



5th International Electronic Conference on Medicinal Chemistry

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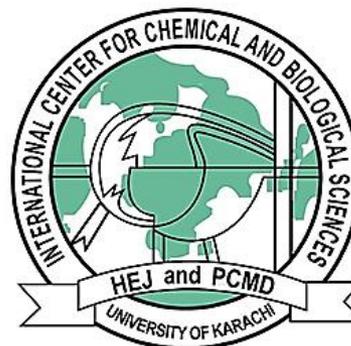
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Production of high valued medicinal compounds using plant cell tissue and organ culture

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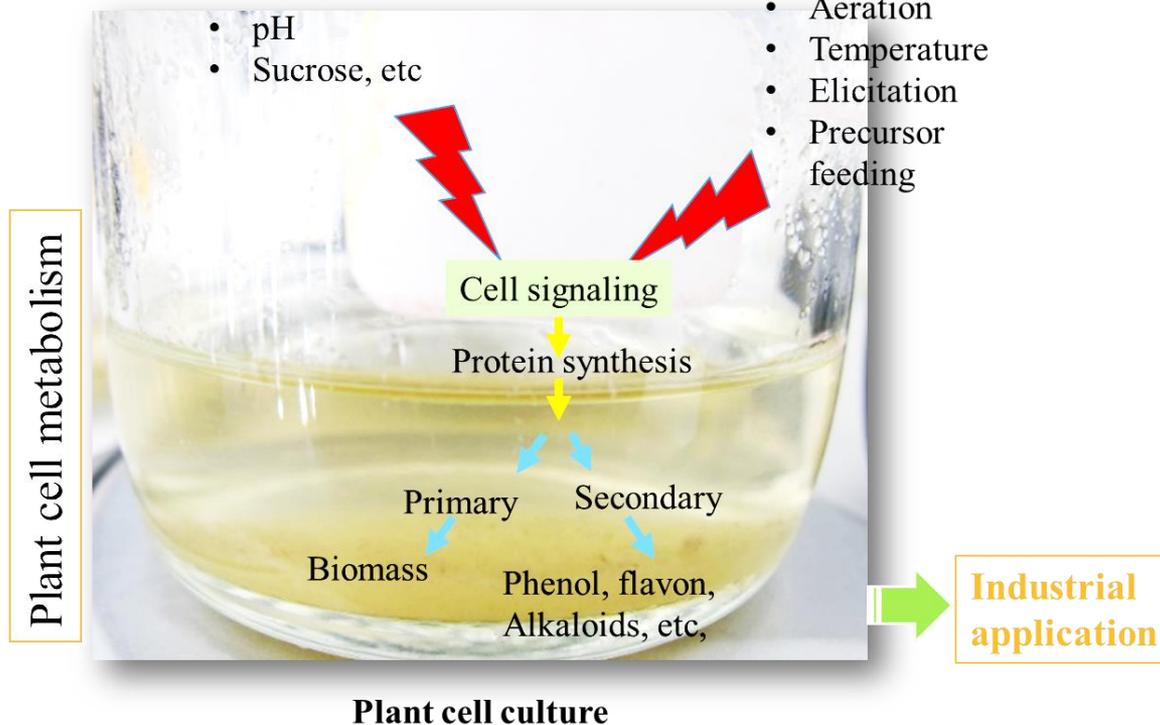


Production of high valued medicinal compounds using plant cell tissue and organ culture

Graphical Abstract

Factors regulating plant cell growth & metabolism

- Media type
- PGRs
- pH
- Sucrose, etc
- Light condition
- Aeration
- Temperature
- Elicitation
- Precursor feeding



