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Role of Phytochemicals in Plants: A Review

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Abstract: ***Phytochemistry is the branch of science that deals with the examination of phytochemicals produced by plants, their structural compositions and their biosynthetic pathways. Phytochemicals in plants are classified as primary and secondary metabolites. They possess variety of functions in plants and animals. Phytochemicals protect plants from various biotic and abiotic stresses and impart color to it. They possess wide range of bioactivities and possess numerous health benefits. The present review summarizes the role of various phytochemicals in plants namely amino acids, phenols, flavanoids, anthocyanins, lipids and so on.***

Keywords: ***Phytochemistry, Phytochemicals, Lipids, Flavanoids, Anthocyanins***

I. INTRODUCTION

Phytochemistry involves the investigation of phytochemicals produced by plants, their structural compositions, biosynthetic pathways, functions and mechanism of actions in the living systems [1]. The chemical substances present in plants or phytochemicals may be classified as primary and secondary metabolites based on their chemical structure and biosynthetic derivation [2]. Primary metabolites (Proteins, carbohydrates, lipids, nucleic acids) are highly analogous in their structure and are vital for metabolism, growth, development, maintenance and survival of plants[3,4,5]. Secondary metabolites (Polyphenols, flavanoids, alkaloids …) are not crucial for survival of the plants but affect the interaction of plant with its surroundings and hence ensuring the quiddity in its ecosystem [6]. Phytochemicals are distinctive to definite plants and parts of plants. They protect plants from deleterious agents such as insects and microbes, traumatic events like extreme temperature and impart color it [7]. Phytochemicals are plant substances comprising diverse bioactivities with numerous health benefits and have been utilized in conventional medicine system to treat various ailments and diseases [8].

II. ROLE OF AMINO ACIDS

In plants amino acids acts as stress reducing agents, source of nitrogen, osmolyte, precursors of hormones, proteins and other nitrogen containing compounds such as nucleic acids. Amino acids also affects root development, antioxidant metabolism, gene expression, redox- homeostasis and are signaling factors of diverse physiological progressions such as glutamate receptors [9, 10, 11]. Glycine acts as a precursor of chlorophyll whereas serine, tryptophan and valine act as precursor of auxin. Phenylalanine serves as precursors to the formation of lignin and woody tissues. Methionine stimulates ethylene synthesis; alanine provokes hormones metabolism, cold weather resistance and resistance mechanism to viruses [12].

III. ROLE OF REDUCING SUGARS

Reducing sugars play pivotal role in plants as carbon and energy transport molecules, osmotica, precursors of proteins, polysaccharides, oils and woody materials and regulates plant immune system. Sugars possess reactive oxygen spieces scavenging potential and are crucial constituents of integrated cellular redox network. In plant-microbe interaction, they act as a signal for modulation of defense genes. In fungal pathogen-plant system, sugars promote oxidative burst at a preliminary stage of infection, and stimulates synthesis of flavanoids and provoke definite pathogen related proteins by enhancing lignification of cell walls [13, 14, 15].

IV. ROLE OF PHENOLS/ POLYPHENOLS

Phenols influence various physiological processes associated with plant growth and development such as seed germination, cell division, synthesis of photosynthetic pigments, improves tolerance and adaptability of plant under trivial conditions, and also participate in defense against ultra-violet radiation or attack by pathogens. Phenols promotes nutrient uptake and mobilization of elements like calcium, potassium, magnesium, zinc , iron by means of chelation of metallic ions, improved active absorption sites and soil porosity[16,17]. The ability of polyphenols to show a discrepancy in nitrogen availability to the plants exists by means of influencing organisms affecting decomposition and specific N transformations or by complexation with proteins. Polyphenols and phenolic acids possess ability to prevent phosphate sorption and desorbed previously bound phosphate in plants [18].

V. ROLE OF FLAVANOIDS

Flavanoids in plants acts as growth regulator, combating agents, signal molecules, phytoalexins, detoxifying agents, stimulants for germination of spores, pollinator attractants, and allelochemical agents [19, 20]. Flavanoids inflect auxin activity as they are proficient inhibitors of glycoproteins that are involved in intercellular auxin movement [21]. Quercetin enhances pollen germination and hence affects plant fertility [22]. K^+ promotes synthesis of flavanoids along with phenolic acids, Anthocyanins, chlorophylls, carotenoids, lycopene and vitamins [23]. In tomato, apple and grapefruit, N content adversely influences biosynthesis of flavanoids [24]. Vacuolar flavanoids also activate stress induced morphogenesis that defends plants from unexpected injuries of diverse origins [25].

VI. ROLE OF LIPIDS

Lipids play pivotal role in plants as signaling molecules to regulate cell metabolism and energy storage compounds. In seeds of some plant speices, lipids are key form of carbon storage and comprise upto 60 % of the dry weight of the seeds. Cuticular lipids produced by epidermal cells acts as hydrophobic barrier preventing water loss and lend protection against pathogens and other environmental stresses. Plant lipids mainly include triacylglycerols, phospholipids, galactolipids and sphingolipids. [26, 27, 28]. Triacylglycerols accumulate as oils in seeds and fruits of vegetative tissues [29]. Triacylglycerol metabolism is associated with cell division and expansion, stomatal opening and membrane lipid remodeling. In reproductive tissues, they are vital for organ development and efficacious pollination [30]. Phospholipid acts as signaling molecules in numerous processes of higher plants such as root growth, pollen and vascular development, hormone effects, cell response to environmental stimuli, stomata closure, embryo development, light and sugar signal transduction [31].

