DISERTASI

EKSPLORASI JAMUR ENDOFITIK TANAMAN CIPLUKAN (*Physalis angulata* L.) YANG BERPOTENSI SEBAGAI SUMBER ANTIOKSIDAN DAN ANTIBAKTERI

Diajukan untuk memenuhi salah satu syarat memperoleh gelar Doktor pada Program Studi Doktor Ilmu MIPA Fakultas MIPA Universitas Sriwijaya

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2025

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EKSPLORASI JAMUR ENDOFITIK TANAMAN CIPLUKAN (*Physalis angulata* L.) YANG BERPOTENSI SEBAGAI SUMBER ANTIOKSIDAN DAN ANTIBAKTERI

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Karya tulis ilmiah berupa Disertasi ini dengan judul "Eksplorasi Jamur Endofitik Tanaman Ciplukan (*Physalis angulata* L.) yang Berpotensi Sebagai Sumber Antioksidan dan Antibakteri" telah dipertahankan di hadapan Tim Penguji Karya Ilmiah Fakultas Matematika dan Ilmu Pengetahuan Alam Program Studi Doktor Ilmu Matematika dan Ilmu Pengetahuan Alam Universitas Sriwijaya pada tanggal 15 September 2025

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HALAMAN PERSEMBAHAN

ومن لم يذق مر التعلم ساعة, تجرع ذل الجهل طول حياته

"Barang siapa yang tidak merasakan pahitnya belajar sesaat, maka dia akan merasakan hinanya kebodohan seumur hidupnya"
(Muhammad bin Idris Asy-Syafi'i)

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Palembang, 15 September 2025
Penulis

RINGKASAN

EKSPLORASI JAMUR ENDOFITIK TANAMAN CIPLUKAN (*Physalis angulata* L.) YANG BERPOTENSI SEBAGAI SUMBER ANTIOKSIDAN DAN ANTIBAKTERI

Karya Tulis Ilmiah berupa Disertasi, September 2025

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viii, 252 halaman, 70 gambar, 29 tabel, 4 lampiran

Tanaman ciplukan (*Physalis angulata* L.) telah dimanfaatkan oleh masyarakat Indonesia dan dunia sebagai obat tradisional untuk mengatasi diabetes, gusi berdarah, hipertensi, bisul, atau luka infeksi, karena efek farmakologi yang kuat sebagai antioksidan, antibakteri, hepatoprotektor, antifibrotik dan antidiare. Senyawa bioaktif tanaman ciplukan dapat diperoleh melalui jamur endofitik dengan keuntungan budidaya yang lebih singkat dan kemampuan jamur dalam menghasilkan metabolit sekunder yang mirip atau lebih baik dari inangnya. Penelitian ini bertujuan untuk menganalisis karakter fenotip dan mengidentifikasi jamur endofitik, menganalisis aktivitas antioksidan dan antibakteri ekstrak jamur endofitik, menganalisis karakterisasi dan menentukan struktur senyawa murni serta bioaktivitas dari senyawa murni tersebut. Isolasi, kultivasi dan ekstraksi jamur endofitik dilakukan untuk mengidentifikasi jenis jamur endofitik dan memperoleh ekstrak jamur endofitik. Jamur endofitik terpilih diidentifikasi secara molekuler, kemudian dianalisis menggunakan BLAST NCBI dan disusun pohon filogenetiknya menggunakan BioEdit 2.2, MEGA 11 dan iTOL. Uji aktivitas antioksidan menggunakan metode DPPH untuk ekstrak jamur endofitik dan senyawa murni. Uji aktivitas antibakteri menggunakan metode difusi *Kirby-Bauer* untuk ekstrak jamur endofitik dan senyawa murni. Senyawa murni di analisis menggunakan spektroskopi NMR dan LCMS/MS, dan penentuan struktur menggunakan ChemDraw. Berdasarkan hasil penelitian, diperoleh 47 jamur endofitik yang diisolasi dari akar (CA1-CA10), batang (CB1-CB5), daun (CD1-CD9), tangkai buah (CT1-CT6), kelopak buah (EP1-EP8) dan perikarp buah (CH1-CH2, BP1-BP7) yang terbagi menjadi 21 genera yaitu *Aspergillus, Bispora, Cladorrhinum, Cylindrocarpon, Diaporthe, Fusarium, Helicocephalum, Hyalodendron, Lasiodiplodia, Mortierella, Mucor, Nigrospora, Paecilomyces, Papulaspora, Penicillium, Periconia, Phialophora, Pythium, Trichocladium, Trichoderma* dan *Verticillium.* Isolasi senyawa murni dari ekstrak jamur endofitik menggunakan kromatografi kolom pada 6 isolat dengan aktivitas antioksidan dan antibakteri yang potensial. Karakterisasi senyawa menggunakan spektroskopi ^{1}H-NMR, ^{13}C-NMR, HSQC, HMBC dan LCMS/MS. Diperoleh senyawa murni *10-hydroxy-benzoisochromen-1-one* yang berasal dari isolat CA3 dan CB1. Senyawa

7-hydroxy-benzochromen-6-one dari isolat CA3, CA7 dan CB1. Senyawa *4,5,6-trihydroxy-2',3',5',6-tetramethyl-[3,4'-bipyranylidene]-2-one* dari isolat CB5 dan CH1. Senyawa *2-hydroxy-5-((6-methylheptyl)oxy)phenyl)(phenyl)methanone* dari isolat CD1. Senyawa tersebut diuji aktivitas antioksidan, secara berurutan menunjukkan IC_{50}, dimulai dari senyawa *10-hydroxy-benzoisochromen-1-one* (IC_{50} 262,68 dan 264,09 µg/mL), *7-hydroxy-benzochromen-6-one* (IC_{50} 259,11 µg/mL, 256,13 µg/mL dan 258,20 µg/mL), *4,5,6-trihydroxy-2',3',5',6-tetramethyl-[3,4'-bipyranylidene]-2-one* (IC_{50} 23,82 µg/mL dan 24,40 µg/mL), dan senyawa murni *2-hydroxy-5-((6-methylheptyl)oxy)phenyl)(phenyl)methanone* (IC_{50} 137,07 µg/mL). Uji aktivitas antibakteri senyawa murni *10-hydroxy-benzoisochromen-1-one, 7-hydroxy-benzochromen-6-one* dan *4,5,6-trihydroxy-2',3',5',6-tetramethyl-[3,4'-bipyranylidene]-2-one*, menunjukkan nilai KHM ≤64 µg/mL (kuat) pada semua bakteri uji. Selanjutnya senyawa murni *2-hydroxy-5-((6-methylheptyl)oxy)phenyl) (phenyl)methanone*, menunjukkan nilai KHM 125 µg/mL (sedang) pada bakteri *S. typhi* dan 250 µg/mL (lemah) pada bakteri uji lainnya. Berdasarkan struktur penyusunnya, semua senyawa murni tersebut merupakan golongan senyawa fenolat, kecuali senyawa dari isolat CB5 dan CH1 yang merupakan golongan bipyranylidene. Uji molekuler dari jamur endofit dengan aktivitas antioksidan dan antibakteri potensial terhadap 8 isolat, teridentifikasi spesies *Trichoderma virens* (CA3), *Papulaspora equi* (CA9), *Paecilomyces variotii* (CB5), *Lasiodiplodia theobromae* (CD1), *Fusarium equiseti* (CD8), *Diaporthe eucalyptorum* (CT5), *Penicillium citrinum* (EP6) dan *Penicillium chermesinum* (BP2). Hasil penelitian ini menunjukkan bahwa jamur endofitik yang diisolasi dari berbagai organ tanaman ciplukan memiliki potensi untuk dikembangkan menjadi antioksidan dan antibakteri alami.

Kata kunci : antibakteri, antioksidan, jamur endofitik, *Physalis angulata* L.
Kepustakaan : 500 (2019-2025)

SUMMARY

EXPLORATION OF ENDOPHYTIC FUNGI FROM CIPLUKAN (*Physalis angulata* L.) WITH POTENTIAL AS A SOURCE OF ANTIOXIDANTS AND ANTIBACTERIAL AGENTS

Doctoral Dissertation, September 2025

Budi Eko Wahyudi; Supervised by Prof. Dr. Elfita, M.Si., Prof. Dr. Hary Widjajanti, M.Si., Prof. Dr. Salni, M.Si.

Doctoral Program in Natural Sciences, Faculty of Mathematics and Natural Sciences, Sriwijaya University

viii, 250 pages, 70 figures, 29 tables, 4 appendices

Physalis angulata L. (commonly known as ciplukan) has been traditionally utilized in Indonesia and several other countries as a medicinal plant for the treatment of diabetes, bleeding gums, hypertension, boils, and infected wounds, owing to its strong pharmacological properties as an antioxidant, antibacterial, hepatoprotective, antifibrotic, and antidiarrheal agent. The bioactive compounds of *P. angulata* can also be obtained from endophytic fungi, which provide advantages such as shorter cultivation periods and the ability to produce secondary metabolites similar to, or even more potent than, those of the host plant. This study aimed to analyze the phenotypic characteristics and identify endophytic fungi, evaluate the antioxidant and antibacterial activities of their extracts, characterize and elucidate the structure of purified compounds, and assess their bioactivities. Isolation, cultivation, and extraction of endophytic fungi were conducted to identify fungal species and obtain crude extracts. Selected endophytic fungi were identified molecularly, analyzed using NCBI BLAST, and their phylogenetic relationships reconstructed with BioEdit 2.2, MEGA 11, and iTOL. Antioxidant activity was evaluated using the DPPH method, while antibacterial activity was tested by the *Kirby–Bauer* diffusion method, for both crude extracts and purified compounds. Purified compounds were analyzed by NMR spectroscopy and LCMS/MS, and their structures determined using ChemDraw. A total of 47 endophytic fungi were isolated from different organs of *P. angulata*, including roots (CA1–CA10), stems (CB1–CB5), leaves (CD1–CD9), fruit stalks (CT1–CT6), calyces (EP1–EP8), and pericarps (CH1–CH2, BP1–BP7). These isolates were assigned to 21 genera: *Aspergillus, Bispora, Cladorrhinum, Cylindrocarpon, Diaporthe, Fusarium, Helicocephalum, Hyalodendron, Lasiodiplodia, Mortierella, Mucor, Nigrospora, Paecilomyces, Papulaspora, Penicillium, Periconia, Phialophora, Pythium, Trichocladium, Trichoderma*, and *Verticillium.* Purification of bioactive compounds from six isolates with promising antioxidant and antibacterial potential was performed using column chromatography. Structural characterization was carried out by ^{1}H-NMR, ^{13}C-NMR, HSQC, HMBC and LCMS/MS analysis. The purified compounds obtained were *10-hydroxy-benzoisochromen-1-one* from isolates CA3 and CB1. *7-hydroxy-benzochromen-6-one* from isolates CA3, CA7, and CB1. *4,5,6-trihydroxy-2',3',5',6-tetramethyl-[3,4'-bipyranylidene]-2-one* from isolates CB5 and CH1. *2-hydroxy-5-((6-methylheptyl)oxy)phenyl)(phenyl)methanone* from isolate CD1. The antioxidant activities of the isolated compounds were evaluated based on their IC_{50} values. The results, in order, were as follows: *10-hydroxy-benzoisochromen-1-one* (IC_{50} 262.68 and 264.09 µg/mL), *7-hydroxy-benzochromen-6-one* (IC_{50} 259.11, 256.13, and 258.20 µg/mL), *4,5,6-trihydroxy-2',3',5',6-tetramethyl-[3,4'-bipyranylidene]-2-one* (IC_{50} 23.82 and 24.40 µg/mL), and *2-hydroxy-5-((6-methylheptyl)oxy)phenyl)(phenyl)methanone* (IC_{50} 137.07 µg/mL). Antibacterial assays showed that *10-hydroxy-benzoisochromen-1-one, 7-hydroxy-benzochromen-6-one, and 4,5,6-trihydroxy-2',3',5',6-tetramethyl-[3,4'-bipyranylidene]-2-one* exhibited strong inhibitory effects against all tested bacteria, with minimum inhibitory concentration (MIC) values ≤64 µg/mL. In contrast, *2-hydroxy-5-((6-methylheptyl)oxy)phenyl)(phenyl)methanone* displayed moderate antibacterial activity against *S. typhi* (MIC = 125 µg/mL) and weak activity against the other tested bacteria (MIC = 250 µg/mL). Structurally, all purified compounds belonged to the phenolic class, except those isolated from CB5 and CH1, which were classified as bipyranylidene derivatives. Molecular identification of eight bioactive isolates revealed them as *Trichoderma virens* (CA3), *Papulaspora equi* (CA9), *Paecilomyces variotii* (CB5), *Lasiodiplodia theobromae* (CD1), *Fusarium equiseti* (CD8), *Diaporthe eucalyptorum* (CT5), *Penicillium citrinum* (EP6), and *Penicillium chermesinum* (BP2). The findings of this study demonstrate that endophytic fungi isolated from different organs of P. angulata have significant potential to be developed as natural sources of antioxidant and antibacterial agents.