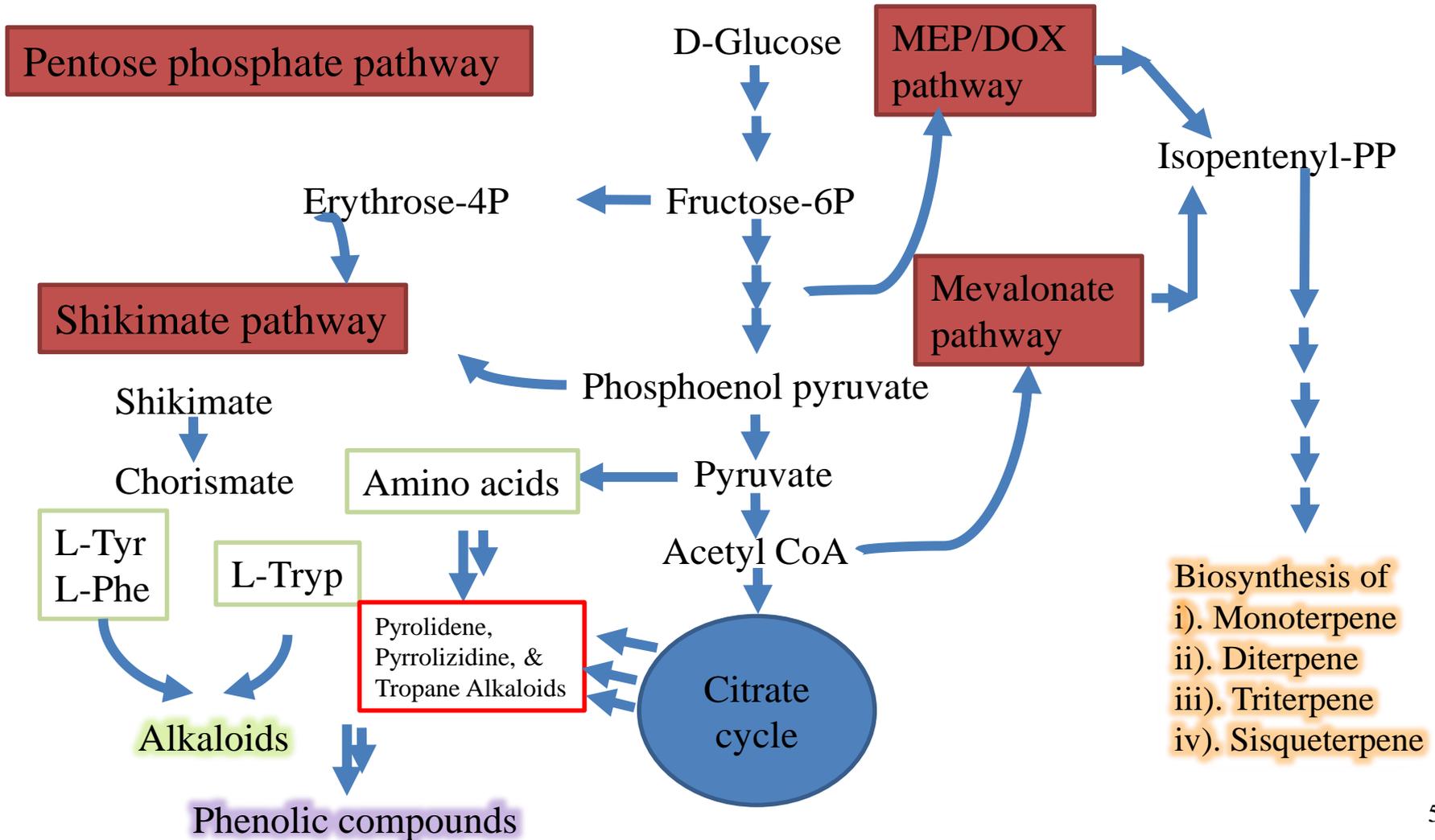
Abstract: One slide, Max 200 words

Today market demand for natural products is high and the conventional practices to get the herbs from wild nature or cultivated fields are not sufficiently efficient to meet the demand. Alternative approaches such as plant tissue organ and cell cultures (PTOC) are believed to be promising and inexpensive methods. The PTOC approach offers the opportunity to sustain the standardized natural products of uniform quality and ensures to be free of agrochemicals, toxins or other environmental pollutants. Number of studies using *in vitro* tissue culture approaches have extensively been studied and adopted for uniform and continuous supply of natural products. There are companies taking advantages of this technology, which offers the opportunity to produce medicinal compounds continuously and in a limited space rather than cultivating on hectares of land. Despite these advantages the PTOC system needs optimization and there are factors regulating plant cell machinery to process primary metabolites for the secondary metabolites (medicinal compounds) production. These factors are plant growth regulators (PGRs), substrate type and concentration, light condition, elicitors and precursors feeding. Additionally, the bioreactor design also plays important role to ensure the large scale production using plant cells and organs cultures.

