

Communal diversity of Endophytic fungi among various Medicinal Plants

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Abstract: Medicinal plants have been traditionally utilized by marginalized communities for curing a broad range of health conditions. In traditional medicine, a range of well-being issues are addressed by utilizing different tissues from medicinal plants. Each tissue of these medicinal plants produces variety of secondary metabolites with pharmacological effects. These tissues also harbour many endophytes that stimulates the growth and secondary metabolite production by the plants. The medicinal plants namely *Andrographis paniculata*, *Abutilon indicum*, *Ipomea lacunose*, *Aegle marmelos*, *Ocimum*, *Withania somnifera*, *Tinospora* are some of the important medicinal plants with a variety of applications like anticancer properties, immunomodulatory effects, anti-hepatotoxic qualities, anti-atherosclerotic attributes, anti-hyperglycemic potential, and antioxidative activities, anti-hyperglycemic potential, anti-convulsant activity and larvicidal activities. These medicinal plants have demonstrated the existence of promising endophytic strains with potential applications for enhancing crop growth and addressing oxidative stress. This study aims to uncover the diversity of endophytes residing within these medicinal plants

Keywords: Endophytic fungi, Medicinal plants, bioactive compounds, Microbial diversity.

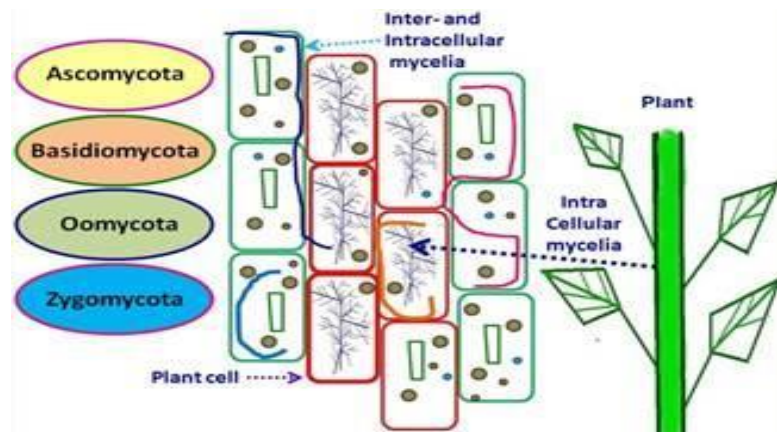
1. INTRODUCTION

Medicinal plants have diverse uses to human beings. Medicinal plants are been used from a number of years to treat wellbeing issues and to treat illness including epidemics. People had the basic information of medicinal values and illnesses curing properties of medicinal plants from a period of past time. (Sharma et al., 2020)^[1] Numerous chemically derived antibiotics are used to treat a no. of microbial disease. It develops a wide range of antibiotic resistance among the microorganisms. Concerns for the use of plant based medicines in treating microbial diseases are increasing.

These days, many medicinal plants are becoming scarce. Therefore, it is very essential to point out the interactions between endophytic fungi and the host plant, because they are able to produce highly diverse compounds, including those from host plants that have important biological activities. Endophytes offer plethora of unknown advantages to the host with enormous applications in agriculture and medicine. [K.Clay, J.Holay 2005]^[2] Recently, challenging hypotheses related to endophyte diversity, [L.Linnakoski, S.Puhakka 2012]^[3] their role in oxidative stress protection [J.F.White, Ms Torres]^[4], heavy metal tolerance, and as components of tropical community ecology [A.E.Arnold]^[5], have emerged. This study aims on the isolation and identification fungal diversity of some important medicinal plants.

2. ENDOPHYTIC FUNGI AND THEIR RELATIONSHIP WITH MEDICINAL PLANTS

"Endophytic fungi" are part of a group of microorganisms that dwell within plant tissues for either the complete or a portion of their life cycle, forming a symbiotic relationship with their host plants. Remarkably, they do so without inflicting any detrimental effects or diseases upon the plant.