Keywords : antibacterial, antioxidant, endophytic fungi, *Physalis angulata* L.
Citation : 500 (2019-2025)

DAFTAR ISI

DAFTAR GAMBAR

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DAFTAR TABEL

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BAB 1
PENDAHULUAN

1.1 Latar Belakang

Penyakit degeneratif dan infeksi bakteri termasuk jenis penyakit yang umum diderita oleh masyarakat, baik di Indonesia maupun di dunia, serta sering menjadi fokus kajian ilmiah dalam bidang kedokteran dan farmasi. Penyakit degeneratif seperti *diabetes mellitus* (DM) dan infeksi bakteri seperti diare merupakan penyakit dengan prevalensi kematian tinggi di dunia. Data GBD (*Global Burden of Disease Study*) tahun 2021 menunjukkan, kematian akibat DM pada semua umur meningkat dari 238.100 kasus menjadi 723.700 kasus dari seluruh negara, atau naik 203,9% sejak tahun 1990. Kemudian, data jumlah DALY (*Disability Adjusted Life Years*) terkait DM pada semua umur juga meningkat dari 10,4 juta menjadi 39,3 juta, atau meningkat 276,7% dari tahun 1990. Kasus tersebut diperkirakan dapat mencapai 1,3 juta kasus kematian dan 85,5 juta untuk jumlah DALY pada semua umur di tahun 2045. Prevalensi global memperkirakan pada tahun 2030, kasus kematian mencapai 7.079 kasus dari setiap 100 ribu penduduk dunia (Huang *et al*., 2025; Khan *et al*., 2020). Data GBD tahun 2019 menunjukkan kematian akibat infeksi bakteri pathogen mencapai 7,7 juta dari total 13,7 juta kasus kematian dunia. Dari keseluruhan data, sebanyak 54,9% kasus infeksi disebabkan oleh bakteri jenis *Staphylococcus aureus, Escherichia coli, Streptococcus pneumoniae, Klebsiella pneumoniae* dan *Pseudomonas aeruginosa.* Selebihnya disebabkan oleh bakteri jenis lain (GBD, 2022; Vaart *et al*., 2022). Penyakit DM, disebabkan oleh resistensi insulin (T2DM) atau kerusakan sel beta pankreas (T1DM). Resistensi insulin atau apoptosis sel β-pankreas dapat diinduksi oleh stress oksidatif akibat tingginya konsentrasi radikal bebas di dalam tubuh (Masenga *et al*., 2023; Yavuz *et al*., 2024). Radikal bebas dinetralisir dengan antioksidan untuk mengurangi stres oksidatif, menurunkan kerusakan sel dan menginisiasi regenerasi sel yang rusak (Chaudhary *et al*., 2023). Kemudian, penyakit diare terjadi akibat infeksi bakteri di dalam tubuh melalui saluran cerna atau luka, ketika imun tubuh mengalami penurunan akibat jumlah atau fungsi neutrofil terlalu rendah (Nemeth & Pfleghaar, 2025). Bakteri penyebab diare seperti *Escherichia coli*, *Shigella* *dysentriae* atau *Salmonella typhi* dapat ditemukan pada air tercemar atau makanan mentah (Teshome *et al*., 2019). Untuk mengobati penyakit akibat radikal bebas dan infeksi bakteri diperlukan antioksidan dan antibakteri.

Antioksidan meredam radikal bebas dengan cara mendonorkan atom H dari gugus hidroksilnya (Moussa & Al-Mamary, 2021). Antioksidan sangat diperlukan tubuh, baik untuk pencegahan penyakit maupun pengobatan. Semakin beragam senyawa antioksidan, maka semakin banyak jenis radikal bebas yang dapat dinetralkan (Zehiroglu & Ozturk Sarikaya, 2019). Selanjutnya, antibakteri membunuh bakteri dengan cara membentuk ikatan dengan membran maupun merusak sel bakteri dengan mengikat DNA polymerase. Senyawa antibakteri, yang dalam penggunaan sehari-hari dikenal sebagai antibiotik, suatu metabolit yang dihasilkan oleh mikroorganisme, yang dapat membunuh atau menghambat pertumbuhan mikroorganisme lain (Byrne *et al*., 2019). Antioksidan sintetik dan antibiotik tersedia banyak dalam berbagai produk yang sudah terstandar.

Penggunaan antioksidan sintetik dan antibiotik memberikan efek yang cepat dan konsisten. Namun, penggunaan yang tidak sesuai dosis dan dalam jangka waktu yang lama, berpotensi menimbulkan efek samping yang membahayakan. Antioksidan *Butylated Hydroxytoluene* (BHT) memiliki efek toksik pada sel Leydig (penghasil testosterone) tikus melalui induksi disregulasi kalsium dan disfungsi retikulum endoplasma-mitokondria (Ham *et al*., 2020). Selanjutnya penggunaan antibiotik secara terus menerus menyebabkan bakteri resisten, seperti bakteri *Staphylococcus aureus* yang resisten terhadap antibiotik penicillin dengan tingkat resistensi 93,1% (Gizaw *et al*., 2023). Bakteri *E. coli* resisten terhadap antibiotik sulfonamide dan trimethoprim (Mulder *et al*., 2019). Bakteri *S. typhi* resisten terhadap antibiotik *sulfamethoxazole* dengan daya resistensi diatas 50% (Rahman, 2019). Bakteri *B. subtilis* juga resisten terhadap chloramphenicol (95,2%), erythromycin (85,7%) dan gentamicin (42,9%) (X. Jin et al., 2024). Beberapa fakta tersebut mengindikasikan pentingnya eksplorasi senyawa antioksidan dan antibakteri dari bahan alam yang lebih aman dengan efek samping yang relatif kecil. Bahan alam dapat berasal dari akar, rimpang, batang, kulit batang, daun, bunga, buah atau biji. Diantara bahan alam yang berpotensi, tanaman ciplukan telah dikenal sebagai obat alami.

Tanaman ciplukan dimanfaatkan sebagai obat tradisional untuk mengatasi diabetes, gusi berdarah, hipertensi, bisul, tukak lambung, demam, atau mengobati penyakit yang terkait dengan sistem saraf pusat dan sindrom metabolik (Vargas-Arana *et al*., 2025; Fadhilla *et al*., 2020). Metabolit sekunder yang terdapat pada tanaman ciplukan diantaranya alkaloid, physalin, withanolides, saponin, steroid, flavonoid dan triterpenoid (Wang *et al*., 2023a; Odusina & and Onocha, 2022) Berdasarkan penelitian, tanaman ciplukan memiliki efek farmakologi seperti antioksidan, antibakteri, antiradang, hepatoprotektor, antifibrotik dan antidiare (Pillai *et al.*, 2022; Lin *et al*., 2020; Liu *et al.*, 2022). Tanaman obat lain yang masih satu familia (Solanaceae) memiliki potensi mirip dengan ciplukan diantaranya *Capsicum spp., Solanum nigrum, Datura metel, Nicotiana tabacum, Withania somnifera* dan *Lycium barbarum.* Beberapa tanaman ini memiliki aktivitas antioksidan yang kuat terhadap DPPH dan antibakteri terhadap *S. aureus, E. coli, Salmonella, Helicobacter pylori* dan *P. aeruginosa* (Zhang *et al*., 2025; Zhang *et al*., 2024b; Islam *et al*., 2023; Mikulska *et al*., 2023; Shailabi *et al*., 2025; Periferakis *et al*., 2023; Romero-Luna *et al*., 2023). Keunggulan tanaman ciplukan dibanding beberapa tanaman tersebut karena komposisi bioaktif yang kuat. Ciplukan mengandung *physalins, withanolides, polifenol* dan *flavonoid*, kombinasi yang memberikan mekanisme ganda: pemerangkap radikal bebas (antioksidan) dan gangguan dinding/virulensi bakteri (antibakteri) (Vargas-Arana *et al*., 2025; Liang *et al*., 2024). Fakta tersebut mendukung tanaman ciplukan untuk dipilih sebagai sampel pada penelitian ini.

Perkembangan ilmu pengetahuan dan teknologi menunjukkan metabolit sekunder yang dihasilkan tanaman ciplukan dapat diperoleh melalui jamur endofitik dalam tanaman. Jamur endofitik dapat ditemukan pada akar batang, daun, bunga dan buah yang menghabiskan setengah atau seluruh siklus hidupnya di dalam jaringan tumbuhan yang sehat, baik intraseluler maupun interseluler. Jamur endofitik memiliki kemampuan untuk meniru metabolit sekunder dari inang dan menunjukkan aktivitas farmakologis yang mirip (Wen *et al*., 2022; Alam *et al*., 2021). Jamur endofitik yang diisolasi dari tanaman ciplukan diantaranya *Penicillium* sp., *Hyphomycetes* sp. dan *Fusarium* sp. Jamur *Penicillium* sp, memiliki aktivitas antibakteri dengan diameter hambat sebesar 7,6 mm pada *S.*

aureus dan 6,4 mm pada *E. coli.* Jamur *Hyphomycetes* sp., menunjukkan aktivitas antioksidan paling baik dengan nilai IC_{50} 52,43 μg/mL (Mahardhika *et al.,* 2021). Aktivitas antibakteri dari kedua jamur tersebut terhadap bakteri *S. aureus* dan *E. coli*, memiliki nilai KHM 8 - 64 μg/mL (Palupi *et al*., 2021). Penelitian tersebut menunjukkan jamur endofitik pada tanaman ciplukan berkhasiat sebagai antioksidan dan antibakteri, mirip seperti inangnya.

Berdasarkan keadaan global tentang bahaya penyakit degeneratif dan infeksi bakteri yang dapat menyebabkan kematian serta efek samping obat sintetik, diperlukan solusi dari bahan alam seperti tanaman ciplukan dengan potensi kuat sebagai obat alami. Khasiat obat alami tanaman ini dapat diperoleh melalui jamur endofitik. Selanjutnya karena kemampuan jamur endofitik dalam meniru metabolit sekunder inang, waktu kultivasi yang singkat dan aktivitasnya yang kuat, perlu adanya eksplorasi lebih lanjut terhadap jamur endofit yang ada pada tanaman ciplukan. Eksplorasi ini bertujuan untuk mengidentifikasi jamur endofit dari akar, batang, daun dan buah tanaman ciplukan, menguji bioaktivitas ekstrak jamur endofitik dan mengisolasi senyawa murni dari jamur tersebut dengan aktivitas paling kuat.

Penelitian ini dimulai dengan mengisolasi jamur endofitik dari organ akar, batang, daun dan buah ciplukan. Isolat jamur dipisahkan dari jamur lain untuk memperoleh isolat jamur murni yang akan digunakan pada proses karakterisasi dan kultivasi. Hasil karakterisasi akan digunakan untuk proses identifikasi fenotip, sementara untuk identifikasi molekuler akan dilakukan terhadap jamur endofitik dengan bioaktivitas paling kuat. Jamur endofitik murni dikultivasi, dipartisi dengan etil asetat kemudian diuapkan hingga diperoleh ekstrak pekat. Ekstrak yang diperoleh akan digunakan untuk uji aktivitas antioksidan dan antibakteri secara invitro. Ekstrak jamur endofitik dengan bioaktivitas paling kuat akan diisolasi senyawa murninya menggunakan kromatografi kolom gravitasi. Senyawa murni yang diperoleh akan digunakan pada uji antioksidan untuk memperoleh IC_{50} dan uji antibakteri untuk memperoleh konsentrasi hambat minimum (KHM).

Eksplorasi jamur endofitik yang akan dilakukan pada penelitian ini bertujuan untuk mengisolasi senyawa murni berkhasiat yang dihasilkan oleh jamur endofitik, karena secara umum penelitian yang dilakukan terhadap jamur endofitik dari tanaman ini terbatas pada bioaktivitas ekstrak jamur endofitik, bukan pada senyawa murni. Selanjutnya, senyawa murni tersebut akan dibandingkan dengan senyawa yang dihasilkan oleh inang, untuk mengetahui kemiripan struktur atau bioaktivitasnya. Senyawa murni yang dihasilkan sangat diperlukan dalam pembuatan antioksidan dan antibakteri untuk mengatasi penyakit akibat radikal bebas dan infeksi bakteri. Senyawa murni ini dapat memberikan pilihan bahan obat yang berkhasiat untuk dikembangkan pada industri farmasi.

Penelitian ini diharapkan dapat memberikan pengetahuan kepada masyarakat, akademisi, peneliti maupun praktisi kesehatan tentang jamur endofitik potensial dari tanaman obat ciplukan dan aktivitas farmakologinya. Diharapkan informasi ini mampu membangkitkan kreativitas masyarakat dalam memanfaatkan jamur endofitik secara lebih sederhana tanpa harus mengisolasi senyawa murninya, sehingga manfaat jamur endofit dari tanaman ciplukan dapat dirasakan oleh semua lapisan masyarakat.