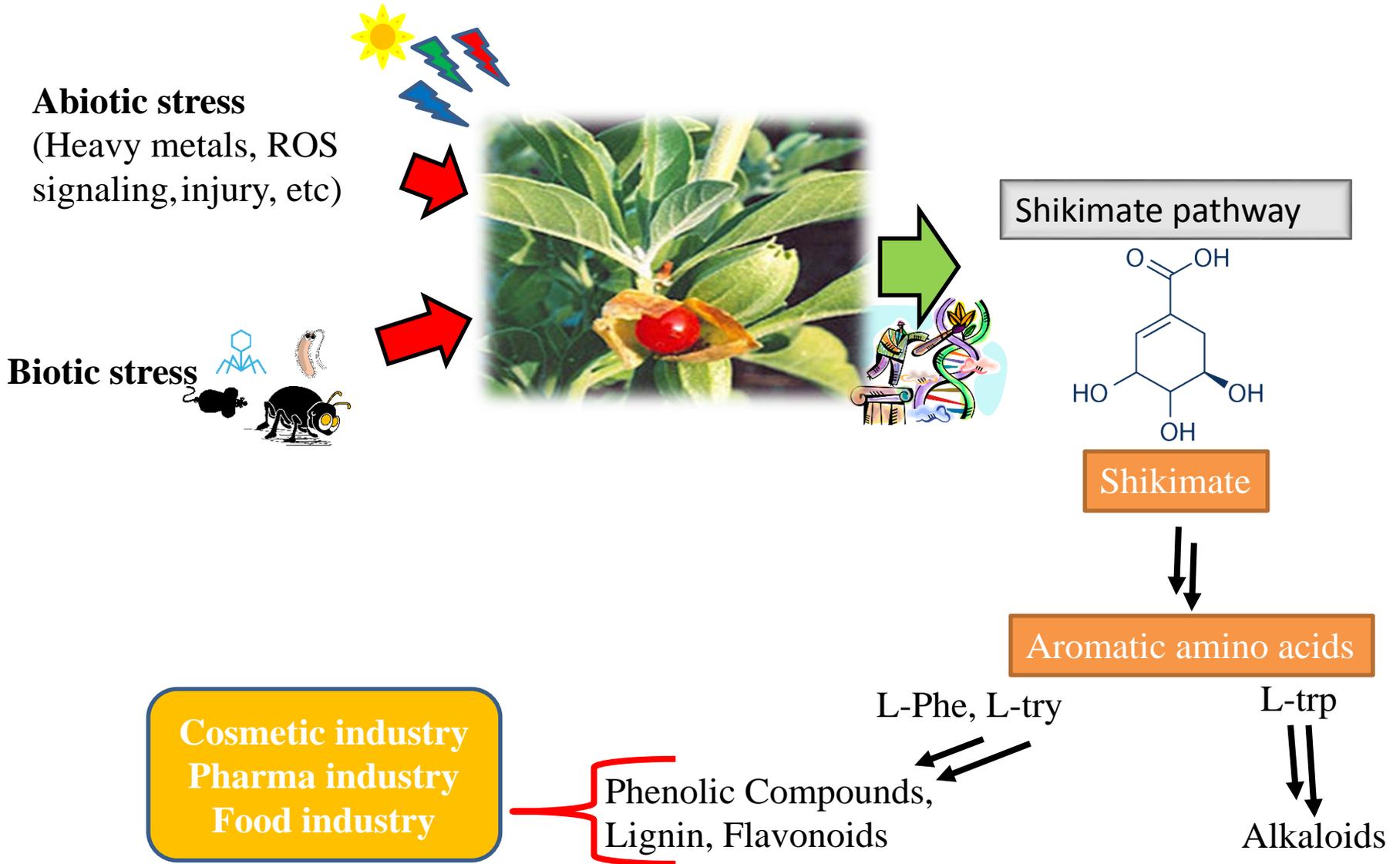
Keywords: tissue culture, metabolites, elicitors, bioreactor, natural products



Plant cell biosynthesis machinery



Shikimate leads to 100s compounds



Problems in medicinal plants cultivation

- **Population growth** – little arable land
- Poor agronomy knowledge
- Medicinal compounds content ???
- Higher market Demand
- **Adulteration** and use of agrochemicals
- Due to **poor soil fertility**, and **costly chemical fertilizers** and **pesticides** its production is not economical or profitable to the poor farmers



Why plant tissue culture?