Fig-2: Classification of endophytic fungi and existence in plant cell

Reviewing the literature from the past several decades reveals a substantial number of ethnomedicinal plant species with a rich history of medicinal use. These plants, often sourced from diverse ecological niches, are known to host potential endophytic microorganisms (Strobel and Daisy, 2003). Researches have unveiled the widespread presence of these fungi, with an estimated 1 million species of endophytic fungi residing within plants [6] and even lichen [7]. Endophytic fungi constitute a significant and quantifiable component of fungal biodiversity, exerting discernible impacts on plant communities, their diversity, and overall structure [7]. It's worth noting that, to date, only around 100,000 fungal species have been formally described, whereas a more conservative estimate suggests there may be as many as 1.5 million fungal species. Recent investigations into endophytic fungi from tropical and temperate forests corroborate these high estimates of species diversity [8].

3. EFFECT OF ENDOPHYTE ON PLANTS

Enhancing plant growth, stimulating systemic resistance, bolstering stress tolerance, managing insect and nematode populations, generating secondary metabolites and siderophores, and combating microbial diseases through antagonistic interactions represent key facets of these microbial activities.

Endophytes remain a largely unexplored reservoir of secondary metabolites with potential applications in the development of novel compounds for the benefit of human health and agriculture. The investigation into the dynamic relationship between plants and endophytic fungi promises to illuminate the ecological and evolutionary intricacies of both these organisms. This exploration encompasses the evolution of the symbiotic relationship between endophytes and plants, as well as the ecological factors influencing the nature and intensity of the interaction between these endophytes and their host plants. Consequently, the primary objective of this study is to identify the specific fungal endophytes associated with a variety of medicinal plants.

4. SOME MEDICINAL PLANTS AND THEIR MEDICINAL IMPORTANCE

4.1.1 *Andrographis paniculata*

Family: **Acanthaceae**

Synonym: *Justicia paniculata* Burm.f

Common name: **Green chireta,**

Telugu name: Nelavembu

The species is widespread across tropical Asian countries and is commonly encountered in diverse habitats, including plains, hillsides, coastlines, as well as in disturbed and cultivated areas like roadsides and farms. Native populations of *A. paniculata* are predominantly found in South India and Sri Lanka, possibly indicating the species' center of origin and its rich diversity.

In terms of medicinal significance, *A. paniculata* is valued for its various health benefits, which encompass its anticancer properties, immunomodulatory effects, anti-hepatotoxic qualities, anti-atherosclerotic attributes, anti-hyperglycemic potential, and antioxidative activities.

Table 1: Endophytic fungal diversity of *Andrographis paniculate*

S.no	Identified isolates
1	<i>Aspergillus niger</i>
2	<i>Aspergillus flavus</i>
3	<i>Curvularia chonburiensis</i>
4	<i>Nodulisporium</i>
5	<i>Alternaria alternate</i>
6	<i>Rhizopus oryzae</i>
7	<i>Aspergillus tubigenesis</i>
8	<i>Xylaria</i>
9	<i>Hypoxyton</i>

4.1.2. *Aeglemarmelos*

Family: Rutaceae

Synonym: *Belou marmelos* (L.) A.LyonsCommon name: **Bael**

Telugu name: Maredu

This tree species is indigenous to the Indian subcontinent and Southeast Asia, and it can be found in India, Pakistan, Bangladesh, Sri Lanka, and Nepal where it has become naturalized. Both Hindus and Buddhists hold this tree in high regard as a sacred species.

In terms of its medicinal significance, this tree is recognized for its wide-ranging health benefits, including anti-inflammatory properties, lipid-lowering effects, analgesic qualities, antioxidant and antibacterial actions, anti-hyperglycemic potential, anti-convulsant activity, larvicidal properties, and ant oxidative activities.