1.2 Rumusan Masalah

Penyakit degeneratif dan infeksi bakteri memiliki tingkat bahaya tinggi hingga kematian. Untuk mengatasi kedua penyakit tersebut digunakan obat sintetik dengan efek yang cepat, terukur dan konsisten. Namun karena penggunaan yang tidak disiplin, timbul efek samping yang justru berbahaya. Selain itu, perubahan struktur sel pada mikoorganisme karena proses adaptasi menimbulkan resistensi obat. Keadaan ini mendorong para ilmuwan atau praktisi kesehatan untuk menemukan agen antioksidan atau antibakteri baru dari bahan alam yang sudah dikenal berkhasiat sebagai obat seperti tanaman ciplukan. Efek penyembuhan dari bahan alam relatif lebih lambat, namun efek samping atau potensi resistensi dari bahan alam relatif lebih kecil. Khasiat tanaman ciplukan tidak selalu menggunakan tanaman inang, melainkan dapat diperoleh melalui jamur endofitik. Diduga jamur endofitik memiliki bioaktivitas yang lebih kuat dibandingkan inang. Pemilihan jamur endofitik juga dikarenakan kultivasi yang singkat dan tidak memerlukan tempat yang luas. Pemanfaatan ekstrak jamur endofitik sebagai obat akan lebih kuat bioaktivitasnya menggunakan senyawa murni yang terbukti efektif sebagai antioksidan dan antibakteri. Senyawa murni diisolasi dari ekstrak jamur endofitik setelah kultivasi. Kultivasi jamur endofitik hanya menggunakan kultur murni jamur yang sudah diidentifikasi fenotip. Karena itu, diperlukan adanya eksplorasi dan identifikasi fenotip jamur endofitik yang tumbuh dan berkembang di dalam organ tanaman ciplukan. Berdasarkan alasan tersebut, rumusan masalah dalam penelitian ini sebagai berikut.

1. Bagaimana keanekaragaman jamur endofitik yang diisolasi dari akar, batang, daun dan buah tanaman ciplukan yang dianalisis berdasarkan karakter fenotipiknya?
2. Apakah ekstrak jamur endofitik yang diisolasi dari tanaman ciplukan menunjukkan aktivitas antioksidan dan antibakteri?
3. Apakah ekstrak dan senyawa murni dari jamur endofitik yang diisolasi dari tanaman ciplukan menunjukkan aktivitas atau struktur yang mirip dengan inangnya?

1.3 Hipotesis

H1 : Jamur endofitik yang ditemukan pada tanaman ciplukan menunjukkan keanekaragaman yang tinggi berdasarkan karakter fenotipnya

H2 : Ekstrak jamur endofitik yang diisolasi dari tanaman ciplukan menunjukkan aktivitas antioksidan dan antibakteri

H3 : Ekstrak dan senyawa murni dari jamur endofitik tanaman ciplukan menunjukkan aktivitas dan struktur yang mirip dengan inangnya

1.4 Tujuan Penelitian

Tujuan penelitian ini adalah:

1. Menganalisis karakter fenotip dan mengidentifikasi jenis jamur endofitik dari akar, batang, daun dan buah tanaman ciplukan untuk menentukan keanekaragaman jamur endofitik
2. Menganalisis aktivitas antioksidan dan antibakteri ekstrak jamur endofitik yang diisolasi dari tanaman ciplukan
3. Menganalisis karakterisasi dan menentukan struktur senyawa murni dari jamur endofitik, membandingkan struktur senyawa murni yang berasal dari jamur endofitik dengan inang, dan menganalisis aktivitas antioksidan dan antibakteri senyawa murni dari jamur endofitik

1.5 Kebaruan Penelitian

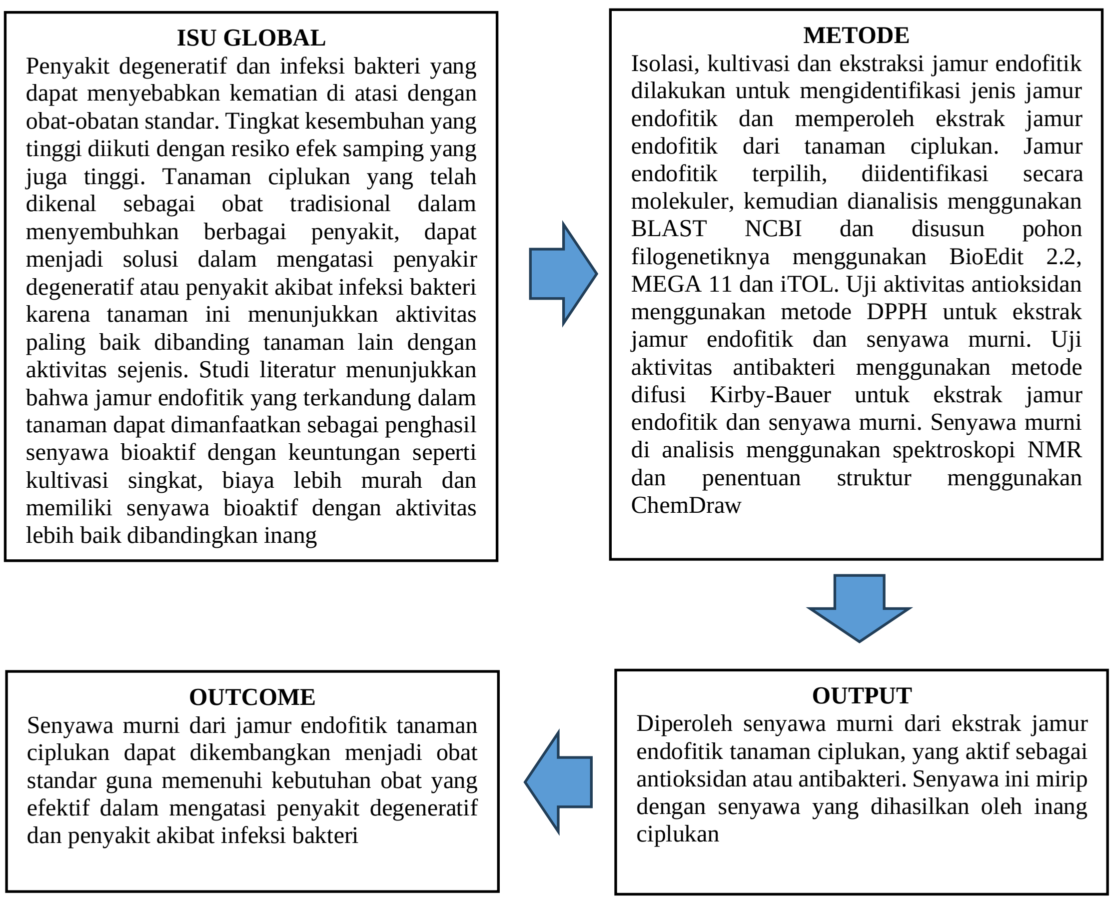
Jamur endofitik yang berhasil diisolasi dari akar, batang, daun dan buah (tangkai, kelopak, perikarp) tanaman ciplukan, diidentifikasi berdasarkan karakter fenotip. Genera jamur endofitik ini belum pernah ditemukan sebelumnya pada tanaman ciplukan yaitu *Bispora, Cladorrhinum, Cylindrocarpon, Diaporthe, Helicocephalum, Lasiodiplodia, Mortierella, Mucor, Nigrospora, Paecilomyces, Papulaspora, Periconia, Phialophora, Pythium, Trichocladium,* dan *Verticillium.* Analisis molekuler terhadap jamur endofitik terpilih menunjukkan spesies yang baru ditemukan pada ciplukan yaitu *Trichoderma virens* (CA3/akar), *Papulaspora equi* (CA9/akar), *Paecilomyces variotii* (CB5/batang), *Lasiodiplodia theobromae* (CD1/daun), *Fusarium equiseti* (CD8/daun), *Diaporthe eucalyptorum* (CT5/tangkai), *Penicillium citrinum* (EP6/kelopak) dan *Penicillium chermesinum* (BP2/perikarp). Jamur endofitik menunjukkan aktivitas antioksidan tertinggi pada isolat CT5 (tangkai buah) dengan nilai IC_{50} 14,11 µg/mL dan antibakteri tertinggi pada isolat CA3 (akar) dengan presentase hambat 73,91%-96,15%. Aktivitas ini lebih kuat dari penelitian terdahulu (IC_{50} 52,43 µg/mL dan diameter hambat 7,6 mm). **Kebaruan** pada penelitian ini adalah senyawa murni yang berhasil diisolasi menunjukkan struktur yang berbeda dari inang. Senyawa tersebut antara lain *10-hydroxy-benzoisochromen-1-one* dihasilkan oleh isolat CA3 (*Trichoderma virens*) dan CB1 (*Papulaspora*). Senyawa *7-hydroxy-benzochromen-6-one* dihasilkan oleh isolat CA3 (*Trichoderma virens*), isolat CA7 (*Verticillium*) dan CB1 (*Papulaspora*). Senyawa *4,5,6-trihydroxy- 2',3',5',6 -tetramethyl- [3,4'-bipyranylidene]-2-one* dihasilkan oleh isolat CB5 (*Paecilomyces variotii*) dan CH1 (*Fusarium*). Senyawa *2-hydroxy-5- ((6-methylheptyl) oxy) phenyl) (phenyl) methanone* dihasilkan oleh isolat CD1 (*Lasiodiplodia theobromae*). Uji aktivitas antioksidan senyawa murni ditunjukkan dengan nilai IC_{50} yaitu *10-hydroxy-benzoisochromen-1-one* (IC_{50} 262,68 dan 264,09 µg/mL) *7-hydroxy-benzochromen-6-one* (IC_{50} 259,11 µg/mL, 256,13 µg/mL dan 258,20 µg/mL), *4,5,6-trihydroxy- 2',3',5',6-tetramethyl-[3,4'-bipyranylidene]-2-one* (IC_{50} 23,82 µg/mL dan 24,40 µg/mL), dan senyawa murni *2-hydroxy-5-((6-methylheptyl) oxy)phenyl) (phenyl) methanone* (IC_{50} 137,07 µg/mL). Uji aktivitas antibakteri senyawa murni dengan nilai KHM ≤64 µg/mL (kuat) pada senyawa *10-hydroxy-*

benzoisochromen-1-one, 7-hydroxy-benzochromen -6-one dan *4,5,6- trihydroxy -2',3',5',6 -tetramethyl -[3,4'-bipyranylidene]-2-one.* Selanjutnya nilai KHM ≥ 65 μg/mL (sedang dan lemah) pada senyawa *2-hydroxy-5-((6-methylheptyl)oxy)phenyl)(phenyl) methanone.*

1.6 Manfaat Penelitian

Penelitian ini diharapkan dapat memberikan pengetahuan kepada masyarakat, akademisi, peneliti maupun praktisi kesehatan tentang keanekaragaman jamur endofitik dari tanaman ciplukan, bioaktivitas ekstrak jamur endofitik, spesies jamur endofitik potensial, dan senyawa murni dari ekstrak jamur endofitik potensial. Selain itu, senyawa murni jamur endofitik yang berhasil diisolasi dapat bermanfaat untuk dikembangkan menjadi obat standar dalam mengobati penyakit degeneratif atau penyakit akibat infeksi bakteri.

1.7 Kerangka Pikir Penelitian



1.8 State of The Art

Tanaman ciplukan telah digunakan secara tradisional untuk mengatasi demam, infeksi, gangguan liver, diabetes, dan peradangan kronis. Penelitian telah mengkonfirmasi bahwa ekstrak dari berbagai bagian tanaman ciplukan seperti buah, daun, batang dan akar, mengandung senyawa sekunder seperti *withanolides* dan *physalins* yang menunjukkan aktivitas antimikroba, anti-inflamasi, antidiabetik, dan antioksidan yang signifikan. Studi kimia-farmakologis pada ciplukan mengungkapkan lebih dari 350 senyawa withanolide, termasuk physangulidines A–C, yang menunjukkan efek antiproliferatif terhadap sel tumor. Beberapa physalin, seperti physalin F, telah dilaporkan memiliki aktivitas imun-supresif terhadap sel mononuklear pasien dengan HTLV-1-associated myelopathy Selain itu, aktivitas inhibisi nitric oxide oleh ekstrak tanaman ini telah menunjukkan potensi sebagai agen anti-inflamasi melalui modulasi jalur NF-κB. Secara keseluruhan, data kimia dan bioaktivitas mendukung penggunaan tradisional ciplukan sebagai sumber senyawa terapeutik alami (Vargas-Arana *et al*., 2025; Wang *et al*., 2021b).

Eksplorasi senyawa tidak terhenti pada inang tanaman ciplukan. Perhatian dunia juga tertuju pada mikroorganisme yang hidup simbiotik di dalam jaringan tanaman yaitu jamur endofitik. Jamur endofitik telah diakui sebagai reservoir metabolit sekunder bioaktif seperti alkaloid, polifenol, terpenoid, steroid, isokumarin, dan lain-lain yang memiliki potensi antikanker, antioksidan, antimikroba, dan antidiabetik (Ebadi & Ebadi, 2024). Studi umum menunjukkan jamur endofitik dari genus *Colletotrichum*, *Penicillium*, *Fusarium*, dan *Epicoccum* mampu menghasilkan senyawa dengan aktivitas farmakologis kuat, termasuk taxol dan emodin (Hashem *et al*., 2023). Khusus tanaman ciplukan, terdapat 14 isolat jamur endofitik dari bunga, batang, daun, dan kelopak buah tanaman, menunjukkan aktivitas antioksidan dan antibakteri. Jamur endofitik *Hyphomycetes* (dari bunga) menunjukkan aktivitas antioksidan moderat dengan IC_{50} 52,43 μg/mL), dan enam isolat lainnya menunjukkan aktivitas antibakteri kuat terhadap *Escherichia coli* dan *Staphylococcus aureus* dengan MIC 8–64 μg/mL. Isolat-isolat tersebut termasuk satu *Fusarium* spp. dari batang dan empat *Colletotrichum* spp. dari daun dan kelopak buah yang menunjukkan aktivitas antibakteri terbaik (Palupi *et al*., 2021).