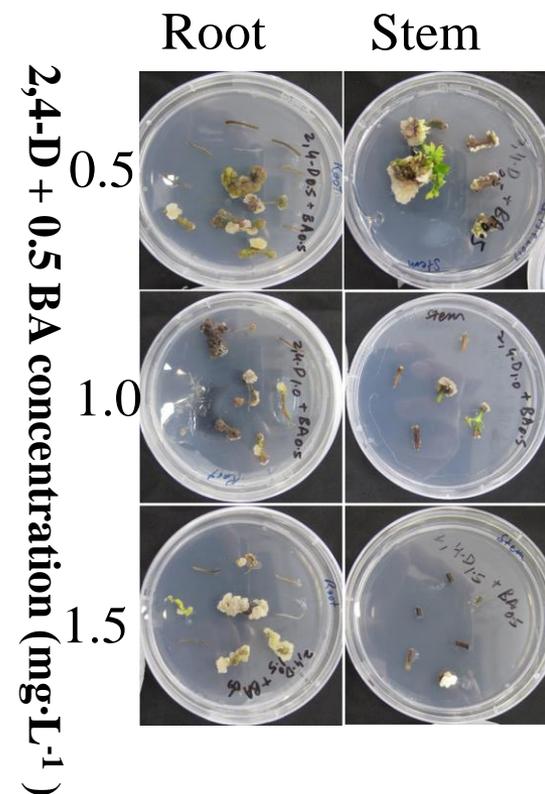
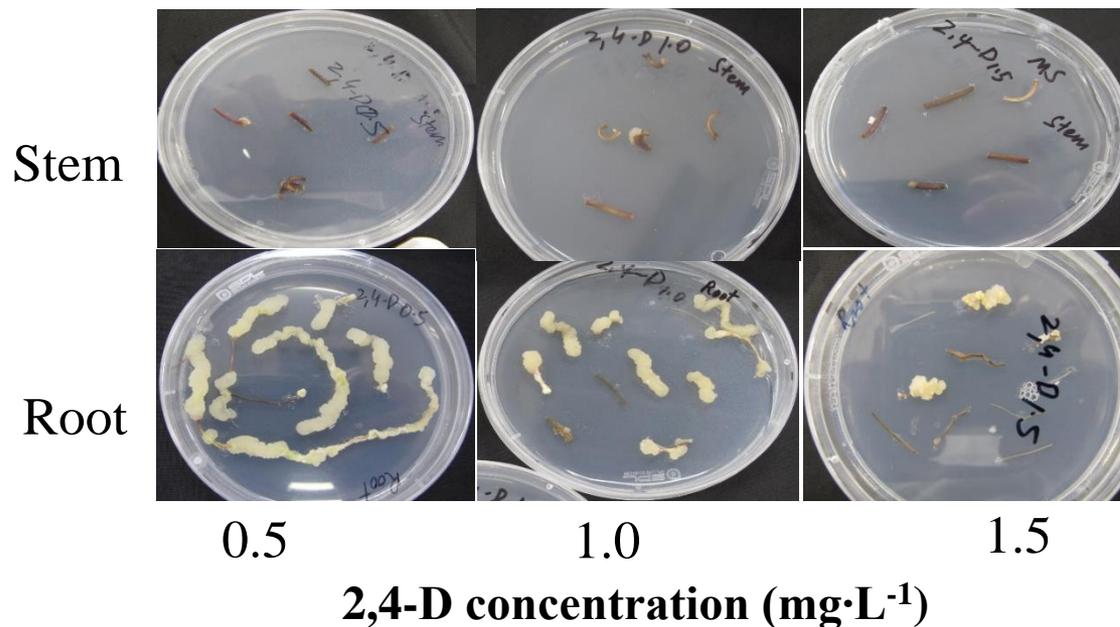
- **Continuous production systems**
- **Defined Good Manufacturing Practice (GMP) systems**
- **Higher secondary metabolites content**
- **Easy downstream processing**
- **Green factory**



Results and discussion

Selection of PGRs & explant

- Plant growth regulators (PGRs) play important role
- Explant of choice determines callus growth & secondary metabolites synthesis
- Leaf explant failed to produce callus



