar,[2]Professor,[3]Associate Professor,[4]Associate Professor,[5]Professor&HOD
Department of Dravyaguna Vigyana, Amrita School of Ayurveda, Amritapuri
Amrita Vishwa Vidyapeetham, India

Abstract

- Large scale plant multiplication-->plant propagation→disease elimination→plant improvement and production of secondary metabolites.
- Hairy root cultures- investigated for several decades for their potential to produce valuable metabolites-viable alternative approach to produce target compounds in certain medicinal plants.
- Hairy roots grow faster than the adventitious roots, or even conventional plant cultures and accumulate higher levels of significant chemical compounds compared with adventitious roots.
- Metabolic engineering of target compounds from medicinal plants has been achieved through the introduction of new genes or pathways such as 'omics, CRISPR/Cas9, and synthetic biology. which are simple as well as less expensive.

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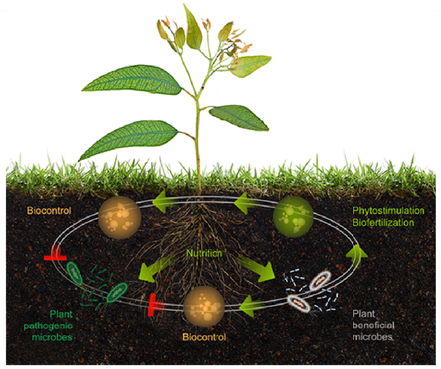
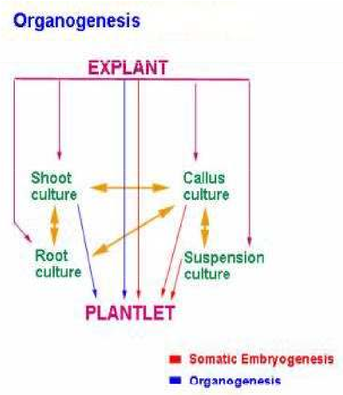
- Once it unveils its potential for commercialization it can be extended to the medical and pharmaceutical industries.

Keywords: Hairy root Cultures, Omics, CRISPR/Cas9, Synthetic Biology

Introduction

- "Hairy root" systems, obtained by transforming plant tissues with the "natural genetic engineer" Agrobacterium rhizogenes, have been known for more than three decades.
- Hairy root cultures have been obtained from more than hundreds of plant species, including several endangered medicinal plants, affording opportunities to produce important phytochemicals and proteins in eco-friendly conditions.

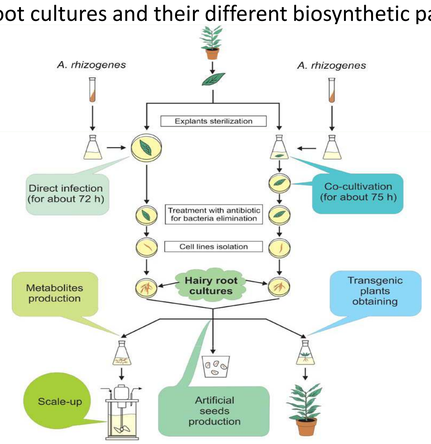




Materials and Methods

Review of articles from various databases like PubMed and Scopus.

Hairy root cultures and their different biosynthetic pathways



omics, CRISPR/Cas9, and synthetic biology

Discussion

Omics: genomics,

transcriptomics,

proteomics, and

Metabolomics

----> Identification of novel genes, pathways, and compounds.

CRISPR/Cas9:

Genome-editing tool,

Engineer various medicinal plant species

Simple and less expensive

Enzymes and pathways involved in regulating secondary metabolite production

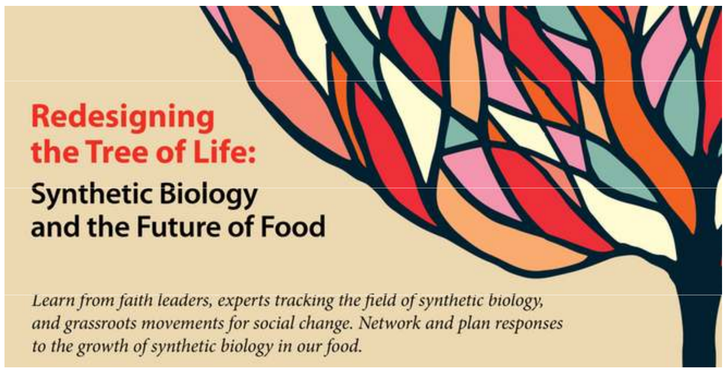
----> Yields in medicinal plants

Synthetic Biology:

Redesigning plants for functional customization

Biological pathways

Computational predictions



Results

MERITS

- No issues with pathogen and herbicide contaminants, transgene dissemination, or other environmental concerns linked with whole plant systems→ thus, GMP procedures can be readily implemented throughout the production in alleviating a number of regulatory concerns regarding plant-made pharmaceuticals.
- The possible extracellular secretion of expressed proteins.
- The cost for downstream processing could be significantly reduced.
- Hairy roots are fast growing cultures that reach large biomass volumes within a short Time.
- Due to altered auxin metabolism, hairy roots are able to grow on plant hormone-free media, thus offering another attractive advantage over suspension cell cultures.
- This technology could potentially be implemented to rare, valuable, threatened, or endemic medicinal species in an effort to preserve biodiversity.

CHALLENGES

- Several challenges remain, such as the low yields of high-value target compounds, the instability of some of the hairy roots, the toxicity of target compounds, and the need for suitable Bioreactors.
- The toxicity problem could be solved by using transporters for target compounds, in situ via adsorption, textile dye adsorption, or advanced bioreactors.
- In particular, approaches used to design bioreactors for the adventitious roots of medicinal plants could be used as guidelines for the large-scale culture of hairy roots from medicinal plants.

Conclusion

- Cost effective
- Preservation of biodiversity
- Crop improvement
- Understanding its full potential
- Faster production
- Utilization in pharmaceutical industries
- Drug discovery
- Plant biosensors

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