VII. ROLE OF ANTHOCYANINS

In plants, anthocyanins play essential role in reproduction by attracting pollinators and seed dispersers, and protection against various biotic and abiotic stresses such as solar radiation and ultraviolet radiation, cold temperature and water stress [32, 33]. Anthocyanins assist plant in their defense against pathogenic microorganisms by acting as chemical repellants or anti—fungal, anti-viral and anti-bacterial agents [34]. Auxin and gibberellins restrain anthocyanin biosynthesis and thus retards fruit maturing. On the contrary, ethylene, jasmonic acid and abscisic acid uphold anthocyanin biosynthesis and thus improve fruit ripening [35]. In *Vernonia amygealina Del.* Potassium promotes anthocyanin and carotenoids biosynthesis at vegetative stage [36].

VIII. CONCLUSION

The present review summarizes the role of different class of phytochemicals in plants. It concludes that phytochemicals play vital role in different physiological processes of plant growth. Phytochemicals in plants are affected by mineral elements, various biotic and abiotic stress and attack by pathogens and microbes. Phytochemicals also regulate plant hormones and hence affects maturation and ripening.

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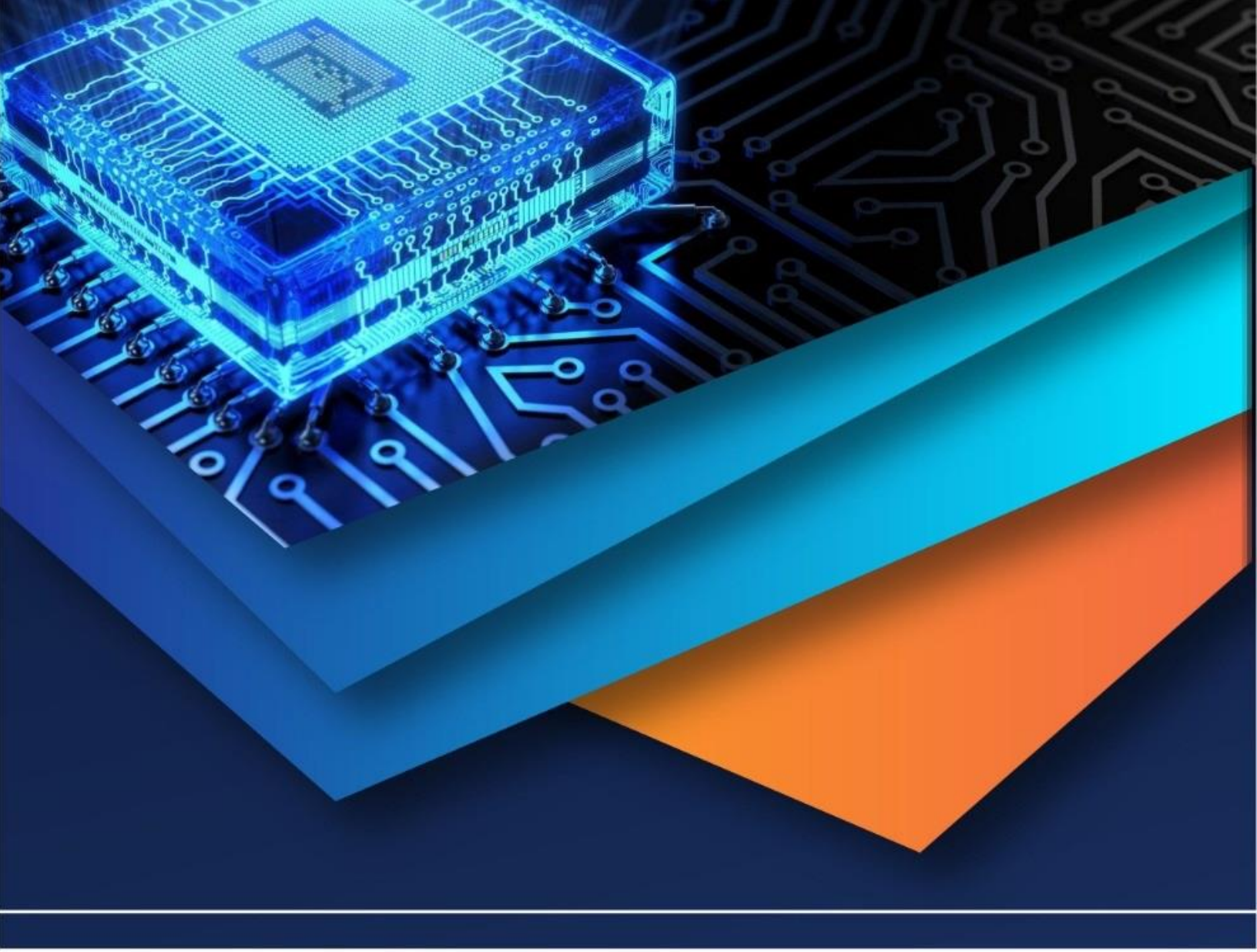

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