Adil et al (2018) Mol. Biol. Rep 6: 1919 – 1927

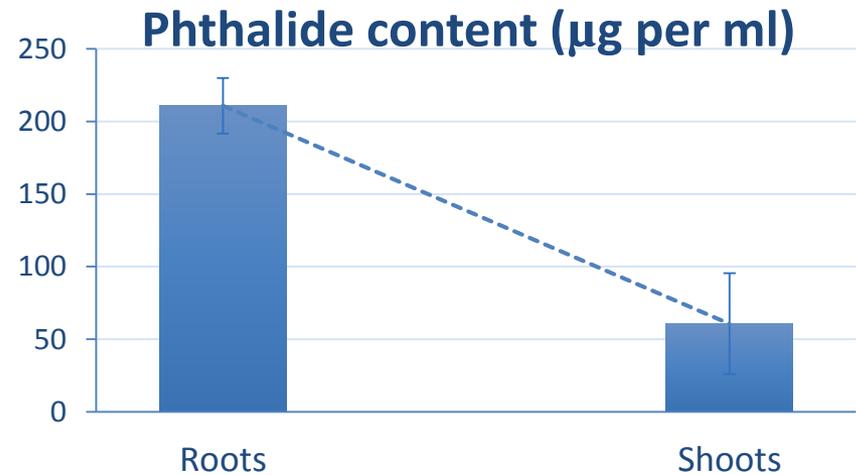
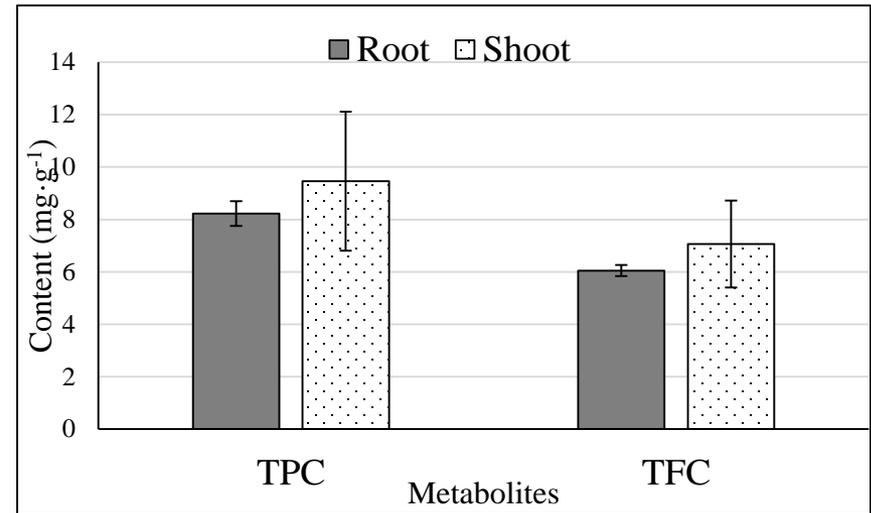


Plant secondary metabolites content varies with organ type



C. Officinale in-vitro grown plant

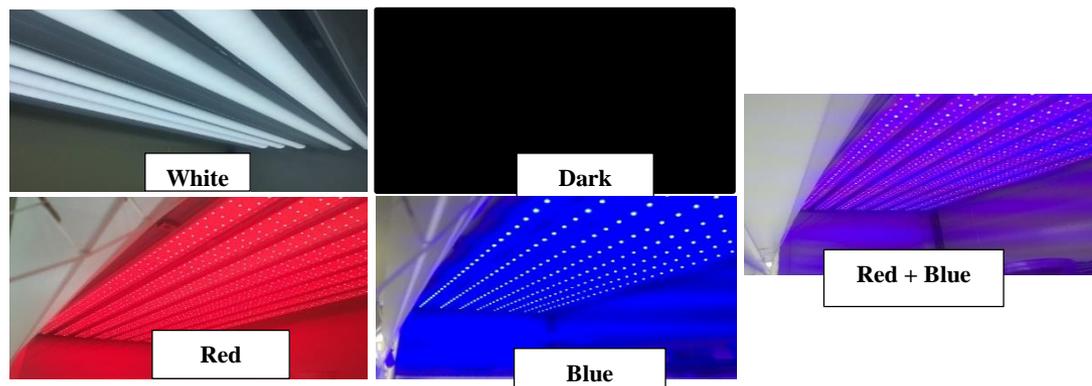
“Genes encoding biosynthetic enzymes or genes encoding regulatory proteins are expressed differentially in different parts of the plants.”



