

Biotechnological and chemo diversity approaches of Plant secondary metabolites

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Abstract

Plant secondary metabolites are evaluated as strong potential for biotechnological applications. Plants are well known of arsenal chemical defense against pathogens, herbivores and pests. These active compounds are chemically diverse and categorized according to their structures reflecting wide spectrum of phyto-chemicals. Among the most active compounds produced by plants are: alkaloids, essential oils, flavonoids, glucosinolates and phenols. Although these compounds are used by plants in their ecological interactions, however; secondary compounds are used as major sources of alternative medicines, bio-pesticides, food additives or in cosmetic industry. These benefits can be achieved through biotechnological approaches for example plant tissue culture and genetic engineering.

Background: chemo diversity

Secondary metabolism is derived from primary metabolism. The secondary natural products play important role in the survival of the plant in its environment. They are not essential for each cell but important for the plant as whole. The human uses of plant secondary compounds include: food additives like taste, coloring, or scent); medical and pharmaceutical applications or even pesticides. The type of these compounds reflects chemical diversity within the plant kingdom ranging from terpenoids (essential oils), steroids, flavonoids and alkaloids. The sites of biosynthesis of secondary metabolites in plant cells are different from the sites of accumulation depending on the cytotoxicity effect.

Production

The intact plants in the field or wild habitats produce high value secondary metabolites. However, the quantity and the availability of these economic products from natural resources restrict their maximized uses for the benefit of the human kind. Therefore, many important economic plants are being investigated through biotechnology applications for production of valuable plant secondary compounds.

Biotechnological applications

The following applications were performed on plants to promote secondary metabolites production:

- 1) *In vitro* plant cell, tissue and organ cultures: i.e. suspension cultures.
- 2) Transgenic (via *Agrobacterium*) organ cultures of shoots and roots.
- 3) Elicitation as response to stress factors i.e. osmotic shock or microbial attack
- 4) Metabolic engineering of targeted pathways of secondary compounds.
- 5) Introducing the working genes of specific pathway to other plants or microbes.
- 6) Biomass and bioreactor scaling up.

Chemical properties & analysis

The advantage of the secondary compound reflects its importance and value. It is important to consider the following in dealing with these compounds either from natural or *in vitro* recourses:

- 1) The secondary compounds are common within the plant kingdom but some compounds are restricted to single species or plant taxa.
- 2) Many of the secondary products are toxic and hence are stored in vacuoles or trichomes. Therefore some of these compounds are considered as antibiotics.
- 3) Many secondary metabolites have signaling functions for communication i.e. with pollinators.
- 4) Secondary compounds are the promising source of pharmaceuticals in alternative medicine.

- 5) Analysis using modern analytical techniques: chromatography, electrophoresis, etc.
- 6) As a result of importance of the secondary metabolites; they have strong potential for commercial applications and have high economic value.