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Pestalotiopsis, an endophytic fungus What is on it and what is for it?

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Introduction

Secondary metabolites that function as biologically active agents in higher plants are abundant in endophytic fungus. Fungal derivatives are essential to human existence, and their chemicals are used to make antimicrobial, anti-cancer, and other drugs. Endophyte-derived secondary metabolites have the ability to prevent the growth of numerous plant diseases. Endophytes are abundant natural product sources employed in phytoremediation, the pharmaceutical industry, and agriculture (plant growth) [1, 2]. Endophytic fungi that have been isolated from medicinal plants exhibit a range of useful chemical types and activity levels [3, 4]. Fungal endophytes generate a lot more secondary activities than other endophytic microorganisms [5]. Derivatives of fungal endophytes are employed in biotechnological applications. Because of its antibacterial, anticancer, and other properties, it is very important in pharmaceutical research [6, 7]. Researchers are paying more and more attention to fungal endophytes because of their capacity to release a variety of structurally unique compounds, making them attractive options for drug discovery. One of the well-known fungal genera, Pestalotiopsis, is renowned for producing and accumulating a wide range of physiologically active chemicals [8–10]. Four novel species have been isolated and identified as a result of the majority of recent study on Pestalotiopsis, which is based on endophytic isolates. Pestalotiopsis hainanensis, Pestalotiopsis jesteri, Pestalotiopsis kunmingensis, and Pestalotiopsis pallidotheae are these [11–13]. The genus Pestalotiopsis exhibits encouraging bioremediation potential for waste reduction and the synthesis of taxol, which has significant uses as an anticancer drug [14, 15]. Description and ecology of Pestalotiopsis
Steyaert [16,17] divided Pestalotia into three genera—Pestalotia, Pestalotiopsis, and Truncatella—based on the conidial forms. The genus Pestalotiopsis is classified under the division Ascomycota, class Sordariomycetes, order Xylariales, family Sporocadaceae. When Pestalotiopsis was isolated from soil in Egypt, the colonies quickly grew on potato dextrose agar, reaching a diameter of 8.5 cm after 7 days of incubation. The margin turned black toward the center, and many acervuli appeared. Conidia fusiform are five-celled, apical cells with 2-4 simple appendages that are either straight or slightly bent. Conidiomata are acervular, black to dark black, and resemble sporodochia. Conidiophores are smooth, septate, hyaline, and irregularly branching (Figure 1, 2). Although they are found on leaves and stems, pestalotiopsis species have also been found in soil on occasion [8, 18]. The conidial morphology of different isolates was thoroughly investigated. The amount of setulae and conidia shape carried over the upper hyaline cell varied significantly throughout Pestalotiopsis species [19–20]. Due to differences in conidial shape, growth rate, and fruiting structure among species, it can be challenging to identify Pestalotiopsis species under a microscope [21]. According to Tejesvi et al. [22], Pestalotiopsis endophytic species are predominant throughout the winter and have relatively modest colonization during the monsoon season. The colonization frequency of Pestalotiopsis species varied and rose as the host plant's age increased [12].

The genus Pestalotiopsis is found on tropical and semitropical plants and seems to be a worldwide organism. Additionally, it has been isolated as an endophyte from the stems, leaves, flowers, and fruits of hundreds of tropical and subtropical rainforest plants, as well as a saprophyte on bark and decomposing plant matter [23–26]. Pestalotiopsis species are found on a variety of substrata and are widely dispersed around the world [12, 27]. Certain species of Pestalotiopsis decompose plants and are saprobes in soil [28].materials [29], or creatures growing on decomposing wild fruits [30], and some live in plant leaves as endophytes [32, 33] or are plant pathogens [31]. From Pestalotiopsis, more than 130 distinct compounds from diverse chemical classes have been identified. The most noteworthy bioactivities of secondary metabolites identified from the genus Pestalotiopsis were shown to be antifungal, antibiotic, and anticancer [34].