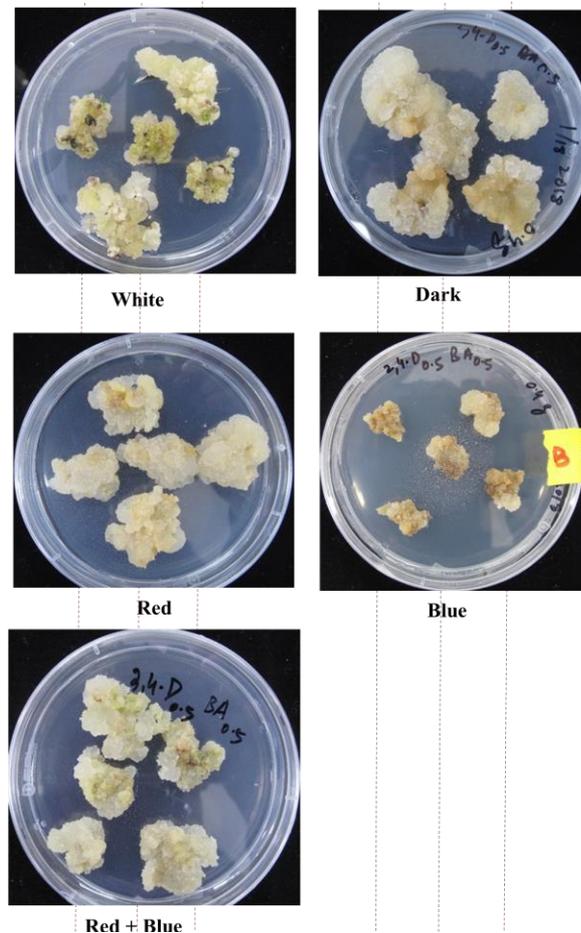
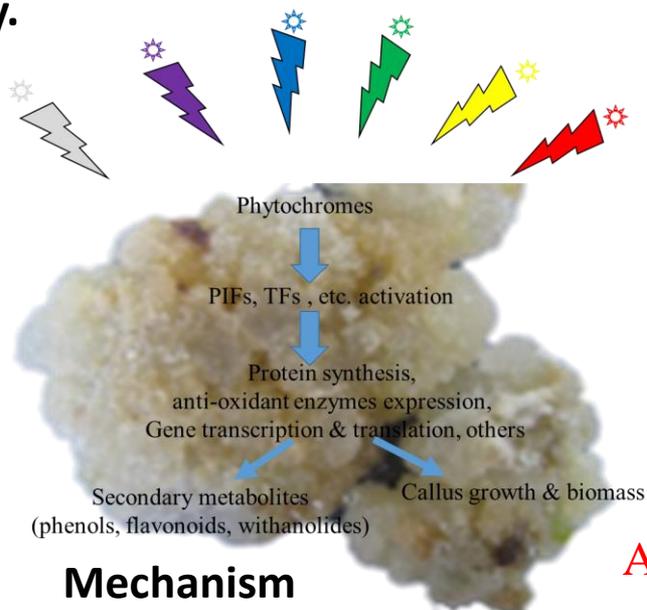
Adil et al (2018) Mol. Biol. Rep 6: 1919 – 1927



Light wavelength effect growth & secondary metabolism



Various light wavelength treatments used in the study.



Morphology of *Cnidium officinale* callus

Adil et al (2019) J. Photochem. Photobiol. B 196:111509



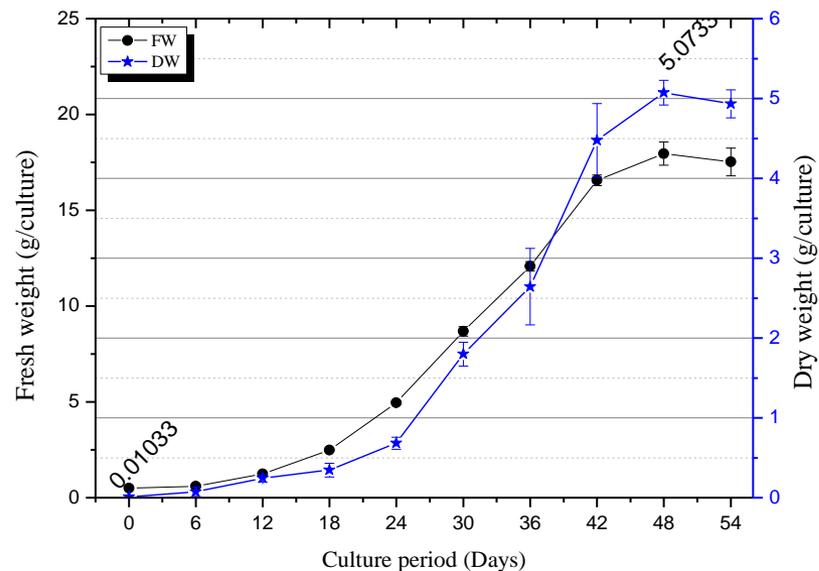
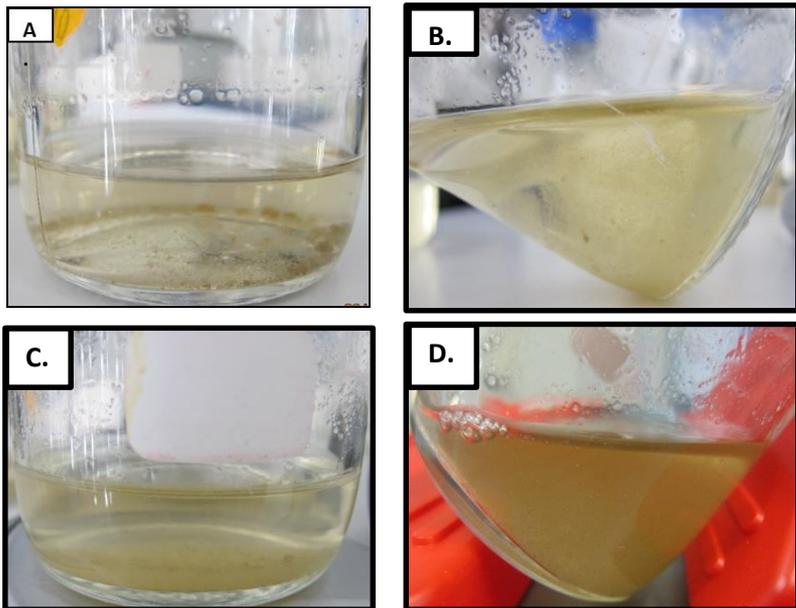
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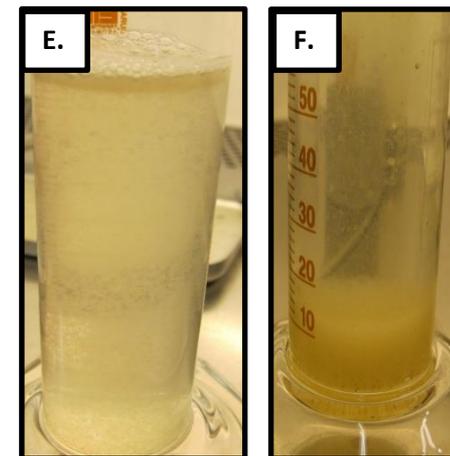
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Plant cell culture