Table 2: Endophytic fungal diversity of *Aegle mermelos*

S.no	Identified isolates
1	<i>C.australiensis</i>
2	<i>Al.citrimacularis</i>
3	<i>Al.alternata,</i>
4	<i>Cladosporiumcladosporioides</i>
5	<i>As. nigerAspergillus flavus</i>
6	<i>Xylariapsidii</i>
7	<i>Barriopsispecies</i>
8	<i>Sphaeropsispecies</i>
9	<i>Fusariumsps</i>
1	<i>Lasiodiplodiasps</i>
2	<i>Aureobasidiumsp</i>
3	<i>stenella</i>
4	<i>nigrosporium</i>
5	<i>Curvularia</i>
6	<i>Drechslera sp</i>
7	<i>Rhizoctonia sp</i>
8	<i>Curvulariaaustraliensis</i>
9	<i>Al. citrimacularis</i>

4.1.3. *Barleriaprionitis*

Family: Acanthaceae

Synonym: *Barleriaechinata* _

Common name: Porcupine flower

Telugu name: *Saireyaka, Mullagorintha*

Confined to the western regions of India, encompassing coastal and subcoastal areas, the Himalayan foothills, and eastern Punjab, as well as southeastern Pakistan, the subspecies *Barleriaprionitis* subsp. *pubiflora* exhibits a significantly more restricted native range.

Its medicinal significance extends to its anti-fungal properties, use in alleviating toothache, addressing joint pains, and promoting wound healing.

Table 3: Endophytic fungal diversity of *Barleriaprionitis*

S.no	Identified isolates
1	<i>Aspergillus niger</i>
2	<i>Aspergillus flavus</i>
3	<i>Curvularia lunata</i>
4	<i>Trichoderma</i>
5	<i>Alternaria alternate</i>
6	<i>Rhizopus oryzae</i>

4.1.4. *Abutilon indicum*

Family: Malvaceae

Synonym: *Guilandina moringa* L

Common name: **Country mallow,**

Telugu name: "Duvvenabenda"

The species is distributed across several tropical and subtropical regions, with one notable occurrence found on the Barrier Reef islands of the Coral Sea.[4]

In terms of medicinal significance, this species is renowned for its diverse health benefits, including anti-inflammatory properties, lipid-lowering effects, analgesic

Table 4: Endophytic fungal diversity of *Abutilon indicum*

S No	IDENTIFIED ISOLATES
1	<i>Rhizopus delemere</i>
2	<i>Aspergillus fumigates</i>

4.15 *Moringa oleifera*

Family: Moringaceae

Synonym: *Sida indica*

Common name: **horse radish tree, drumstick tree**

Telugu name: *Munagakaya*

The origin of the plant is traceable to sub-Himalayan tracts of India, Pakistan, Bangladesh and Afghanistan (Fahey, 2005). It is known as a 'miracle tree', because all the parts of the tree have multi-uses, including being used as a functional food (medicinal and nutritious) (Ashfaq et al., 2012). Medicinally, it is reported that it can cure more than 100 diseases (Anwar et al., 2007, Ganguly, 2013) treating myriads of ailments and diseases including body pains and weakness, fever, asthma, cough, blood pressure, arthritis, diabetes, epilepsy, wound, and skin infection.

Table 5: Endophytic fungal diversity of *Moringa oleifera*

S No	IDENTIFIED ISOLATES
1	<i>Aspergillus fumigates</i>
2	<i>Chaetomium globosum</i>

4.1.6 *Catharanthus roseus*

Family: Apocynaceae

Synonym: *Vinca rosea*, *Acokanthera rosea*,

Common name: Madagascar periwinkle, Old Maid

Telugu name: Billa Ganneru

It is native to the Indian Ocean Island of Madagascar. It is now common in many tropical and subtropical regions worldwide, including the Southern United states.