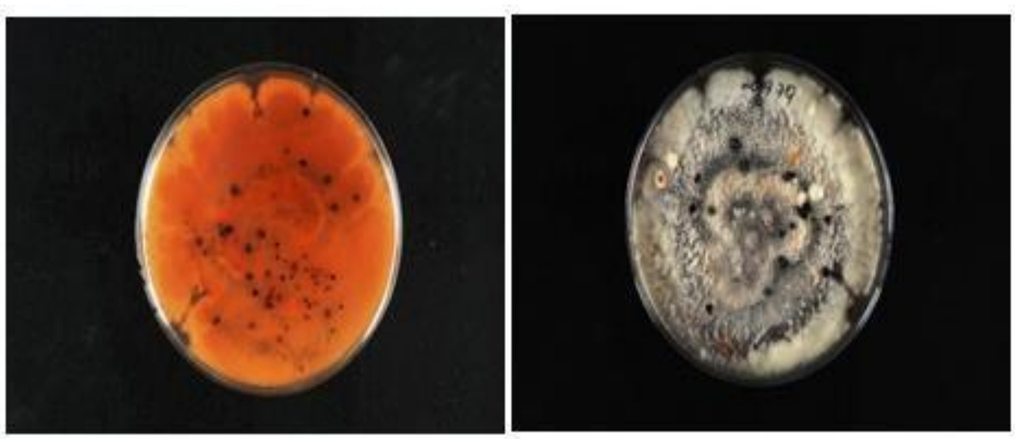

Figure (1). *Pestalotiopsis spp.* (Photographs was taken by Tangthirasunun Locality Thailand, hosted by *http://mycoportal.org*).

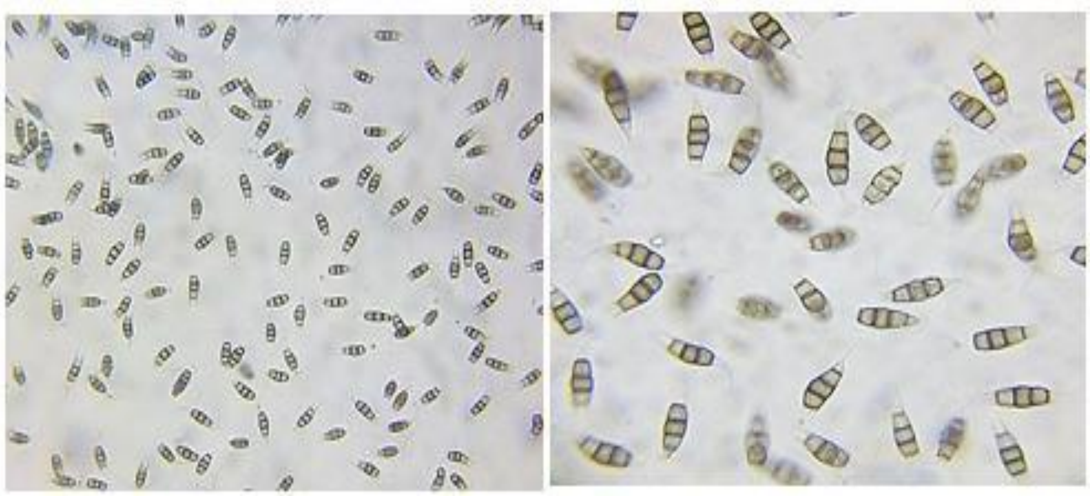

Figure (2). *Pestalotiopsis spp.* showing fusiform conidia with apical and basal appendages (Photographs was taken by Matthew Schink, Locality: United States, Florida, hosted by *http://mycoportal.org*).

Pestalotiopsis secondary metabolites

The presence of several structurally peculiar secondary metabolites has drawn attention to Pestalotiopsis species in recent years. Given that this species contains a number of antioxidants, immunosuppressants, anticancer agents, and other compounds, some of them may be significant as potential future therapeutic leads for the treatment of human diseases and the management of plant diseases [35, 36]. This review's objectives are to illustrate secondary metabolites from Pestalotiopsis species, highlight their documented bioactivities, and draw attention to the genus's generosity and distinctive chemical variety. Peptides, phenolic compounds, alkaloids, lactones, terpenoids, coumarins, isocoumarin derivatives, chromones, quinones, semiquinones, xanthones, and xanthone derivatives were all isolated from

Pestalotiopsis species, according to Xu et al. [34]. The diversity of physiologically active metabolites released by species in this genus has also been extensively studied [37, 38]. Dihydroberkleasmin A, a new eremophilane-type sesquiterpene, was isolated from Pestalotiopsis culture broth by Yang et al. [39]. Photiniae. Additionally, they reported that berkleasmin C was isolated from the same culture broth. In a different investigation, six new photinides A–F, which are γ-lactones produced from benzofuranone, were found in the endophyte Pestalotiopsis photiniae. Roystonea regia, a plant that was gathered from Jianfeng Mountain in China, was the source of the P. photiniae culture [40].