Penelitian lain berhasil mengidentifikasi berbagai jenis jamur endofitik dari tanaman ciplukan seperti *Penicillium verrucosum*, *Colletotrichum alienum*, *Fusarium subglutinans*, *Aspergillus nidulans*, *Mycelia sterilia*, dan *Rhizoctonia* spp. Metabolit yang dihasilkan oleh *Penicillium verrucosum* menunjukkan aktivitas antimikroba tertinggi terhadap *B. subtilis*, *E. coli*, dan *S. aureus* (Hastuti *et al*., 2021).

Penelitian jamur endofitik pada ciplukan sampai saat ini sebagian besar hanya mencakup ekstrak kasar, profil KLT dan aktivitas bioaktif umum, tanpa isolasi dan karakterisasi sistematis senyawa bioaktif murni. Jamur endofitik *Colletotrichum* yang juga ada pada ciplukan mampu memproduksi senyawa antimikroba seperti emodin dan taxol pada inang lain (Yehia, 2023; Hashem *et al.*, 2023). Selanjutnya, banyak jamur endofitik menghasilkan berbagai jenis senyawa bioaktif seperti flavonoid, fenolik, terpenoid, isokumarin dan steroid yang belum dievaluasi dari tanaman ciplukan secara terstruktur (Anwar *et al*., 2023; Bando *et al*., 2024; Yu *et al*., 2023).

Berdasarkan data hasil penelitian, terdapat gap penelitian proposional yaitu belum ada laporan isolasi dan karakterisasi lengkap senyawa murni dari jamur endofitik yang berasal dari tanaman ciplukan, sementara jamur endofitik Colletotrichum, Fusarium, dan Penicillium yang terbukti aktif sebagai antioksidan atau antibakteri belum dievaluasi lebih lanjut ke arah senyawa murni. Oleh karena itu, arah penelitian ke depan sangat penting untuk fokus pada isolasi fraksi aktif dari ekstrak endofitik ciplukan dengan pendekatan kromatografi (KLT, kolom) dan karakterisasi struktural senyawa murni menggunakan spektroskopi NMR. Setiap senyawa yang diisolasi harus diuji aktivitas antioksidan, antibakteri, sitotoksisitas, dan menentukan nilai IC_{50} atau MIC. Kemudian, membandingkan sifat bioaktif senyawa murni endofit dengan senyawa yang diperoleh dari tanaman itu sendiri, seperti physalin atau withanolide, akan memberikan pemahaman lebih dalam tentang kontribusi mikroba endofitik terhadap khasiat farmakologis ciplukan tradisional. Lebih lanjut, penelitian ini dapat diarahkan untuk identifikasi genetik (DNA ITS sequencing) dari isolat jamur endofitik yang terbukti aktif sebagai antioksidan atau antibakteri.

DAFTAR PUSTAKA

Abdul-Halim, A. M. A. A., Shivanand, P., Krishnamoorthy, S., & Taha, H. (2023). A review on the biological properties of Trichoderma spp. as a prospective biocontrol agent and biofertilizer. *Journal of Applied Biology and Biotechnology*, *11*(5), 34–46. https://doi.org/10.7324/JABB.2023.11504

Abdulhadi, S. Y., Hasan, G. Q., & Gergees, R. N. (2020). Molecular detection and antimicrobial activity of Endophytic fungi isolated from a medical plant Rosmarinus officinalis. *Annals of Tropical Medicine and Public Health*, *23*(13B). https://doi.org/10.36295/ASRO.2020.231384

Abdulkareem, H. M., Abood, A. I., & Dakheel, M. M. (2022). Antimicrobial Resistance of Tannin Extract against E. coli Isolates from Sheep. *Archives of Razi Institute*, *77*(2), 697–701. https://doi.org/10.22092/ARI.2022.356982.1955

Abramczyk, B., Marzec-Grzadziel, A., Grzadziel, J., Król, E., Gałazka, A., & Oleszek, W. (2022). Biocontrol Potential and Catabolic Profile of Endophytic Diaporthe eres Strain 1420S from Prunus domestica L. in Poland—A Preliminary Study. *Agronomy*, *12*(1). https://doi.org/10.3390/agronomy12010165

Abumaali, D. A., Al-Hadidi, S. H., Daly Yahia, M. N., Erfanian, M. B., Ahmed, T. A., & Alatalo, J. M. (2023). The date palm microbiome: A review. *Ecological Genetics and Genomics*, *29*(May). https://doi.org/10.1016/j.egg.2023.100212

Adione, N. M., Peter, I., Christiana, C., Nkasi, N., & Maduabuchi, P. (2022). Antimicrobial Activities of the Endophytic Fungus , Fusarium equiseti , Isolated from The leaves of Ocimum gratissimum. *Journal of Advances in Medical and Pharmaceutical Sciences*, *24*(7), 11–23. https://doi.org/10.9734/JAMPS/2022/v24i730312

Aini, K., Widjajanti, H., Setiawan, A., & Kurniawati, A. R. (2022). Antibacterial activity of endophytic fungi isolated from the stem bark of jambu mawar (Syzygium jambos). *Biodiversitas*, *23*(1), 521–532. https://doi.org/10.13057/biodiv/d230156

Aisyiyah, I. N., Rahmawati, H., Agustini, D. M., Purbaya, S., Aisyah, L. S., & Yun, Y. F. (2023). ANTIOXIDANT PROPERTIES OF THE ETHYL ACETATE EXTRACT OF ENDOPHYTIC FUNGUS Penicillium Citrinum FROM Kalanchoe Millotii STEM THROUGH SECONDARY METABOLITES. *Al-Kimiya*, *10*(2), 123–132. https://doi.org/10.15575/ak.v10i2.30323

Akram, S., Ahmed, A., He, P., He, P., Liu, Y., Wu, Y., Munir, S., & He, Y. (2023). Uniting the Role of Endophytic Fungi against Plant Pathogens and Their Interaction. *Journal of Fungi*, *9*(1). https://doi.org/10.3390/jof9010072

Al-Bader, S. M. (2023). Proteolytic Activity and Health Impact of Fungi Isolated from Chickens Feathers in House Breeding Cages. *International Journal of Agriculture and Biology*, *30*(2), 154–160. https://doi.org/10.17957/IJAB/15.2070

Al-Khayri, J. M., Rashmi, R., Toppo, V., Chole, P. B., Banadka, A., Sudheer, W. N., Nagella, P., Shehata, W. F., Al-Mssallem, M. Q., Alessa, F. M., Almaghasla, M. I., & Rezk, A. A. S. (2023). Plant Secondary Metabolites: The Weapons for Biotic Stress Management. *Metabolites*, *13*(6), 1–37. https://doi.org/10.3390/metabo13060716

Al-Obaidi, J. R., Jambari, N. N., & Ahmad-Kamil, E. I. (2021). Mycopharmaceuticals and nutraceuticals: Promising agents to improve human well-being and life quality. *Journal of Fungi*, *7*(7). https://doi.org/10.3390/jof7070503

Al Mamari, H. (2021). *Phenolic Compounds: Classification, Chemistry, and Updated Techniques of Analysis and Synthesis* (F. Badria (ed.)). IntechOpen. https://doi.org/10.5772/intechopen.98958

Alam, B., Lǐ, J., Gě, Q., Khan, M. A., Gōng, J., Mehmood, S., Yuán, Y., & Gǒng, W. (2021). Endophytic Fungi: From Symbiosis to Secondary Metabolite Communications or Vice Versa? *Front Plant Sci*, *12*(December), 1–24. https://doi.org/10.3389/fpls.2021.791033

Alara, O. R., Abdurahman, N. H., & Ukaegbu, C. I. (2021). Extraction of phenolic compounds: A review. *Current Research in Food Science*, *4*(March), 200–214. https://doi.org/10.1016/j.crfs.2021.03.011

Alawode, T. T., Lajide, L., Olaleye, M., & Owolabi, B. (2021). Stigmasterol and β-Sitosterol: Antimicrobial Compounds in the Leaves of Icacina trichantha identified by GC–MS. *Beni-Suef University Journal of Basic and Applied Sciences*, *10*(1). https://doi.org/10.1186/s43088-021-00170-3

Ali, F., Akhtar, N., Shafique, S., & Shafique, S. (2021). Isolation and identification of Aspergilli causing Banana fruit rot. *Open Journal of Chemistry*, *4*(1), 8–18. https://doi.org/10.30538/psrp-ojc2021.0019

Ali, M. A., Ahmed, T., Ibrahim, E., Rizwan, M., Chong, K. P., & Yong, J. W. H. (2024). A review on mechanisms and prospects of endophytic bacteria in biocontrol of plant pathogenic fungi and their plant growth-promoting activities. *Heliyon*, *10*(11), e31573. https://doi.org/10.1016/j.heliyon.2024.e31573

Ali, W. M., Abdel-Mageed, M. A., Hegazy, M. G. A., Abou-Shlell, M. K., Sultan, S. M. E., Salama, E. A. A., & Yousef, A. F. (2023). Biocontrol agent of root-knot nematode Meloidogyne javanica and root-rot fungi, Fusarium solani in okra morphological, anatomical characteristics and productivity under greenhouse conditions. *Scientific Reports*, *13*(1), 1–13.

https://doi.org/10.1038/s41598-023-37837-z

Aljeldah, M. M., El-Sayyad, H., Elhadi, N., & Rabaan, A. A. (2019). Effect of Gamma-Rays on the Growth and Penicillin Production of Penicillium chrysogenum. *Journal of Pure and Applied Microbiology*, *13*(2), 779–788. https://doi.org/10.22207/JPAM.13.2.13

Alomran, M., Houbraken, J., & Newcombe, G. (2020). Aspergillus tubingensis is a pre-emergent pathogen of date palm seedlings. *Forests*, *11*(12), 1–8. https://doi.org/10.3390/f11121327

Alshaibani, D., Zhang, R., & Wu, V. C. H. (2017). Antibacterial characteristics and activity of Vaccinium macrocarpon proanthocyanidins against diarrheagenic Escherichia coli. *Journal of Functional Foods*, *39*, 133–138. https://doi.org/10.1016/j.jff.2017.10.003

Ameen, M., Mahmood, A., Sahkoor, A., Zia, M. A., & Ullah, M. S. (2024). The role of endophytes to combat abiotic stress in plants. *Plant Stress*, *12*(September 2023), 100435. https://doi.org/10.1016/j.stress.2024.100435

Ampomah-Wireko, M., Luo, C., Cao, Y., Wang, H., Nininahazwe, L., & Wu, C. (2021). Chemical probe of AHL modulators on quorum sensing in Gram-Negative Bacteria and as antiproliferative agents: A review. *European Journal of Medicinal Chemistry*, *226*, 113864. https://doi.org/10.1016/j.ejmech.2021.113864

Andrés, C. M. C., Lastra, J. M. P. de la, Juan, C. A., & Pérez-Lebeña, E. (2024). Michael Acceptors as Anti-Cancer Compounds: Coincidence or Causality? *Int. J. Mol. Sci.*, *25*, 2–48.

Angeles, D. M., & Scheffers, D.-J. (2021). The Cell Wall of Bacillus subtilis. *Curr. Issues Mol. Biol.*, *41*, 539–596.

