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Medicinal Uses of Plant Secondary Metabolites: A Short Review

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Abstract: Plant secondary metabolites are unique sources for medicines, food additives, flavours, and other commercial uses. In recent years, due to the commercial relevance of these secondary metabolites, there has been a significant deal of interest in their synthesis and in researching ways to increase their production using tissue culture technology. To produce secondary metabolites, cell culture methods were established around the end of the 1960s. Some of the most significant secondary metabolites found in plants are discussed in the present review

Keywords: Medicinal plants, Antimicrobial activity, Secondary metabolites, Flavonoids, Phenols, Quinones, Tannins

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Introduction

A plant's potential to manufacture aromatic compounds is virtually infinite, with the majority of these being phenols or their oxygen-substituted counterparts. It is believed that fewer than 10% of the total number of secondary metabolites have been isolated. It has been shown that several of these compounds are used by plants to protect themselves from microbial, insect and animal attacks (Tiwari and Rana, 2015). Other compounds, such as terpenoids, are responsible for plants' smells and pigments. Some of the same herbs and spices used by humans to season food also contain valuable therapeutic ingredients. A variety of antimicrobial phytochemicals can be

classified as suggested by Kabera *et al.* (2014). In this review, some of the most significant secondary metabolites found in plants are discussed.

Phenols:

A single phenolic ring is required for some of the most potent phytochemicals on the planet. The phenylpropane-derived chemicals cinnamic and caffeic acids are typical examples. There are two popular plants that contain caffeic acid-- Tarragon and Thyme. Microorganisms have been found to be poisoned by catechol and pyrogallol, which are both hydroxylated phenols. Catechol and

pyrogallol both have two 2OH groups (Jain *et al.*, 2019). There is evidence that the number of hydroxyl groups on the phenol group and the number of sites on the phenol group are connected to their relative toxicity to microorganisms. According to other research, higher levels of oxidised phenols are more inhibiting (Namedo, 2007).

Enzyme inhibition by oxidised substances, perhaps by reactivity with sulfhydryl groups or through nonspecific interactions with the proteins, occurs in plants with antibacterial activity. In addition to being antibacterial, essential oils that have a C3 side chain that is at a lower state of oxidation are also known as phenolic compounds. When it comes to clove oil, eugenol is a well-known representative. Antifungal and antibacterial properties of Eugenol have been established (Aftab, 2019).

Quinones:

These compounds are characterised by their aromatic rings which have two ketone replacements in them. In nature, they may be found anywhere and they have a reputation for being very reactive (Bourgau *et al.*, 2001). Colored chemicals like these are responsible for fruits and vegetables turning brown when they have been sliced or slashed, and they are an intermediary in the melanin production process in the human skin. Henna's colouring capabilities are due to its existence. In simple terms, the transition from diphenol to diketone happens via oxidation and reduction processes.

Quinones are known to form irreversible complexes with nucleophilic amino acids in proteins, resulting in the inactivation of the protein and its loss of function. Quinone antibacterial properties can therefore have a wide range of possible applications. Surface-exposed adhesion molecules, cell wall polypeptides, and membrane-bound enzymes are likely targets. Quinones may also prevent microorganisms from accessing substrates (Karuppusamy, 2009).

Flavonoids:

One carbonyl group is found on flavones, which are phenolic compounds. A flavonol is created by adding a 3-hydroxyl group. As with hydroxylated phenols, flavonoids are a C6-C3 unit connected to an aromatic ring. In light of the fact that plants produce them as a defence mechanism against microbes, their antibacterial properties should not come as a surprise. Lipophilic flavonoids may potentially disrupt bacterial membranes because of their propensity to form complexes with extracellular and soluble proteins, as well as with bacterial cell walls (Mishra, 2016).

When administered topically, alpinumiso-flavone, an isoflavone discovered in a West African bean, inhibits schistosomal infection. Apples with phloretin may have antimicrobial properties against certain bacteria. From the annual plant *Helichrysum aureonitens*, galangin (3,5,7-trihydroxyflavone) appears to be a particularly beneficial chemical, since it has demonstrated action against a wide variety of gram-positive bacteria, along with fungi and viruses (Wink, 2012).

Contradictory data make it difficult to determine flavones and flavonoids' potential mechanisms of action. When it comes to fighting germs, flavonoids without hydroxyl groups on their b-rings are more effective. In light of these findings, it is likely that the membrane is their microbiological target. As a result of this, lipophilic chemicals would be more disruptive (Cardoso *et al.*, 2019). As a result, several researchers have observed that hydroxylation increases antibacterial action. A similar result was seen for simple phenolics. It is reasonable to conclude that the degree of hydroxylation and toxicity of microorganisms cannot be accurately predicted.

Tannins:

'Tannin' refers to a category of polymeric phenolic compounds capable of tanning leather or precipitating gelatin from solution, a characteristic known as astringency'. From 500 to 3,000

molecular weights are present in nearly every plant part: bark, wood, leaves. Plants can produce tannins by combining flavanoid derivatives that have been transferred to their woody tissues. A polymerization of quinone units may also produce tannins (Hussein and Anssary, 2019; Twilley *et al.*, 2020).

Over the past several years, tannins have been the focus of a lot of research since it has been proposed that drinking tannin-containing drinks, such as green tea and red wine, can heal or prevent a number of ailments.

In humans, tannins are responsible for several physiological functions, including the activation of phagocytic cells, host-mediated tumour activity, and a variety of anti-infective effects. Hydrogen bonding and hydrophobic effects, as well as the creation of covalent bonds, are some of their chemical activities. They may be able to inactivate microbial adhesins, enzymes, cell envelope transport proteins, etc. Polysaccharide is also a component of their structure. Antimicrobial relevance of this action has yet to be investigated by the scientific community. Also, low tannin concentrations alter the shape of the germ tubes of *Crinipellis perniciosa* (Julsing *et al.*, 2006).

Conclusion

A plant's secondary metabolism produces secondary metabolites, which are valuable natural compounds. When plants develop, the cells undergo morphological differentiation and maturation, which leads to the synthesis of certain secondary metabolites. Compared to non-differentiated or less differentiated tissues, differentiated tissues produce much more secondary metabolites *in vitro*. Plant cultures are particularly beneficial when dealing with tough or expensive plants, and selecting cell lines for large yields of secondary metabolites will be simple with these metabolites. In addition to these examples, plant metabolic engineering is a rapidly growing study topic. In unstructured callus or suspension cultures, advanced research has

produced a wide range of important secondary phytochemicals; in other situations, production needs highly specialised micro plant or organ cultures.

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