

Advanced Structured Materials

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Bioactive Natural Products for Pharmaceutical Applications

 Springer

Editors

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Chapter 1

Elicitor Signal Transduction Leading to the Production of Plant Secondary Metabolites

Supriyo Saha and Dilipkumar Pal

Abstract Plant metabolites are highly effective as medicine with a higher efficacy and lower adverse effect. Two basic metabolites are obtained from nature, namely primary metabolites and secondary metabolites. Alkaloids, glycosides, terpenoids, flavonoids are the principal secondary metabolites, and also the primary source for the drug discovery and development. Elicitors are the substances which under stress conditions induce the biosynthesis of secondary metabolites of plants. Both biotic and abiotic elicitors are used in the process. Most common secondary metabolites Ferulic acid, cinnamic acid, vanillin, coumaric acid, silymarin, affinin, hypocrellin A, steroside, menthone, piperitone, glycyrrhizic acid, colchicine, thiocolchicoside, phenolic acid, gymnemic acid, flavonoids are utilized the elicitation technique. Elicitors are two types such as: abiotic and biotic. Abiotic elicitors such as salicylic acid, methyl jasmonate, hydrogen peroxide, lanthanum, different hormones, light, gamma rays and controlled temperature are used to generate secondary metabolites of wheat grass, *Thymus vulgaris*, *Silybum marianum*, *Shiraia bambusicola*, *Ajuga bracteosa*, broccoli plant, etc. Biotic elicitors like chitosan, rhizobacteria, *Rhizobium leguminosum*, *Aspergillus tenius*, *Agrobacterium tumefaciens*, carageenan, *Streptomyces*, *Rhizopus*, dextran, yeast are used to develop or improvise secondary metabolites of Khus, *Mentha pulegium*, *Tavernia cuneifolia*, chickpea, - *Vitis vinifera*, *Rumex gmelini* Turcz, *Cupressus lusitanica*, etc. Some secondary metabolites of *Coleus aromaticus* Benth, *Rhododendron tomentosum*, *Fagonia indica*, *Rauwolfia serpentine*, *Solanum khasianum*, *Ocimum tenuiflorum*, *Stevia rebaudiana* etc. are used both abiotic and biotic elicitors.

Keywords Secondary metabolites · Abiotic elicitor · Biotic elicitor · Phenolic compounds · Silymarin · Affinin · Hypocrellin A

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1.1 Introduction

Nowadays, plants are the primary sources of food and medicine for mankind. High efficacy and lesser side effects are the main advantage of plant metabolites (Sato and Matsui 2012). Not only that, synthetic molecules carry various side and adverse effects to our body system (Hesketh et al. 2002). Natural sources contain diversified medicinal components such as alkaloids, glycosides, terpenoids, flavonoids; these are essential for maintaining the body immune system. Plants are capable of cultivating a diversified source of natural metabolites; these are important to link up the behavior of other organisms. Also, in present time exposure to air pollution, water pollution, ultraviolet ray exposure and deforestation are the most common factors to our nature and our life style. Natural sources also help to protect us from these abiotic changes (Hiroaki et al. 2012). In this situation ancient folkloric knowledge of plants and their metabolites is the primary weapon to conquer against various viruses, pathogens, bacteria and their mutant strains. Also in this era different complex structures of secondary metabolites are developed using recombinant DNA technology. As per the definition, metabolites are compounds produced by plants for essential functions (Buchanan et al. 2015); as growth and development (primary metabolites), as well as specific functions as pollinator attraction or defense mechanism. Also metabolites are organic compounds procured from enzyme-dependent chemical reactions of organisms known as metabolic pathways (Lena 2012). Nowadays there is a tremendous demand of various plant-derived products as health supplements, natural flavors, natural colors, but due to natural calamity and lesser growth of the secondary metabolites the producer does not able to fulfill the demand of the market. Plant tissue culture is one of the ways to cope with the market demand of secondary metabolites (such as alkaloids, glycosides, terpenoids, flavonoids etc.) and helps to over produce the secondary metabolites (Pichersky and Gang 2000). Actually plant tissue culture comprises of cloning, propagation, callus formation and formation of germplasm using a perfect combination of plant hormones, temperature, humidity and elicitors. Tissue culture not only helps to generate secondary metabolites but also participate in seed germination, improvement of crop quality, immobilization, biomass accumulation, micropropagation and existence of some rare plants (those are lost during evolution) (Jensen et al. 2014). Tissue culture mainly focused on shortening of biosynthetic process of plant cell, higher cell division and metabolism; these all factors cumulatively increase the growth of secondary metabolites. This chapter mainly focus on the role of elicitors on the production of secondary metabolites.