Anh, N. M., Huyen, V. T. T., Quyen, V. T., Dao, P. T., Quynh, D. T., Huong, D. T. M., Van Cuong, P., Dat, T. T. H., & Minh, L. T. H. (2023). Antimicrobial and Cytotoxic Secondary Metabolites from a Marine-Derived Fungus Penicillium Citrinum VM6. *Current Microbiology*, *81*(1), 32. https://doi.org/10.1007/s00284-023-03568-7

Annadurai, P. (2021). Extraction and isolation of bioactive compounds from lantana camara leaves by column chromatographic techniques. *Research Journal of Pharmacy and Technology*, *14*(3), 1607–1611. https://doi.org/10.5958/0974-360X.2021.00285.7

Anwar, R., Pratama, G. B., Supratman, U., Harneti, D., Azhari, A., Fajriah, S., Azmi, M. N., & Shiono, Y. (2023). Steroids from Toona sureni-derived Endophytic Fungi Stemphylium sp. MAFF 241962 and Their Heme Polymerization Inhibition Activity. *Natural and Life Sciences Communications*, *22*(3), 1–29. https://doi.org/10.12982/NLSC.2023.055

Arruda, J. C. C., Rocha, N. C., Santos, E. G., Ferreira, L. G. B., Bello, M. L., Penido, C., Costa, T. E. M. M., Santos, J. A. A., Ribeiro, I. M., Tomassini, T. C. B., & Faria, R. X. (2021). Physalin pool from Physalis angulata L. leaves and physalin D inhibit P2X7 receptor function in vitro and acute lung injury in vivo. *Biomedicine and Pharmacotherapy*, *142*(February), 112006. https://doi.org/10.1016/j.biopha.2021.112006

Aryal, S. (2021). *McFarland Standards- Principle , Preparation , Uses , Limitations P*. https://microbenotes.com/mcfarland-standards

Aryal, S. (2022). *Mueller Hinton Agar (MHA) – Composition , Principle , Uses and Preparation*. https://microbiologyinfo.com/mueller-hinton-agar-mha-composition-principle-uses-and-preparation

Ashoka, G. B., & Shivanna, M. B. (2023). Antibacterial, antioxidant, and anticancer activities of Penicillium citrinum Thom. endophytic in Jatropha heynei. *Journal of Applied Pharmaceutical Science*, *13*(3), 196–207. https://doi.org/10.7324/JAPS.2023.95958

Asomadu, R. O., Ezeorba, T. P. C., Ezike, T. C., & Uzoechina, J. O. (2024). Exploring the antioxidant potential of endophytic fungi: a review on methods for extraction and quantification of total antioxidant capacity (TAC). *3 Biotech*, *14*(5), 1–18. https://doi.org/10.1007/s13205-024-03970-3

Atkins, S. D., Clark, I. M., Pande, S., Hirsch, P. R., & Kerry, B. R. (2005). The use of real-time PCR and species-specific primers for the identification and monitoring of Paecilomyces lilacinus. *FEMS Microbiology Ecology*, *51*(2), 257–264. https://doi.org/10.1016/j.femsec.2004.09.002

Bahri, S., Setiawan, W. A., Setiawan, F., Lutfiah, R., Juliasih, N. L. G. R., Ambarwati, Y., Ahmadi, P., Arai, M., Hendri, J., Hadi, S., & Setiawan, A. (2024). Activity of Mangrove-Derived Fusarium equiseti 20CB07RF Extract Against Clinical, Antibacterial-Resistant Pseudomonas aeruginosa. *Science and Technology Indonesia*, *9*(3).

Bai, J., Zhang, Y., Tang, C., Hou, Y., Ai, X., Chen, X., Zhang, Y., Wang, X., & Meng, X. (2021). Gallic acid: Pharmacological activities and molecular mechanisms involved in inflammation-related diseases. *Biomedicine and Pharmacotherapy*, *133*(November 2020). https://doi.org/10.1016/j.biopha.2020.110985

Bakrim, S., Benkhaira, N., Bourais, I., Benali, T., Lee, L. H., El Omari, N., Sheikh, R. A., Goh, K. W., Ming, L. C., & Bouyahya, A. (2022). Health Benefits and Pharmacological Properties of Stigmasterol. *Antioxidants*, *11*(10), 1–32. https://doi.org/10.3390/antiox11101912

Baliyan, S., Mukherjee, R., Priyadarshini, A., Vibhuti, A., Gupta, A., Pandey, R. P., & Chang, C. M. (2022). Determination of Antioxidants by DPPH Radical Scavenging Activity and Quantitative Phytochemical Analysis of Ficus religiosa. *Molecules*, *27*(4). https://doi.org/10.3390/molecules27041326

Ball, J., Panerai, R. B., Williams, C. A. L., & Beishon, L. (2022). Principal component analysis to identify the major contributors to task-activated neurovascular responses. *Cerebral Circulation - Cognition and Behavior*, *3*(October 2021), 100039. https://doi.org/10.1016/j.cccb.2022.100039

Bando, K., Kushibe, R., Kitaoka, N., Tamai, Y., Narisawa, K., & Matsuura, H. (2024). *Isolation, structural elucidation, and biological activity of a novel isocoumarin from the dark septate endophytic fungus Phialocephala fortinii*. *79*(3–4), 89–92. https://doi.org/doi:10.1515/znc-2023-0139

Barker, D. (2019). Lignans. *Molecules*, *24*(7), 2–5. https://doi.org/10.3390/molecules24071424

Baron, N. C., & Rigobelo, E. C. (2022). Endophytic fungi: a tool for plant growth promotion and sustainable agriculture. *Mycology*, *13*(1), 39–55. https://doi.org/10.1080/21501203.2021.1945699

Bashabsheh, R. H. F., AL-Fawares, O., Natsheh, I., Bdeir, R., Al-Khreshieh, R. O., & Bashabsheh, H. H. F. (2024). Staphylococcus aureus epidemiology, pathophysiology, clinical manifestations and application of nano-therapeutics as a promising approach to combat methicillin resistant Staphylococcus aureus. *Pathogens and Global Health*, *118*(3), 209–231. https://doi.org/10.1080/20477724.2023.2285187

Bashir, A., Manzoor, M. M., Ahmad, T., Farooq, S., Sultan, P., Gupta, A. P., & Riyaz-Ul-Hassan, S. (2023). Endophytic fungal community of Rosa damascena Mill. as a promising source of indigenous biostimulants: Elucidating its spatial distribution, chemical diversity, and ecological functions. *Microbiological Research*, *276*(July), 127479. https://doi.org/10.1016/j.micres.2023.127479

Basso Valeria, G., Gabriela, D. B., & Gustavo, R. (2024). Trichoderma spp.: characteristics and applications. *Journal of Applied Biotechnology & Bioengineering*, *11*(1), 18–22. https://doi.org/10.15406/jabb.2024.11.00354

Benfield, A. H., & Henriques, S. T. (2020). Mode-of-Action of Antimicrobial Peptides: Membrane Disruption vs. Intracellular Mechanisms. *Frontiers in Medical Technology*, *2*(December), 25–28. https://doi.org/10.3389/fmedt.2020.610997

Bhaskar, R., Xavier, L. S. E., Udayakumaran, G., Kumar, D. S., Venkatesh, R., & Nagella, P. (2022). Biotic elicitors: a boon for the in-vitro production of plant secondary metabolites. *Plant Cell, Tissue and Organ Culture*, *149*(1–2), 7–24. https://doi.org/10.1007/s11240-021-02131-1

Biang, J. (2022). The Importance of Catechins. *Oxidants and Antioxidants in Medical Science*, *11*(2), 1.

Bibi, A., Mubeen, F., Rizwan, A., Ullah, I., Hammad, M., Waqas, M. A. B., Ikram, A., Abbas, Z., Halterman, D., & Saeed, N. A. (2024). Morpho-Molecular Identification of Fusarium equiseti and Fusarium oxysporum Associated with Symptomatic Wilting of Potato from Pakistan. *Journal of Fungi*, *10*(10). https://doi.org/10.3390/jof10100701

Bina, E. F. S., Irawan, B., Setiawan, W. A., & Ekowati, C. N. (2022). Artikel Review: Aplikasi Inokulum Fungi Trichoderma spp. Untuk Pertumbuhan dan Penekan Fitopatogen. *Jurnal Biologi Papua*, *14*(2), 158–168. https://doi.org/10.31957/jbp.2377

Boban, T., Nadar, S., & Tauro, S. (2023). Breaking down bacterial communication: a review of quorum quenching agents. *Future Journal of Pharmaceutical Sciences*, *9*(1). https://doi.org/10.1186/s43094-023-00526-9

Brereton, R. G. (2022). Graphical introduction to principal components analysis. *Journal of Chemometrics*, *36*(6), 1–8. https://doi.org/10.1002/cem.3404

Budiono, Elfita, Muharni, Yohandini, H., & Widjajanti, H. (2019). Antioxidant activity of Syzygium samarangense L. and their endophytic fungi. *Molekul*, *14*(1), 48–55. https://doi.org/10.20884/1.jm.2019.14.1.503

Byrne, M. K., Miellet, S., McGlinn, A., Fish, J., Meedya, S., Reynolds, N., & Van Oijen, A. M. (2019). The drivers of antibiotic use and misuse: The development and investigation of a theory driven community measure. *BMC Public Health*, *19*(1), 1–11. https://doi.org/10.1186/s12889-019-7796-8

Carneiro, R. da S., de Almeida Da Costa, M. H., Santos, J. Z. L. V., Uchôa, V. T., da Silva Lopes, L., & Mendes, A. N. (2025). Therapeutic actions of terpenes in neurodegenerative disorders and their correlations with the regulation and remodeling of the extracellular matrix. *Biocell*, *49*(1), 109–125. https://doi.org/10.32604/biocell.2024.058405

Carvalho, N., da Mata, L. R., Ribeiro, P. G., Moreira, A. L. D. C., Pinedo, A. S., Ribeiro, C. S. d. C., Souza, N. O. S., & Buso, G. S. C. (2021). Morphological and anatomical characterization of peduncle, flower and fruit related to easy fruit abscission of Capsicum chinense (Solanaceae) genotypes. *Genetics and Molecular Research*, *20*(4). https://doi.org/10.4238/GMR18887

Chang, Y., Che, Q., Xing, L., Ma, C., Han, Y., Zhu, T., Pfeifer, B. A., Peng, J., Zhang, G., & Li, D. (2021). Antibacterial p-Terphenyl with a Rare 2,2′-Bithiazole Substructure and Related Compounds Isolated from the Marine-Derived Actinomycete Nocardiopsis sp. HDN154086. *Journal of Natural Products*, *84*(4), 1226–1231. https://doi.org/10.1021/acs.jnatprod.0c01296

Chaudhary, P., Janmeda, P., Docea, A. O., Yeskaliyeva, B., Abdull Razis, A. F., Modu, B., Calina, D., & Sharifi-Rad, J. (2023). Oxidative stress, free radicals and antioxidants: potential crosstalk in the pathophysiology of human diseases. *Frontiers in Chemistry*, *11*(May), 1–24.

https://doi.org/10.3389/fchem.2023.1158198

Chen, H., Singh, H., Bhardwaj, N., Bhardwaj, S. K., Khatri, M., Kim, K. H., & Peng, W. (2022). An exploration on the toxicity mechanisms of phytotoxins and their potential utilities. *Critical Reviews in Environmental Science and Technology*, *52*(3), 395–435. https://doi.org/10.1080/10643389.2020.1823172

Chen, Q., Li, Z., Qu, Z., Zhou, H., Qi, Y., Liu, Z., & Zhang, M. (2020). Maize yield and root morphological characteristics affected by controlled-release diammonium phosphate and Paecilomyces variotii extracts. *Field Crops Research*, *255*(April), 107862. https://doi.org/10.1016/j.fcr.2020.107862

Chen, X., Li, X., Zhang, G., Wang, C., & Li, C. (2024). Application of Synthetic Biology to the Biosynthesis of Polyketides. *Synthetic Biology and Engineering*, *2*(3), 10012–10012. https://doi.org/10.35534/sbe.2024.10012

Chhabra, S., Taksande, A. B., & Munjewar, P. (2024). The Penicillin Pioneer: Alexander Fleming's Journey to a Medical Breakthrough. *Cureus*, *16*(7). https://doi.org/10.7759/cureus.65179

Cho, H. U., Yoon, N. Y., Noh, H. J., Kim, Y. I., & Kim, S. H. (2024). Six Unrecorded Species of Sordariomycetes Isolated from Soil in the Republic of Korea. *Korean Journal of Mycology*, *52*(4), 349–370. https://doi.org/10.4489/kjm.520414

Christaki, E., Giannenas, I., Bonos, E., & Florou-Paneri, P. (2019). Innovative uses of aromatic plants as natural supplements in nutrition. *Feed Additives: Aromatic Plants and Herbs in Animal Nutrition and Health*, *October 2022*, 19–34. https://doi.org/10.1016/B978-0-12-814700-9.00002-9

Collins, J. A., & Osheroff, N. (2024). Gyrase and Topoisomerase IV: Recycling Old Targets for New Antibacterials to Combat Fluoroquinolone Resistance. *ACS Infectious Diseases*, *10*(4), 1097–1115. https://doi.org/10.1021/acsinfecdis.4c00128

Corsini, P. M., Wang, S., Rehman, S., Fenn, K., Sagar, A., Sirovica, S., Cleaver, L., Edwards-Gayle, C. J. C., Mastroianni, G., Dorgan, B., Sewell, L. M., Lynham, S., Iuga, D., Franks, W. T., Jarvis, J., Carpenter, G. H., Curtis, M. A., Bernadó, P., Darbari, V. C., & Garnett, J. A. (2022). Molecular and cellular insight into Escherichia coli SslE and its role during biofilm maturation. *Npj Biofilms and Microbiomes*, *8*(1), 1–16. https://doi.org/10.1038/s41522-022-00272-5

Cortesão, M., de Haas, A., Unterbusch, R., Fujimori, A., Schütze, T., Meyer, V., & Moeller, R. (2020). Aspergillus niger Spores Are Highly Resistant to Space Radiation. *Frontiers in Microbiology*, *11*(April), 1–12. https://doi.org/10.3389/fmicb.2020.00560 da Silva Santos, S. da S., da Silva, A. A. da, Polonio, J. C., Polli, A. D., Orlandelli, R. C., dos Santos Oliveira, J. A. D. S., Brandão Filho, J. U. T., Azevedo, J. L., & Pamphile, J. A. (2022). Influence of plant growth-promoting endophytes Colletotrichum siamense and Diaporthe masirevici on tomato plants (Lycopersicon esculentum Mill.). *Mycology*, *13*(4), 257–270. https://doi.org/10.1080/21501203.2022.2050825

