THE USE OF CULTURED PLANT CELLS TO PRODUCE BIOCHEMICAL THROUGH BIOTECHNOLOGY

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Highlights: **Bio-chemicals, Cultured Cell, Metabolites**

ABSTRACT

Biotechnology is the product of interaction between the science of biology and technology. This relationship between science and technology has been observed to be complex, so that not only science has influenced technology but the technology has also influenced science. Because of this complex relationship and its major impact on human- life.Biotechnology being such an important area of study. Plants are the source of a large variety of biochemical, which are metabolites of primary and secondary metabolisms. But secondary metabolites are of so much greater interest since they have impressive biological activities like antimicrobial, antibiotic, insecticides, hormonal properties and valuable pharmaceutical activities.Cultured plant cells are known to produces biochemical. The bio-chemicals obtained from plant cell cultures are comparable to those derived from intact plants in their chemical, biochemical and biological properties.

1. Introduction

Application of tissue culture to the controlled production of such compounds as alkaloids, steroids, antibodies and enzymes on a commercial scale is possible. For such production systems, cellssuspension culture is ideal. It may be recalled that penicillin and other antibiotics and some genetically engineered products are obtained through in vitro system. Tissue culture techniques are now regularly being used in commercial production of certain biochemical.

Biochemical production requires continuous in vitro culture of cells for product isolation. For this rapid clonal multiplication, haploid production etcare operations becomes essential. The plants developer though a biochemical activity should have a useful features, must be fertile, biochemical activity must be suitably linked with active and efficient plant breeding and fieldevaluation programmes in order to produce a reliable and commercially viable products

2. METHOD OF LARGE SCALE CULTURE

Commercial applications of tissue culture necessitate scaling up culture system.The strategy of scaling up depends on the physical condition of mediumagar or liquid used for cultures. Agar gelled medium is the most commonly used for experimental and some commercial activities whereas use of liquid medium in suspension culture allows easy and extensive scaling up by employing bioreactors.

No single medium can be suggested for all types of plants and organs,. Several recipes have been developed during the last few decades.

2.1*AGAR CULTURES*

Agar gelled medium is the most commonly used for experimental and some commercial activities.

1. During experimentation, culture tubes of 25-150 mm are used for culture; here scaling up can be achieved by increasing the number of culture vessels.

2. These culture tubes are usually arranged in test tube baskets or stands, which are placed on culture racks.
3. Fr scaling up 38 200 mm culture vessels and tubes and wide mouth bottles are required.
4. 2-4 pieces of tissue inoculums may be placed in a single vessel.
5. 5 half liter bottles were used of commercial micro propagation activities.

The Bio-chemicals obtained from plant cell cultures are comparable to those derived from intact plants in their chemical, biochemical and biochemical properties. In addition, cultured cells of many plant species produces novel biochemical, which have not been detected so far.

Biochemical yields from cultured plant cells can be improved by increasing cell biomass yields per unit volumeof culture and biochemical contained of the cell biomass. Increased biochemical yield reduce production costs.

3. BiochemicalsFrom Cultured Plant Cells

Cultured plant cells are known to produce bio-chemicals of interest since 1950's, but initially the yields were very low. Refined culture systems have improved the biochemical yields considerably, and over half a dozen cell cultures produce 2 g/1 or more of the biochemical (Table 8.3). Shikonin (a naphthoquinone) is produced on a commercial scale from cell cultures of Lithospermumerythrorhizon, while berberine (an alkaloid) is obtained from Coptis japonica cell cultures. Interstingly, Ginseng tissues produced in vitro are used as additives in tonic drinks, wines, soups, herbal liquours, etc. The bio-chemicals obtained from plant cell cultures are comparable to those derived from intact plants in their chemical, biochemical and biological properties. In addition, cultured cells of many plant species produce novel bio-chemicals, which have so far not been detected in whole plants. For example, cell suspention cultures of Rauwolfiaserpentina have been shown to produce 4 highly polar alkaloids, which are novel glucosides of ajmaline and its derivatives.

Biochemical yields from cultured plant cells can be improved by increasing (1) cell biomass yield per unit volume of culture and (2) biochemical content of the cell biomass. Increased biochemical yields reduce production costs.therefore they are critical to the commercialization of the process since the break-even price for a biochemical is estimated as $ 1.500/kg.