Cell culture growth kinetics

Cell culture growth phases, lag (A.), log (B.), Stationary (C.), & Death phases (D.). The cell suspended (E.) & compact cell volume (F.).

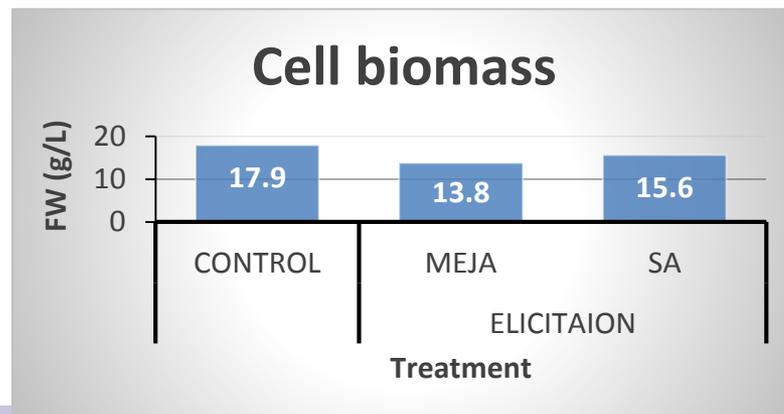
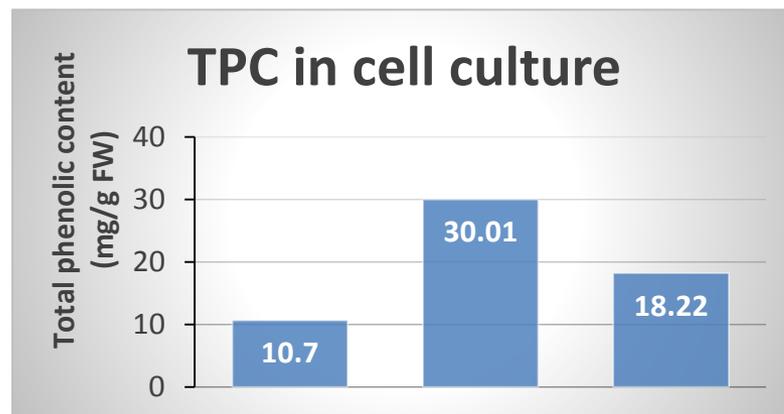
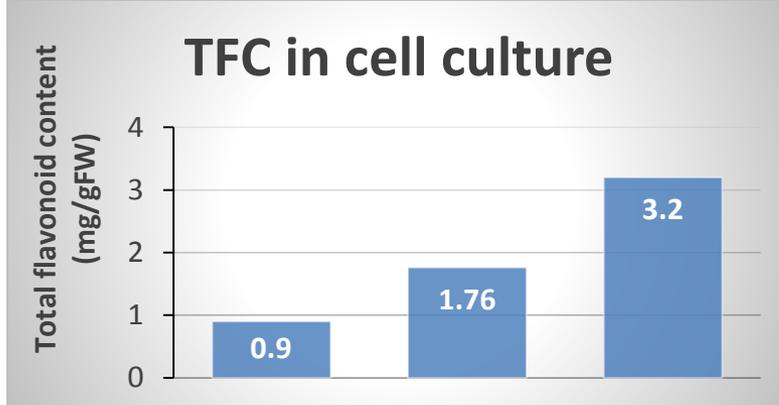


These stages are important to be studied & helpful to determine the time frame of cells growth in suspension.