Dai, Z. B., Wang, X., & Li, G. H. (2020). Secondary Metabolites and Their Bioactivities Produced by Paecilomyces. *Molecules*, *25*(21), 1–18. https://doi.org/10.3390/molecules25215077

Damen, F., Simo Mpetga, J. D., Demgne, O. M. F., Çelik, İ., Wamba, B. E. N., Tapondjou, L. A., Beng, V. P., Levent, S., Kuete, V., & Tene, M. (2022). Roeperone A, a new tetraoxygenated xanthone and other compounds from the leaves of Hypericum roeperianum Schimp. (Hypericaceae). *Natural Product Research*, *36*(8), 2071–2077. https://doi.org/10.1080/14786419.2020.1845674

Danışman, B., Kelek, S. E., & Aslan, M. (2023). Resveratrol in Neurodegeneration, in Neurodegenerative Diseases, and in the Redox Biology of the Mitochondria. *Psychiatry and Clinical Psychopharmacology*, *33*(2), 147–155. https://doi.org/10.5152/pcp.2023.23633

Das, A. K., Islam, M. N., Faruk, M. O., Ashaduzzaman, M., & Dungani, R. (2020). Review on tannins: Extraction processes, applications and possibilities. *South African Journal of Botany*, *135*, 58–70. https://doi.org/10.1016/j.sajb.2020.08.008

Datta, C., Jha, R. K., Ahmed, W., Ganguly, S., Ghosh, S., & Nagaraja, V. (2019). Physical and functional interaction between nucleoid-associated proteins HU and Lsr2 of Mycobacterium tuberculosis: altered DNA binding and gene regulation. *Molecular Microbiology*, *111*(4), 981–994. https://doi.org/10.1111/mmi.14202

De Almeida, A. J. P. O., De Oliveira, J. C. P. L., Da Silva Pontes, L. V., De Souza Júnior, J. F., Gonçalves, T. A. F., Dantas, S. H., De Almeida Feitosa, M. S., Silva, A. O., & De Medeiros, I. A. (2022). ROS: Basic Concepts, Sources, Cellular Signaling, and its Implications in Aging Pathways. *Oxidative Medicine and Cellular Longevity*, *2022*. https://doi.org/10.1155/2022/1225578

de Oliveira, A. M., Malunga, L. N., Perussello, C. A., Beta, T., & Ribani, R. H. (2020). Phenolic acids from fruits of Physalis angulata L. in two stages of maturation. *South African Journal of Botany*, *131*(May), 448–453. https://doi.org/10.1016/j.sajb.2020.02.029

Dędek, K., Rosicka-Kaczmarek, J., Nebesny, E., & Kowalska, G. (2019). Biotechnology and Food Science Characteristics and biological properties of ferulic acid. *Biotechnol Food Sci*, *83*(1), 71–85. http://www.bfs.p.lodz.pl

Degani, O., Khatib, S., Becher, P., Gordani, A., & Harris, R. (2021). Trichoderma asperellum secreted 6-pentyl-α-pyrone to control magnaporthiopsis maydis, the maize late wilt disease agent. *Biology*, *10*(9). https://doi.org/10.3390/biology10090897

Deng, S., Liu, Q., Chang, W., Liu, J., & Wang, H. (2023). First specific detection and validation of tomato wilt caused by Fusarium brachygibbosum using a PCR assay. *PeerJ*, *11*, 1–15. https://doi.org/10.7717/peerj.16473

Dhayanithy, G., Subban, K., & Chelliah, J. (2019). Diversity and biological activities of endophytic fungi associated with Catharanthus roseus. *BMC Microbiology*, *19*(1), 1–14. https://doi.org/10.1186/s12866-019-1386-x

Dias, M. C., Pinto, D. C. G. A., & Silva, A. M. S. (2021). Plant flavonoids: Chemical characteristics and biological activity. *Molecules*, *26*(17), 1–16. https://doi.org/10.3390/molecules26175377

Díaz-García, E., Valenzuela-Quintanar, A. I., Sánchez-Estrada, A., González-Mendoza, D., Tiznado-Hernández, M. E., Islas-Rubio, A. R., & Troncoso-Rojas, R. (2024). Phenolic Compounds Synthesized by Trichoderma longibrachiatum Native to Semi-Arid Areas Show Antifungal Activity against Phytopathogenic Fungi of Horticultural Interest. *Microbiology Research*, *15*(3), 1425–1440. https://doi.org/10.3390/microbiolres15030096

Ding, Z., Tao, T., Wang, L., Zhao, Y., Huang, H., Zhang, D., Liu, M., Wang, Z., & Han, J. (2019). Bioprospecting of novel and bioactive metabolites from endophytic fungi isolated from rubber tree ficus elastica leavess. *Journal of Microbiology and Biotechnology*, *29*(5), 731–738. https://doi.org/10.4014/jmb.1901.01015

Divekar, P. A., Narayana, S., Divekar, B. A., Kumar, R., Gadratagi, B. G., Ray, A., Singh, A. K., Rani, V., Singh, V., Singh, A. K., Kumar, A., Singh, R. P., Meena, R. S., & Behera, T. K. (2022). Plant Secondary Metabolites as Defense Tools against Herbivores for Sustainable Crop Protection. *International Journal of Molecular Sciences*, *23*(5). https://doi.org/10.3390/ijms23052690

Dong, Z., Manawasinghe, I. S., Huang, Y., Shu, Y., Phillips, A. J. L., Dissanayake, A. J., Hyde, K. D., Xiang, M., & Luo, M. (2021). Endophytic Diaporthe Associated With Citrus grandis cv. Tomentosa in China. *Frontiers in Microbiology*, *11*(February), 1–20. https://doi.org/10.3389/fmicb.2020.609387

Du, W., Yao, Z., Li, J., Id, C. S., Xia, J., Wang, B., Shi, D., & Ren, L. (2020). *Diversity and antimicrobial activity of endophytic fungi isolated from Securinega suffruticosa in the Yellow River Delta*. 1–18.

Du, W., Yao, Z., Li, J., Sun, C., Xia, J., Wang, B., Shi, D., & Ren, L. (2020). Diversity and antimicrobial activity of endophytic fungi isolated from Securinega suffruticosa in the Yellow River Delta. *PLoS ONE*, *15*(3), 1–18.

https://doi.org/10.1371/journal.pone.0229589

Dudaš, T., Todić, A., Budakov, D., Grahovac, M., Loc, M., & Stojšin, V. (2022). Penicillium: Species causing blue mold on stored apple fruits. *Biljni Lekar*, *50*, 92–100. https://doi.org/10.5937/BiljLek2202092D

Duta-Bratu, C. G., Nitulescu, G. M., Mihai, D. P., & Olaru, O. T. (2023). Resveratrol and Other Natural Oligomeric Stilbenoid Compounds and Their Therapeutic Applications. *Plants*, *12*(16). https://doi.org/10.3390/plants12162935

Dutra, R., Nogueira, A., Rossi, S., Chacon Dória, L., Buttò, V., & Marcati, C. R. (2023). The Role of Organ and Leaf Habit on the Secondary Xylem Anatomy Variation across 15 Species from Brazilian Cerrado. *Forests*, *14*(2), 1–13. https://doi.org/10.3390/f14020269

Ebadi, M., & Ebadi, A. (2024). *Importance and Applications of Endophytic Fungi* (J. Putzke (ed.)). IntechOpen. https://doi.org/10.5772/intechopen.1006383

Echeverria, M., Izzi, Y. S., Criado, M. V., & Caputo, C. (2024). Isolation and characterization of dematiaceous endophytic fungi isolated from barley (Hordeum vulgare L.) roots and their potential use as phosphate solubilizers. *The Microbe*, *3*(June 2023), 100058. https://doi.org/10.1016/j.microb.2024.100058

Ekeke, C., Obute, G. C., & Ogazie, C. A. (2019). ISSN 1995-6673 Pages 1-4 Jordan Journal of Biological Sciences A Comparative Anatomical and Epidermal Analysis of Physalis angulata L. and Physalis micrantha L. *Jjbs*, *12*(1), 1–4.

Ekwomadu, T. I., & Mwanza, M. (2023). Fusarium Fungi Pathogens, Identification, Adverse Effects, Disease Management, and Global Food Security: A Review of the Latest Research. *Agriculture (Switzerland)*, *13*(9). https://doi.org/10.3390/agriculture13091810

El-Zehery, H. R. A., Ashry, N. M., Faiesal, A. A., Attia, M. S., Abdel-Maksoud, M. A., El-Tayeb, M. A., Aufy, M., & El-Dougdoug, N. K. (2024). Antibacterial and anticancer potential of bioactive compounds and secondary metabolites of endophytic fungi isolated from Anethum graveolens. *Frontiers in Microbiology*, *15*(October), 1–10. https://doi.org/10.3389/fmicb.2024.1448191

El Obeid Sewaikit, A. M. (2025). Identification and Antimicrobial Activity of Endophytic Fungi Associated with Ocimum basilicum (L.) from Sudan. *International Journal of Current Microbiology and Applied Sciences*, *14*(5), 152–169. https://doi.org/10.20546/ijcmas.2025.1405.016

ELFITA, MARDIYANTO, FITRYA, LARASATI, J. E., JULINAR, WIDJAJANTI, H., & MUHARNI. (2019). Antibacterial activity of Cordyline fruticosa leaf extracts and its endophytic fungi extracts. *Biodiversitas*, *20*(12), 3804–3812. https://doi.org/10.13057/biodiv/d201245

Elfita, Oktiansyah, R., Mardiyanto, Setiawan, A., & Widjajanti, H. (2024). Combination Effect of Extracts and Pure Compounds of Endophytic Fungi Isolated from Sungkai (Peronema canescens) Leaves on Antioxidant Activity. *Science and Technology Indonesia*, *9*(1), 69–76. https://doi.org/10.26554/sti.2024.9.1.69-76

Elfita, Oktiansyah, R., Mardiyanto, Widjajanti, H., & Setiawan, A. (2022). Antibacterial and antioxidant activity of endophytic fungi isolated from Peronema canescens leaves. *Biodiversitas*, *23*(9), 4783–4792. https://doi.org/10.13057/biodiv/d230946

Elfita, Oktiansyah, R., Mardiyanto, Widjajanti, H., Setiawan, A., & Nasution, S. S. A. (2023). Bioactive Compounds of Endophytic Fungi Lasiodiplodia theobromae Isolated From The Leaves of Sungkai (Peronema canescens). *Biointerface Research in Applied Chemistry*, *13*(6). https://doi.org/10.33263/BRIAC136.530

Elkhateeb, W. A., Daba, G. M., Elnahas, M., & Thomas, P. (2019). Anticoagulant Capacities of Some Medicinal Mushrooms. *ARC Journal of Pharmaceutical Sciences*, *5*(4). https://doi.org/10.20431/2455-1538.0504001

Elkhateeb, W., & Daba, G. (2023). Fungal Pigments: Their Diversity, Chemistry, Food and Non-Food Applications. *Applied Microbiology*, *3*(3), 735–751. https://doi.org/10.3390/applmicrobiol3030051

Elshafie, H. S., Camele, I., & Mohamed, A. A. (2023). A Comprehensive Review on the Biological, Agricultural and Pharmaceutical Properties of Secondary Metabolites Based-Plant Origin. *International Journal of Molecular Sciences*, *24*(4). https://doi.org/10.3390/ijms24043266

Elumalai, S., Soundararajan, S., Kanagaraj, P., & Sadhasivam, D. R. (2022). In vitro antioxidant and antibacterial activity of Quercetin isolated from Indigofera aspalathoides and Quercetin-Zinc metal complex. *International Journal of Health Sciences*, *6*(March), 4314–4326. https://doi.org/10.53730/ijhs.v6ns3.6859

Engel, A., Simler-Williamson, A., Ravenscraft, A., Bittleston, L., & de Graaff, M. A. (2024). Interactive effects of fungal community structure and soil moisture on Wyoming big sagebrush performance. *Plant and Soil*, *0123456789*. https://doi.org/10.1007/s11104-024-06809-1

Erdoğan, M., Polat Köse, L., Eşsiz, S., & Gülçin, İ. (2021). Synthesis and biological evaluation of some 1-naphthol derivatives as antioxidants, acetylcholinesterase, and carbonic anhydrase inhibitors. *Archiv Der Pharmazie*, *354*(8). https://doi.org/10.1002/ardp.202100113

Eze, P. M., Abonyi, D. O., Abba, C. C., Proksch, P., Okoye, F. B. C., & Esimone,

C. O. (2019). *Toxic , but beneficial compounds from endophytic fungi of Carica papaya*. *3*(2), 105–111. https://doi.org/10.2478/ebtj-2019-0012

Fadhilla, G., Adnyana, I. K., & Chaniago, R. (2020). AKTIVITAS ANALGETIK EKSTRAK ETANOL DAUN CIPLUKAN (Physalis peruviana L.) PADA MENCIT SWISS WEBSTER JANTAN DENGAN METODE GELIAT (Sigmund). *Jurnal Ilmiah Farmako Bahari*, *11*(1), 75. https://doi.org/10.52434/jfb.v11i1.716

Fadhillah, Elfita, Muharni, Yohandini, H., & Widjajanti, H. (2019). Chemical compound isolated from antioxidant active extract of endophytic fungus Cladosporium tenuissimum in Swietenia mahagoni leaf stalks. *Biodiversitas*, *20*(9), 2645–2650. https://doi.org/10.13057/biodiv/d200929

Falahiya, M. T., Bahri, S., Marnita, Y., & Dalimunthe, C. I. (2023). UJI EFEKTIVITAS BEBERAPA ISOLAT Trichoderma sp . TERHADAP. *J. Agroplantae*, *21*(1), 204–216.

