Life Sciences and Facility Management

ICBT Institute of Chemistry and Biotechnology
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Plant cell-based bioprocessing

Summary

Plant cell and tissue cultures (Figure 1) have become an attractive production platform for secondary metabolites and recombinant proteins. They are already used to manufacture products for the food, cosmetics and pharmaceutical industries. Prominent product examples are Mibelle Biochemistry's PhytoCellTec Malus Domestica, in whose development our group was involved, or Phyton Biotech's paclitaxel. In fact, applying plant cell culture technology ensures sustainable and controllable production while competing with drawbacks which arise when plants are grown in the field.

Callus culture of *Malus domestica* — Hairy root culture of *Beta vulgaris** — Tobacco suspension cells in the UniVessel SU 2 L

Figure 1: Examples of plant cell and tissue cultures used in our lab

* Established by Milen I. Georgiev from the Bulgarian Academy of Sciences

Vision and activities

Our knowledge allows us to establish potential production cell lines as shown for plant cell suspension cell line-derived bioactive compounds for cosmetic application in Figure 2. This also includes suspension cell line screening performed in High-Throughput Systems such as the TubeSpin Bioreactor or the BioLector and long-term storage procedures for the production cell line. Improvement of cell growth and increase of the product titer are mainly achieved by medium optimization and elicitation by light or/and chemical compounds.

In addition, our bioengineering knowledge enables the selection of the most appropriate bioreactor type and bioreactor operation mode. In so doing, we take into account the product formation pattern that is either growth or non-growth associated and product secreted or intracellularily accumulated. The usage of modern bioengineering tools such as Computational Fluid Dynamics supports determining of the optimum process parameters while avoiding mass transfer limitations as well as undesired shear stress for the production cells. In other words, upstream process scale-up may be speeded up, and the number of experiments can be reduced, which shortens the product development time. It is worth mentioning that our largest bioreactors have 200 L working volume and that we are also experienced in expanding root cultures and growing embryogenic cells of plant origin in bioreactors.

In order to develop the subsequent downstream processing of the target product and to obtain the latest findings of metabolomics and molecular biology involved, we closely co-operate with in-house specialists from the Institute of Chemistry and Biotechnology, and with partners abroad such as those from the VTT Espoo, the Fraunhofer IME in Aachen, the University of Barcelona or the Technical University Dresden.

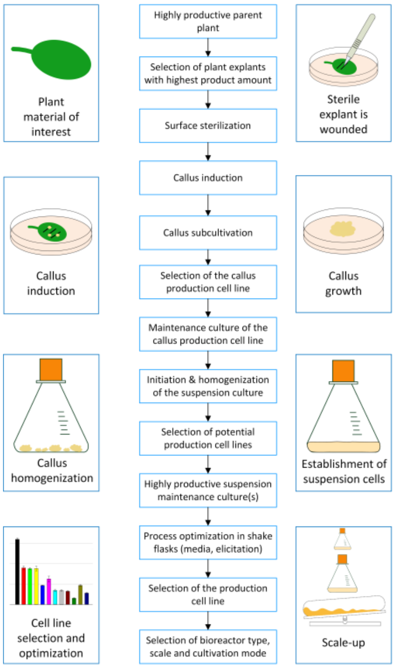

Figure 2: Process of establishing a plant cell suspension culture

Selected publications

- Methyl jasmonate enhanced production of rosmarinic acid in cell cultures of *Satureja khuzistanica* in a bioreactor. A. Khojasteh et al., *Engineering in Life Sciences*, 2016
- Suspension culture of plant cells under heterotrophic conditions. N. Imseng et al., In: Industrial scale suspension culture, *Wiley Blackwell*, 2014
- Hosting the plant cells *in vitro*: recent trends in bioreactors. M. Georgiev et al., *Applied Microbiology and Biotechnology*, 2013
- Disposable bioreactors for plant liquid cultures at Litre-scale. R. Eibl et al., *Engineering in Life Sciences*, 2009

Collaboration opportunities

We have carried out and are carrying out projects in cooperation with various well-known companies such as Nestlé, Givaudan, Phyton Biotech and Mibelle Biochemistry. We were also involved in EU projects (e.g. Smartcell/Green Factory and ComoFarm).

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