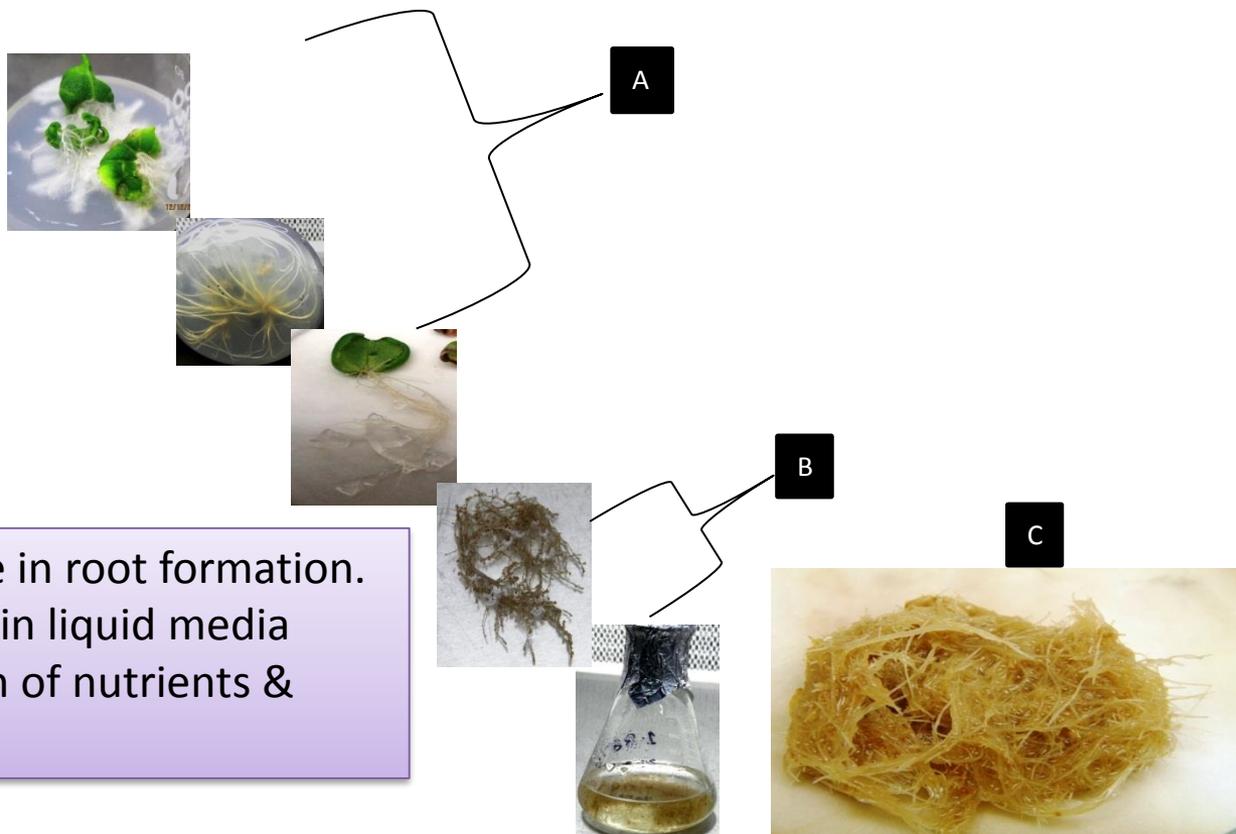


Elicitation: a strategy to increase secondary metabolites yield

In cell cultures both biomass & secondary metabolites are of importance.



Adventitious root culture



- Auxin plays important role in root formation.
- Maintaining roots growth in liquid media needs proper optimization of nutrients & PGRs concentration

Cotyledon explant of *B. oleracea* var. *acephala*. **(A)** Induction and elongation of adventitious roots from cotyledon explant **(B)** AR suspension culture **(C)** Maximum biomass obtain in shake flask.



Conclusions

Need to establish in-vitro cultures

- Callus cultures – **cell suspension**
- Organs culture – **adventitious roots culture**
- Hairy root culture

Most importantly scaling up from lab (<1000 ml) to pilot scale (1 to 100 liters)

Need innovation

- Understand biosynthetic pathways**
- Control carbon flux**
- Genetic engineering – synthetic biology**
- Bioreactor design**



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