Fan, M., Chen, X., Luo, X., Zhang, H., Liu, Y., Zhang, Y., Wu, J., Zhao, C., & Zhao, P. (2020). Diversity of endophytic fungi from the leaves of Vaccinium dunalianum. *Letters in Applied Microbiology*, *71*(5), 479–489. https://doi.org/10.1111/lam.13345

Farha, A. K., Yang, Q. Q., Kim, G., Li, H. Bin, Zhu, F., Liu, H. Y., Gan, R. Y., & Corke, H. (2020). Tannins as an alternative to antibiotics. *Food Bioscience*, *38*(August), 100751. https://doi.org/10.1016/j.fbio.2020.100751

Fathallah, N., Elkady, W. M., Zahran, S. A., Darwish, K. M., Elhady, S. S., & Elkhawas, Y. A. (2024). Unveiling the Multifaceted Capabilities of Endophytic Aspergillus flavus Isolated from Annona squamosa Fruit Peels against Staphylococcus Isolates and HCoV 229E—In Vitro and In Silico Investigations. *Pharmaceuticals*, *17*(5). https://doi.org/10.3390/ph17050656

Fathoni, A., Ilyas, M., Praptiwi, Wulansari, D., & Agusta, A. (2022). Antibacterial and Antioxidant Activities of Fungal Endophytes Isolated from Medicinal Plants in Simeulue Island, Aceh. *HAYATI Journal of Biosciences*, *29*(6), 720–732. https://doi.org/10.4308/hjb.29.6.720-732

Fernandez, M. R., Abdellatif, L., Lokuruge, P., Schellenberg, M. P., & Lupwayi, N. Z. (2022). Root disease and fungal populations in organic crops under different tillage–cropping systems. *Crop Science*, *62*(3), 1288–1304. https://doi.org/10.1002/csc2.20663

Ferraz, C. R., Franciosi, A., Emidio, N. B., Rasquel-Oliveira, F. S., Manchope, M. F., Carvalho, T. T., Artero, N. A., Fattori, V., Vicentini, F. T. M. C., Casagrande, R., & Verri, W. A. (2021). *Chapter 15 - Quercetin as an antiinflammatory analgesic* (M. Mushtaq & F. B. T.-A. C. of V. P. B. Anwar (eds.); pp. 319–347). Academic Press. https://doi.org/https://doi.org/10.1016/B978-0-12-822923-1.00023-6

Ferraz, M. P. (2024). Antimicrobial Resistance: The Impact from and on Society According to One Health Approach. *Societies*, *14*(9), 1–22. https://doi.org/10.3390/soc14090187

Ferreira, L., Vale, A. do, Souza, A. de, & Leite, K. (2019). Anatomical and phytochemical characterization of Physalis angulata L.: A plant with therapeutic potential. *Pharmacognosy Research*, *11*, 171–17. https://doi.org/10.4103/pr.pr

Figueiredo, M. C. C., Passos, A. R., Hughes, F. M., Santos, K. S. dos, Silva, A. L. da, & Soares, T. L. (2020). Reproductive biology of Physalis angulata L. (Solanaceae). *Scientia Horticulturae*, *267*(February), 109307. https://doi.org/10.1016/j.scienta.2020.109307

Foti, M. C. (2015). Use and Abuse of the DPPH• Radical. *Journal of Agricultural and Food Chemistry*, *63*(40), 8765–8776. https://doi.org/10.1021/acs.jafc.5b03839

Gabrekiristos, E., & Demiyo, T. (2020). Hot Pepper Fusarium Wilt (Fusarium oxysporum f. sp. capsici): Epidemics, Characteristic Features and Management Options. *Journal of Agricultural Science*, *12*(10), 347. https://doi.org/10.5539/jas.v12n10p347

Gao, Y.-Q., Du, S.-T., Xiao, J., Wang, D.-C., Han, W.-B., Zhang, Q., & Gao, J.-M. (2020). Isolation and Characterization of Antifungal Metabolites from the Melia azedarach-Associated Fungus Diaporthe eucalyptorum. *Journal of Agricultural and Food Chemistry*, *68*(8), 2418–2425. https://doi.org/10.1021/acs.jafc.9b07825

Gao, Y., Xu, Y., Dong, Z., Guo, Y., Luo, J., Wang, F., Yan, L., & Zou, X. (2025). Endophytic Fungal Diversity and Its Interaction Mechanism with Medicinal Plants. *Molecules*, *30*(5), 1–22. https://doi.org/10.3390/molecules30051028

Garde, S., Chodisetti, P. K., & Reddy, M. (2021). Peptidoglycan: Structure, Synthesis, and Regulation. *EcoSal Plus*, *9*(2). https://doi.org/10.1128/ecosalplus.esp-0010-2020

Gärditz, K. F., & Czesnick, H. (2024). Paclitaxel - a Product of Fungal Secondary Metabolism or an Artefact? *Planta Medica*, 726–735. https://doi.org/10.1055/a-2309-6298

Garrett, A. T. de A., Dos Santos, Á. F., Filho, A. F., Tambarussi, E. V., Gonçalves, A. B., & Garcia, F. A. de O. (2019). Mycelial growth and sporulation of apoharknessia eucalyptorum on different culture media. *Summa Phytopathologica*, *45*(3), 272–278. https://doi.org/10.1590/0100-5405/207327

GBD. (2022). Global mortality associated with 33 bacterial pathogens in 2019: a systematic analysis for the Global Burden of Disease Study 2019. In *The*

Lancet (Vol. 400, Issue 10369, pp. 2221–2248). https://doi.org/10.1016/S0140-6736(22)02185-7

Ghareeb, R. Y., Jaremko, M., Abdelsalam, N. R., Abdelhamid, M. M. A., EL-Argawy, E., & Ghozlan, M. H. (2024). Biocontrol potential of endophytic fungi against phytopathogenic nematodes on potato (Solanum tuberosum L.). *Scientific Reports*, *14*(1), 1–14. https://doi.org/10.1038/s41598-024-64056-x

Gizaw, F., Kekeba, T., Teshome, F., Kebede, M., Abreham, T., Berhe, H. H., Ayana, D., Edao, B. M., Waktole, H., Tufa, T. B., Abunna, F., Beyi, A. F., & Abdi, R. D. (2023). Multidrug-Resistant Staphylococcus aureus Strains Thrive in Dairy and Beef Production, Processing, and Supply Lines in Five Geographical Areas in Ethiopia. *Veterinary Sciences*, *10*(12). https://doi.org/10.3390/vetsci10120663

Gorai, P. S., Barman, S., Gond, S. K., & Mandal, N. C. (2020). *Chapter 28 - Trichoderma* (N. Amaresan, M. Senthil Kumar, K. Annapurna, K. Kumar, & A. B. T.-B. M. in A.-E. Sankaranarayanan (eds.); pp. 571–591). Academic Press. https://doi.org/https://doi.org/10.1016/B978-0-12-823414-3.00028-9

Górniak, I., Bartoszewski, R., & Króliczewski, J. (2019). Comprehensive review of antimicrobial activities of plant flavonoids. In *Phytochemistry Reviews* (Vol. 18, Issue 1). https://doi.org/10.1007/s11101-018-9591-z

Gowtham, H. G., Hema, P., Murali, M., Shilpa, N., Nataraj, K., Basavaraj, G. L., Singh, S. B., Aiyaz, M., Udayashankar, A. C., & Amruthesh, K. N. (2024). Fungal Endophytes as Mitigators against Biotic and Abiotic Stresses in Crop Plants. *Journal of Fungi*, *10*(2), 1–34. https://doi.org/10.3390/jof10020116

Grigor'eva, A., Bardasheva, A., Tupitsyna, A., Amirkhanov, N., Tikunova, N., Pyshnyi, D., & Ryabchikova, E. (2020). Changes in the ultrastructure of staphylococcus aureus treated with cationic peptides and chlorhexidine. *Microorganisms*, *8*(12), 1–19. https://doi.org/10.3390/microorganisms8121991

Gryganskyi, A. P., Golan, J., Muszewska, A., Idnurm, A., Dolatabadi, S., Mondo, S. J., Kutovenko, V. B., Kutovenko, V. O., Gajdeczka, M. T., Anishchenko, I. M., Pawlowska, J., Tran, N. V., Ebersberger, I., Voigt, K., Wang, Y., Chang, Y., Pawlowska, T. E., Heitman, J., Vilgalys, R., … Stajich, J. E. (2023). Sequencing the Genomes of the First Terrestrial Fungal Lineages: What Have We Learned? *Microorganisms*, *11*(7), 1–24. https://doi.org/10.3390/microorganisms11071830

Gu, H., Zhang, S., Liu, L., Yang, Z., Zhao, F., & Tian, Y. (2022). Antimicrobial Potential of Endophytic Fungi From Artemisia argyi and Bioactive Metabolites From Diaporthe sp. AC1. *Frontiers in Microbiology*, *13*(June), 1–13. https://doi.org/10.3389/fmicb.2022.908836

Gu, K., Chen, C. Y., Selvaraj, P., Pavagadhi, S., Yeap, Y. T., Swarup, S., Zheng, W., & Naqvi, N. I. (2023). Penicillium citrinum Provides Transkingdom Growth Benefits in Choy Sum (Brassica rapa var. parachinensis). *Journal of Fungi*, *9*(4). https://doi.org/10.3390/jof9040420

Gulcin, İ. (2020). Antioxidants and antioxidant methods: an updated overview. *Archives of Toxicology*, *94*(3), 651–715. https://doi.org/10.1007/s00204-020-02689-3

Gulcin, İ. (2025). Antioxidants: a comprehensive review. In *Archives of Toxicology*. https://doi.org/10.1007/s00204-025-03997-2

Gulcin, İ., & Alwasel, S. H. (2023). DPPH Radical Scavenging Assay. *Processes*, *11*(8). https://doi.org/10.3390/pr11082248

Gultom, E. D., Rambe, R., Paramitha, R., & Ginting, O. S. B. (2021). UJI AKTIVITAS ANTIDIARE EKSTRAK ETANOL DAUN CIPLUKAN (Physallis minima L.) TERHADAP MENICT JANTAN (Mus musculus). *Forte Journal*, *1*(1), 26–44. https://doi.org/10.51771/fj.v1i1.37

Guo, D., Wang, H., Zhang, S., & Lan, T. (2022). The type III polyketide synthase supergene family in plants: complex evolutionary history and functional divergence. *Plant Journal*, *112*(2), 414–428. https://doi.org/10.1111/tpj.15953

Gupta, S., Schillaci, M., Walker, R., Smith, P. M. C., Watt, M., & Roessner, U. (2021). Alleviation of salinity stress in plants by endophytic plant-fungal symbiosis: Current knowledge, perspectives and future directions. *Plant and Soil*, *461*(1–2), 219–244. https://doi.org/10.1007/s11104-020-04618-w

Hădărugă, N.-G., & Hădărugă, D.-I. (2022). *Stilbenes and Its Derivatives and Glycosides BT - Handbook of Food Bioactive Ingredients: Properties and Applications* (S. M. Jafari, A. Rashidinejad, & J. Simal-Gandara (eds.); pp. 1–58). Springer International Publishing. https://doi.org/10.1007/978-3-030-81404-5_14-1

Ham, J., Lim, W., Whang, K. Y., & Song, G. (2020). Butylated hydroxytoluene induces dysregulation of calcium homeostasis and endoplasmic reticulum stress resulting in mouse Leydig cell death. *Environmental Pollution*, *256*(xxxx), 113421. https://doi.org/10.1016/j.envpol.2019.113421

Hami, A., Rasool, R. S., Khan, N. A., Mansoor, S., & Mir, M. A. (2021). Morpho - molecular identification and first report of Fusarium equiseti in causing chilli wilt from Kashmir (Northern Himalayas). *Scientific Reports*, *0123456789*, 1–14. https://doi.org/10.1038/s41598-021-82854-5

Hammoumi, D., Al-Aizari, H. S., Alaraidh, I. A., Okla, M. K., Assal, M. E., Al-Aizari, A. R., Moshab, M. S., Chakiri, S., & Bejjaji, Z. (2024). Seasonal Variations and Assessment of Surface Water Quality Using Water Quality Index (WQI) and Principal Component Analysis (PCA): A Case Study. *Sustainability (Switzerland)*, *16*(13), 1–22.

