Drug Invention Today
ISSN: 0975-7619
Review Article
www.ditonline.info

Endophytes: Natural Warehouse of Bioactive Compounds

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Endophytes are microorganisms that reside asymptomatically in the tissues of higher plants and reported to be promising source of bioactive compounds. Bioactive compounds discovery is a multidisciplinary endeavor that includes the search for new pharmaceuticals from various sources. Endophytes secrete structurally diversified bioactive compounds as secondary metabolite via fermentation process and can be inexhaustible and sustainable resource. Perusal of studies reported so far envisioned that endophytes forms ware house of biologically active compounds. Modern technologies have opened new avenue on endophytic research for highly sustainable and economically feasible novel natural products which are presumed to push forward the frontiers of drug discovery. The present review has compiled reports of diverse class of valuable secondary metabolites produced by endophytes of pharmaceutical importance.

Key words: Endophytes, bioactive compounds, Pharmaceuticals

INTRODUCTION

Pharmaceutical biology perceives plants as 'bio-factories' of potentially valuable therapeutic compounds. But slow growing rate and harvesting of rare endangered species pose a risk and imbalance in the biodiversity of plants. Therefore, alternative sources are outmost essential since organic synthesis are not yet economically feasible and high cost makes it unavailable to people in the under developed countries of the world. In plants thriving communities of microbes do exist as their co-partner. The diversity of microorganism with which plants co-exist can bring both plague and benefit. However, parasitic and symbiotic associations are merely the two extreme outcomes of a continuum of inter organismal interactions. Remarkably little is understood about plant-microbe interplay that is, at first glance, symptomless. Complex communities of poorly studied plant-associated microbes could insight an untapped reservoir of natural products bearing pharmaceutical potential. The more we understand the mechanism of plants tame, thwart and succumb with microorganisms and *vice versa*, the more likely we will be able to extract new resources of potentially novel therapeutic agents.

As the research on plant-microbe interaction upsurge, chemical diversity bearing pharmaceutical potential reached beyond the plant kingdom and offered an expended view promising to transform glimpses of reductionist research of the past years to snapshots of an exuberant world of systems biology by microbial source which forms a huge diversity in nature and is one of the largest unexplored reservoirs forming a **"ware house of natural bioactive compounds on the earth"**. Hence this has generated more attention and interest over other source such as plant due to various drawbacks [1].

Interest in the exploration of microbial diversity has been spurred by the fact that microbes are essential for sustainable and development of bioactive compounds. If a microbial source of the drug would be available, it would reduce the price for the drug would then be reduced, since it would conceivably be produced via fermentation [2].

Associations between plants and microorganisms is said to be versatile and is very complex subject, plants are constantly association. However over the years a great deal of scientific attention has been attributed towards plants as it harbor untold number of microbes known as endophytes and epiphytes. Among which endophytic plethora in habitat a unique niches in host and are known to produce novel bioactive compounds of pharmaceutical importance.

Starting with the disambiguation of the very definition of endophytes, it gives account of their impact on their applications. Further, it focuses on the nature of the interactions between endophytes and their plant host. Endophytic microorganisms reside in the living tissues of the host plant and do so in a variety of relationships ranging from symbiotic to pathogenic and are found to be in virtually every plant on earth. Endophytes may contribute to their host plant by producing a plethora of substances that provide protection and ultimately survival value to the plant [3].Recently Rodriguez *et al*., 2008 has classified endophytes based on their role and site at which it has been isolated from plant material and have reported four classes of endophytes which are listed below.

Class 1 endophytes frequently increase plant biomass, confer drought tolerance, and produce chemicals that are toxic to animals and decrease herbivory.

Class 2 endophytes may grow in both above- and below-ground tissues. These class 2 endophytes have their ability to confer habitat-specific stress tolerance to host. Endophyte-conferred fitness benefits are defined here as habitat-adapted if the benefits are a result of habitat-specific selective pressures such as pH, temperature and salinity; or as non habitat-adapted if the benefits are common among endophytes regardless of habitat.

Class 3 endophytes are distinguished on the basis of their occurrence primarily or exclusively in above-ground tissues; horizontal transmission; the formation of highly localized. These class of endophytes include the hyperdiverse endophytic fungi associated with leaves of tropical trees as well as the highly diverse associates of above-ground tissues of nonvascular plants, seedless vascular plants, conifers, and

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Received 15-09-2012; **Accepted** 06-11-2012