According to Liu et al. [41], solid state cultures of Pestalotiopsis fici were used to isolate the three known metabolites, siccayne, anofinic acid, and pyrenophorol, as well as the novel isoprenylated chromone derivatives Q, R, and S. The endophytic fungus Pestalotiopsis fici (W106-1) was isolated from the branches of the tea plant Camellia sinensis (Theaceae) in a Hangzhou, People's Republic of China, suburb. It also produced the novel two metabolites, pestalotriols A and B, which have a distinctive spiro [2.5] octane skeleton [41].

Along with 4-hydroxyphenylethanol, Pestalotiopsol A was also extracted from Pestalotiopsis species [42]. Pestalotiopsis species generated a lot of

Polyketides, caprolactams, chlorinated pupukeanane, benzo [c]oxepin, isoprenylated chromone, benzofuranone-derived γ-lactones, highly functionalized spiroketal, cyclohexanone, ambuic acid, chlorinated benzophenone, cyclopropane, spiro azaphilone, chloropupukeananin, caryophyllene-type, humulane sesquiterpene, isobenzofuranone, and oxysporone are among the various compounds with different carbon skeletons [43–45]. It is widely acknowledged that several secondary metabolite types are likely to be produced by microbes under various fermentation settings [46]. According to numerous earlier investigations, Pestalotiopsis spp. Utilizing a variety of solid and fermentation media, numerous intriguing bioactive secondary metabolites were generated.

The biological activities of Pestalotiopsis

Many of the fungi in the genus Pestalotiopsis are saprobes, while others are either endophytic or harmful to living plants, making them one of the most widely dispersed classes of endophytic fungus [47–49]. Interest in looking for bioactive chemicals from the genus Pestalotiopsis has grown dramatically since the anticancer drug taxol was discovered in an endophytic fungus strain of the species [35, 36].

Additionally, these substances from Pestalotiopsis species. had a variety of bioactivities: pestalofones, photinides, and pestalotiopsones F shown strong cytotoxic effects; chloropupukeanolide A, pestalotheol, and pestaloficiols demonstrated an inhibitory effect on HIV-1.

Ambuic acid and 6-hydroxypunctaporonins demonstrated antibacterial action against gram-positive bacteria; pestalotines considerably decreased the radical development of Echinochloa crusgalli; pestalachlorides, ambuic acid, pestalofones, and isopestacin demonstrated considerable antifungal properties. [33–45], [50; 51].

Pestalotiopsis species, which are plant endophytes, are innovative producers of bioactive secondary metabolites. Chemical investigations of Pestalotiopsis spp. have produced more than 70 novel natural compounds through various biosynthesis pathways. Cytotoxic, antibacterial, and anti-HIV properties are among the biological actions that some of these metabolites have demonstrated [52].

The use of fungal cells in nanotechnology to produce nanoparticles is a relatively new development. Compared to other alternative technologies, fungi are chosen for producing huge quantities of nanoparticles. fungus such as Pestalotiopsis sp. has been applied to the creation of nanoparticles that combat harmful microorganisms [53]. The potential of fungi is still largely unexplored, despite the fact that numerous papers on the biological synthesis of nanoparticles have been published [53].

Negative aspects of Pestalotiopsis

This genus's species can infect a wide range of plants and occasionally behave severely, leading to significant losses in plant yield [23, 54]. For instance, it has been observed that Pestalotiopsis oenotherae causes evening primrose leaf spot disease [50].

The morphological features of the fungal colony (colony color, size, and number of acervuli) and conidia (length, width, and color of median cells, length, and the number of apical and basal appendages) were used to isolate and identify five different species of Pestalotiopsis. These species were P. psidii, P. microspora, P. clavispora, P. neglecta, and Pestalotiopsis spp. Every isolation has the ability to cause harm to guava fruits [55]. The pathogenic fungus Pestalotia psidii was isolated, purified, and identified as the cause of guava leaf spot. Pestalotia species. received a lot of attention in recent years after being isolated from a variety of plants, including guava leaves and fruits [23], pecan trees [56], strawberry fruits [57–59], olive trees and fruits, and many other species.

In conclusion

Endophytic fungi's secondary metabolites will be an inexpensive supply for the agricultural, medical, and other sectors. There is no doubt that more unique chemicals will be isolated as a result of endophytic fungal research. The chemistry and bioactivities of secondary metabolites from the fungus Pestalotiopsis are illustrated in this review. Pestalotiopsis species have been found to contain over 130 different chemicals. According to bioassays, the most notable bioactivities of the secondary metabolites from Pestalotiopsis are their antifungal, antibiotic, and anticancer properties. The endophytic fungus Pestalotiopsis is special because it produces a lot of secondary metabolites that have both pathogenic and therapeutic control effects.

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