4.Biochemical Production

Plants are the source of a large variety of bio-chemicals, which are metabolites of both primary and secondary metabolisms. But secondary metabolites are of much greater interest since they have impressive biological activities like antimicrobial, antibiotic, insecticidal molluscidal, hormonal properties, and valuable pharmacological and pharmaceutical activities, and many are used as flavors, fragrances, colors, etc. The term ***secondary metabolite*** is ill-defined but convenient: it is applied to all those compounds, which are not directly involved in the primary metabolic processes, e.g., photosynthesis, respiration, protein and lipid biosyntheses, etc. Secondary metabolites include a wide variety of compounds, e.g. alkaloids, terpenoids, phenyl propanoids etc.

List of some groups of bio-chemicals obtained from plants

Group	Examples
Alkaloids	Morphine, codeine, quinine, nicotine, cocaine, hyoscyamine, etc.
Terpenoids	Menthol, camphor, carotenoids, polyterpenses (e.g., rubber), etc.
Phenylpropanoids	Anthocyanins, flavonoids, isoflavonoids, stilbenes, tannins, etc.
Quinones	Anthraquinones, benzoquinones, naphthoquinones
Steroids	Diosgenin, sterols, ferruginol

List of some pharmaceutically valuable bio-chemicals obtained from plants

Compound	Plant species	Medicinal Value
Shikonin	Lithospermumerythrorhizon	Antiseptic (also used as dye)
Berberine	Coptis japonica	Antibavterial, antinflammatory
Codeine	Papaversomniferum	Analgesic
Diosgenin	Dioscoreadeltoidea	Antifertility agents
Quinine	Cinchona	Antimalarial
Scopolamine	Daturastramonium	Antihypertensive
Vincristine	Catharanthusroseus	Antileukaemic
Taxol *	Taxus species	Breast and ovarian cancer treatment
Artmisin	Artemisia sp.	Antimalarial
Trichosanthin and karasurin **	Trichosanthes sp.	Cytotoxicity against HIV infercted cells, immunosuppressant, induces abortion

* Acts on spindle like colchicines: promotes dissolution of microtubules into tubulin molecules.

** Proteins isolated from rhizomes of the traditional Chinese medicinal plant.

5. Enhancing Biomass Yields

Virtually all high value bio-chemicals from cultured plant cells are secondary metabolites, which are usually produced in differentiated cells or organized tissues. Therefore, most such bio-chemicals are not produced by rapidly growing cell cultures, and the culture conditions favoring growth suppress biochemical production (and vice-versa). Therefore, the production strategy should consist of two distinct phases: (i) growth phase for cell biomass accumulation and, (ii) production phase for biosynthesis and accumulation of the bio-chemicals, But in at least some cases, culture growth and biochemical production occur together, e.g., barbering production in Thalictrum minus.

Biomass accumulation can be improved by using optimum culture conditions of which nutrient medium and inoculums size are particularly important. Experience with L. erythrorhizon cell cultures, which yield shikonin (the first commercial example), suggests the following. The different standard medium formulations may differ considerably in terms of culture growth; for example, L. erythrorhizon suspension cultures yielded only 6.8 g cell dry weight/l on White's medium, while the yield on LS (Linsmaier and Skoog) medium was 16.8 g/l. Further improvements in culture growth may be obtained by appropriate modifications of the most suitable standard recipe. A modification of the LS medium (called M-5 medium) resulted in a 15% improvement in cell dry weight yields from L. erythrorhizon cultures.

Biomass production can be markedly increased by the use of a larger inoculums size, to give higher initial cell density, in combination with proportionately enriched nutrient medium, e.g. twice the concentration of normal medium for a two- fold increased inoculums size, etc, Often suitable alterations in the medium composition have to be made, and fresh medium may have to be added at regular intervals for optimum biochemical/biomass yields. In case of C. japonica cell cultures, four-times the normal inoculums (combined with X4 concentration modified medium) yielded 55 g cell dry weight/l as against 14 g/l from normal inoculums combined with normal concentration of the modified medium. However, the berberine yield remained almost comstant at 3.5 g/l since the cell from higher inoculums size showed markedly lower berberine content.

6. Conclusion

Plants are the chief source of carbohydrates, e.g. starch, sugar, etc., lipids,

proteins, and chemicals. Transgenic have been shown to introduce novel branches in the biosynthetic pathways of plants and, thereby, to generate valuable products or to produce new, valuable proteins.

7. References

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