It shows the medicinal properties like anti dysenteric, anti haemorrhagic, diuretic, sedative, antiviral activities., and wound healing

Table 6: Endophytic fungal diversity of *Catharanthus roseus*

S No	IDENTIFIED ISOLATES
1	Colletotrichum truncatum
2	Drechslera sp
3	Cladosporium sp.
4	Nigrosporasphaerica
5	Alternaria aletrnata
6	Colletotrichum falcatum
7	Curvulariasp
8	Colletotrichum gloesporoides
9	Myrothecium sp.
10	Phoma sp.
11	Nigrosporasp
12	Colletotrichum sp.
13	Fusarium sp
14	Cladosporium cladosporoides
15	Penicillium sp.
16	Curvularialunata
17	Coniothyrium sp.
18	Phyllosticta sp.
19	Aspergillus flavus
20	Aspergillus fumigates
21	Paceliomyces sp
22	<i>Fusarium oxysporum</i>

4.1.7 *Tinospora cordifolia*

Family: Menispermaceae

Synonym: *Chasmanthera cordifolia* (DC.) Baill.

Common name: Guduchi

Telugu name: **Tippatige**

It is indigenous to areas of India, Myanmar, Sri Lanka, China, Thailand, Philippines, Indonesia, Malaysia, Borneo, Vietnam, Bangladesh, North Africa, West Africa, and South Africa

It is widely used to treat fever, jaundice, chronic diarrhea, cancer, dysentery, bone fracture, pain, asthma, skin disease, poisonous insect, snake bite, eye disorders.

Medicinal importance: anti-periodic, anti-spasmodic, anti-microbial, anti-osteoporotic, anti-inflammatory, anti-arthritic, anti-allergic, and anti-diabetic properties

Table 7: Endophytic fungal diversity of *Tinosporacardifolia* :

S No	IDENTIFIED ISOLATES
1	Alternaria
2	Nigrosporaoryzae
3	<i>Trichoderma longibrachiatum</i>
4	Asperigillus versicolor
5	Asperigillus oryzae
6	Pencilliumrubens
7	Fusarium solani
8	Trichoderma asperellum

4.1.8 *Ocimumtenuiflorum*

Family:Lamiaceae family

Synonym:Geniosporumtenuiflorum (L.)

Common name:Holy basil

Telugu name: **Tulsi**

O. Sanctum has wide distributions, covering the entire Indian subcontinent, ascending up to 1,800 m in the Himalayas and as far as the Andaman and Nicobar Islands. This plant occupies a wide range of habitats.

Medicinally used in aiding cough, asthma, diarrhea, fever, dysentery, arthritis, eye diseases, indigestion, gastric ailments, etc.

Table 8: Endophytic fungal diversity of *Ocimumtenuiflorum* :

S .no	Identified isolates
1	Acremonium
2	Alternaria
3	Asperigillus
4	Aureobasidium
5	Bipolaris
6	Colletotrichum
7	Curvularia
8	Paecilomyces
9	Pencillium
10	Fusarium
11	Pestalotiopsis

4.1.9 *Withaniasomnifera*

Family:Solanaceae

Synonym:*Physalis somnifera* L.

Common name:Indian Winter cherry

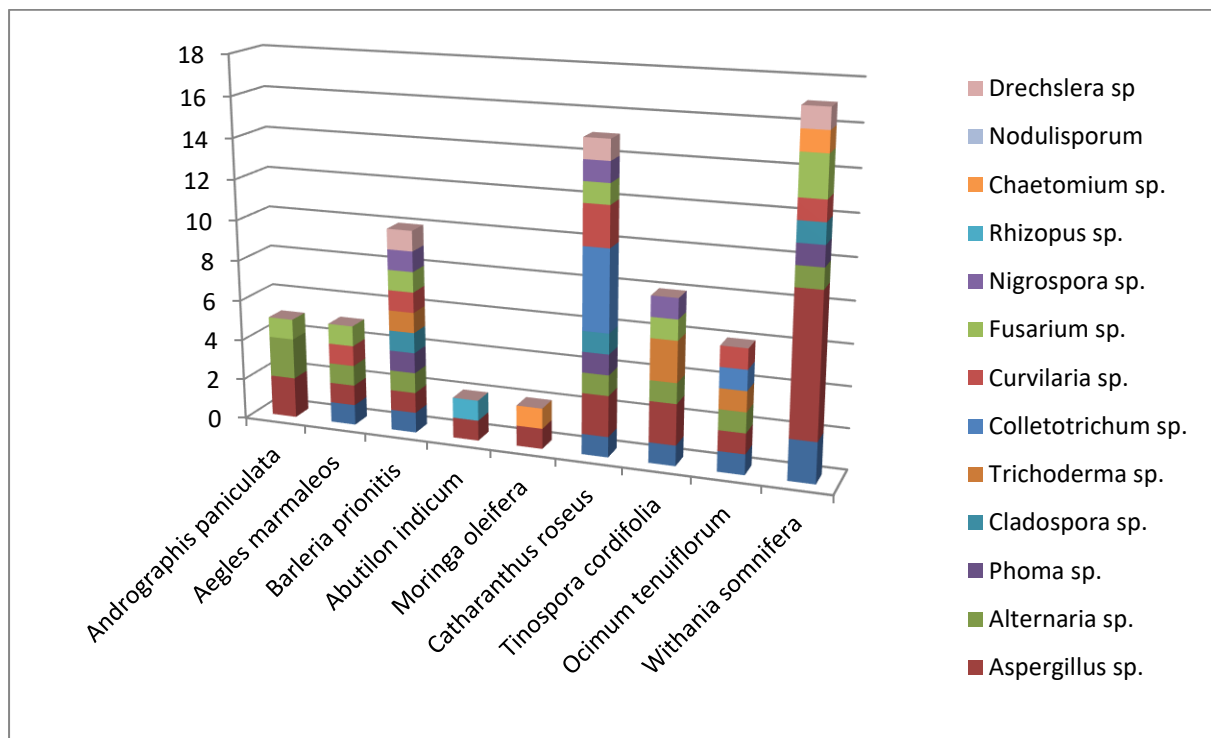
Telugu name: Ashwagandha

Withania possesses a natural occurrence, most probably in the drier and humid areas, spread from the Mediterranean region to throughout tropical region of Africa to South Africa and also from the Cape Verde Islands and Canary region to the Arabia and Middle East region like India, southern China and Sri Lanka

Widely used in treating anxiety, infertility, depression, insomnia, oxidative stress

Table 9: Endophytic fungal diversity of Withaniasominifera:

S.no	Identified isolates
1	Chaetomium bostrycode
2	Eurotium rubrum
3	Melanospora, fuisispora
4	Aspergillus awamori
5	Aspergillus auricomus
6	Aspergillus flavus
7	Aspergillus niger
8	Aspergillus thomii
9	Aspergillus terreus
10	Aspergillus terricol
11	Alternaria alternate
12	Cladosporium cladosporioides
13	Curvulariaoryzae
14	Drechsleraaustraliensis
15	Fusarium moniliforme
16	Fusarium semitectum
17	Myrothecium roridum
18	Penicillium corylophilum
19	Penicillium sp.
20	Phoma sp
21	Taleromycespinophilus

Table 10: Distribution of endophytic fungi among nine medicinal plants

5. FUTURE ASPECTS

Recent advancements in scientific literature regarding endophytic fungi, which are fungi associated with plants, have unveiled their extensive ecological distribution, biodiversity, and multifaceted interactions within their host organisms and other microorganisms in the symbiotic spectrum. The specific relationships between endophytic fungi and their hosts have

led to the production of numerous compounds, falling into diverse categories, each capable of exerting a wide range of effects against various pathogens. Exploring the unexplored domain of plant-associated microorganisms presents a fascinating and promising avenue for providing solutions in agriculture, pharmaceuticals, and medicine. Scientists are increasingly directing their attention to the potential applications of endophytes found in medicinal plants, scrutinizing their secondary metabolites for their significant pharmacological potential.

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