https://doi.org/10.3390/su16135644

Han, Y.-K., Dumin, W., Park, M.-J., Bae, Y.-S., Park, J.-H., & Back, C.-G. (2022). *Disease Note Diseases Caused by Fungi and Fungus-Like Organisms First Report of Fusarium Wilt Disease Caused by Fusarium equiseti on Grafted Watermelon in Korea*. *November*, 2989. https://doi.org/10.1094/PDIS-

Haque, S., Sengupta, S., Khan, A., Mukhopadhyay, A. K., Bhan, M. K., Kumar, R., & Jailkhani, B. (2023). Immune response of S. Typhi-derived Vi polysaccharide and outer membrane protein a conjugate in mice. *Pediatrics and Neonatology*, *64*(5), 518–527. https://doi.org/10.1016/j.pedneo.2022.12.011

Hashem, A. H., Attia, M. S., Kandil, E. K., Fawzi, M. M., Abdelrahman, A. S., Khader, M. S., Khodaira, M. A., Emam, A. E., Goma, M. A., & Abdelaziz, A. M. (2023). Bioactive compounds and biomedical applications of endophytic fungi: a recent review. *Microbial Cell Factories*, *22*(1), 1–23. https://doi.org/10.1186/s12934-023-02118-x

Hassanpour, S. H., & Doroudi, A. (2023). Review of the antioxidant potential of flavonoids as a subgroup of polyphenols and partial substitute for synthetic antioxidants. *Avicenna Journal of Phytomedicine*, *13*(4), 354–376. https://doi.org/10.22038/AJP.2023.21774

Hastuti, U. S., Sulisetijono, Rahmawati, D., Sari, R. Y., Hartono, S., Thoyibah, C., Maulita, F., Ningsih, F. N. I., & Pratiwi, S. H. (2021). Identification and histological observation of endophytic fungisolated from medicinal plant, physalis angulata L. *HAYATI J Biosci*, *28*(2), 130–135. https://doi.org/10.4308/hjb.28.2.130

Hawar, S. N., Taha, Z. K., Hamied, A. S., Al-Shmgani, H. S., Sulaiman, G. M., & Elsilk, S. E. (2023). Antifungal Activity of Bioactive Compounds Produced by the Endophytic Fungus Paecilomyces sp. (JN227071.1) against Rhizoctonia solani. *International Journal of Biomaterials, 2023*. https://doi.org/10.1155/2023/2411555

He, T., Li, X., Iacovelli, R., Hackl, T., & Haslinger, K. (2023). Genomic and Metabolomic Analysis of the Endophytic Fungus Fusarium sp. VM-40 Isolated from the Medicinal Plant Vinca minor. *Journal of Fungi*, *9*(7). https://doi.org/10.3390/jof9070704

Hengge, R. (2020). Linking bacterial growth, survival, and multicellularity – small signaling molecules as triggers and drivers. *Current Opinion in Microbiology*, *55*, 57–66. https://doi.org/10.1016/j.mib.2020.02.007

Herve, M., & Ndomou, S. C. (2023). *The Use of Plants as Phytobiotics: A New Challenge*. https://doi.org/10.5772/intechopen.110731

Hilje-Rodríguez, I., & Molina-Bravo, R. (2020). Inoculation and co-inoculation of two monosporic fungi onto surface-sterile blackberry fruits for quantification experiments. *MethodsX*, *7*, 10–13. https://doi.org/10.1016/j.mex.2020.101092

Himawan, C. H., Inawati, & Lubis, A. (2020). AKTIVITAS ANTIOKSIDAN EKSTRAK AIR DAUN JAMBU MAWAR (Syzygium Jambos Alston) METODE PERENDAMAN RADIKAL BEBAS DENGAN DPPH. *Jurnal Farmamedika (Pharmamedica Journal)*, *5*(2), 52–59. https://doi.org/10.47219/ath.v5i2.105

Holzknecht, J., Kühbacher, A., Papp, C., Farkas, A., Váradi, G., Marcos, J. F., Manzanares, P., Tóth, G. K., Galgóczy, L., & Marx, F. (2020). The penicillium chrysogenum Q176 antimicrobial protein pafc effectively inhibits the growth of the opportunistic human pathogen Candida albicans. *Journal of Fungi*, *6*(3), 1–21. https://doi.org/10.3390/jof6030141

Hoque, N., Khan, Z. R., Rashid, P. T., Begum, M. N., Sharmin, S., Hossain, M. J., Rana, M. S., & Sohrab, M. H. (2023). Antimicrobial, antioxidant, and cytotoxic properties of endophytic fungi isolated from Thysanolaena maxima Roxb., Dracaena spicata Roxb. and Aglaonema hookerianum Schott. *BMC Complementary Medicine and Therapies*, *23*(1), 1–11. https://doi.org/10.1186/s12906-023-04185-4

Hossain, M., Rahman, W., Ali, M., Sultana, T., & Hossain, K. (2021). Identification and Antibiogram Assay of Escherichia Coli Isolated From Chicken Eggs. *Journal of Bio-Science*, *29*(1), 123–133. https://doi.org/10.3329/jbs.v29i0.54828

Hu, X., Li, X., Yang, S., Liu, H., & Meng, L. (2020). Three New Sesquiterpenoids from the Algal-Derived. *Mar. Drugs*, *18*(194), 1–10.

Huang, J., Xu, W., Zhai, J., Hu, Y., Guo, J., Zhang, C., Zhao, Y., Zhang, L., Martine, C., Ma, H., & Huang, C. H. (2023). Nuclear phylogeny and insights into whole-genome duplications and reproductive development of Solanaceae plants. *Plant Communications*, *4*(4), 1–22. https://doi.org/10.1016/j.xplc.2023.100595

Huang, W., Wang, Y., Tian, W., Cui, X., Tu, P., Li, J., Shi, S., & Liu, X. (2022). Biosynthesis Investigations of Terpenoid, Alkaloid, and Flavonoid Antimicrobial Agents Derived from Medicinal Plants. *Antibiotics*, *11*(10). https://doi.org/10.3390/antibiotics11101380

Huang, X., Wu, Y., Ni, Y., Xu, H., & He, Y. (2025). Global, regional, and national burden of type 2 diabetes mellitus caused by high BMI from 1990 to 2021, and forecasts to 2045: analysis from the global burden of disease study 2021. *Frontiers in Public Health*, *13*(January), 1–12. https://doi.org/10.3389/fpubh.2025.1515797

Huda-Shakirah, A. R., Kee, Y. J., Wong, K. L., Zakaria, L., & Mohd, M. H. (2021). Diaporthe species causing stem gray blight of red-fleshed dragon fruit

(Hylocereus polyrhizus) in Malaysia. *Scientific Reports*, *11*(1), 1–12. https://doi.org/10.1038/s41598-021-83551-z

Hurtado-Barroso, S., Quifer-Rada, P., Marhuenda-Muñoz, M., Rinaldi de Alvarenga, J. F., Tresserra-Rimbau, A., & Lamuela-Raventós, R. M. (2019). Increase of 4-hydroxybenzoic, a bioactive phenolic compound, after an organic intervention diet. *Antioxidants*, *8*(9), 1–12. https://doi.org/10.3390/antiox8090340

Hussein, Z. M., Abedali, A. H., & Ahmead, A. S. (2019). Improvement Properties of Self-Healing Concrete by Using Bacteria. *IOP Conference Series: Materials Science and Engineering*, *584*(1). https://doi.org/10.1088/1757-899X/584/1/012034

Hymøller, K. M., Christiansen, S. H., Schlosser, A. G., Skov Sørensen, U. B., Lee, J. C., & Thiel, S. (2024). Recognition of Staphylococcus aureus by the pattern recognition molecules langerin, mannan-binding lectin, and surfactant protein D: the influence of capsular polysaccharides and wall teichoic acid. *Frontiers in Immunology*, *15*(January), 1–14. https://doi.org/10.3389/fimmu.2024.1504886

Ibrahim, M., Oyebanji, E., Fowora, M., Aiyeolemi, A., Orabuchi, C., Akinnawo, B., & Adekunle, A. A. (2021). Extracts of endophytic fungi from leaves of selected Nigerian ethnomedicinal plants exhibited antioxidant activity. *BMC Complementary Medicine and Therapies*, *21*(1), 1–13. https://doi.org/10.1186/s12906-021-03269-3

Igiehon, N. O., Babalola, O. O., Cheseto, X., & Torto, B. (2021). Effects of rhizobia and arbuscular mycorrhizal fungi on yield, size distribution and fatty acid of soybean seeds grown under drought stress. *Microbiological Research*, *242*, 126640. https://doi.org/10.1016/j.micres.2020.126640

Ikram, M., Ali, N., Jan, G., Hamayun, M., Jan, F. G., & Iqbal, A. (2019). Novel antimicrobial and antioxidative activity by endophytic Penicillium roqueforti and Trichoderma reesei isolated from Solanum surattense. *Acta Physiologiae Plantarum*, *41*(9), 164. https://doi.org/10.1007/s11738-019-2957-z

Inayati, A., Setyowati, L., Aini, L. Q., & Yusnawan, E. (2021). Plant growth promoter produced by Trichoderma virens and its effect on mungbean (Vigna radiata (L.) Wilczek) seedling. *IOP Conference Series: Earth and Environmental Science*, *803*(1). https://doi.org/10.1088/1755-1315/803/1/012013

Indradi, R. B., Muhaimin, M., Barliana, M. I., & Khatib, A. (2023). Potential Plant-Based New Antiplasmodial Agent Used in Papua Island, Indonesia. *Plants*, *12*(9). https://doi.org/10.3390/plants12091813

Islam, T., Ara, I., Islam, T., Sah, P. K., Almeida, R. S. de, Matias, E. F. F., Ramalho, C. L. G., Coutinho, H. D. M., & Islam, M. T. (2023). Ethnobotanical uses and phytochemical, biological, and toxicological profiles of Datura metel L.: A review. *Current Research in Toxicology*, *4*(January), 100106. https://doi.org/10.1016/j.crtox.2023.100106

ITIS. (2023). Physalis angulata L. In *ITIS - Report: Physalis angulata*. https://doi.org/10.5860/choice.49-6871

Iwansyah, A. C., Luthfiyanti, R., Ardiansyah, R. C. E., Rahman, N., Andriana, Y., & Hamid, H. A. (2022). Antidiabetic activity of Physalis angulata L. fruit juice on streptozotocin-induced diabetic rats. *South African Journal of Botany*, *145*, 313–319. https://doi.org/10.1016/j.sajb.2021.08.045

Jalab, A. Z., & Al-Rufaye, Z. T. A. (2023). Chemical composition and antioxidant activity of Physalis angulata AH-ZE. *World Journal of Advanced Research and Reviews*, *19*(2), 1072–1077. https://doi.org/10.30574/wjarr.2023.19.2.1610

Jamali, S. (2015). First report of Helicocephalum sarcophilum (Zoopagomycotina) in Iran. *Mycol. Iran*, *2*(June 2014), 78.

Jayalakshmi, R., Oviya, R., Premalatha, K., Mehetre, S. T., Paramasivam, M., Kannan, R., Theradimani, M., Pallavi, M. S., Mukherjee, P. K., & Ramamoorthy, V. (2021). Production, stability and degradation of Trichoderma gliotoxin in growth medium, irrigation water and agricultural soil. *Scientific Reports*, *11*(1), 1–14. https://doi.org/10.1038/s41598-021-95907-6

Jayatilake, P. L., & Munasinghe, H. (2020). Antimicrobial Activity of Cultivable Endophytic and Rhizosphere Fungi Associated with “mile-a-Minute,” Mikania cordata (Asteraceae). *BioMed Research International*, *2020*. https://doi.org/10.1155/2020/5292571

Jha, P., Kaur, T., Chhabra, I., Panja, A., Paul, S., Kumar, V., & Malik, T. (2023). Endophytic fungi: hidden treasure chest of antimicrobial metabolites interrelationship of endophytes and metabolites. *Frontiers in Microbiology*, *14*(July), 1–16. https://doi.org/10.3389/fmicb.2023.1227830

Jian, Z., Zeng, L., Xu, T., Sun, S., Yan, S., Yang, L., Huang, Y., Jia, J., & Dou, T. (2021). Antibiotic resistance genes in bacteria: Occurrence, spread, and control. *Journal of Basic Microbiology*, *61*(12), 1049–1070. https://doi.org/10.1002/jobm.202100201

Jiang, Y., Chen, J., Wang, Z., Zhou, J., & Hu, G. (2025). Mechanical Properties of Korla Fragrant Pear Fruiting Branches and Pedicels: Implications for Non-Destructive Harvesting. *Horticulturae, 11*(8), 880. https://doi.org/10.3390/horticulturae11080880

Jiang, Y., Jin, Y., Shan, Y., Zhong, Q., Wang, H., Shen, C., & Feng, S. (2024). Advances in Physalis molecular research: applications in authentication, genetic diversity, phylogenetics, functional genes, and omics. *Frontiers in Plant Science*, *15*(June), 1–11. https://doi.org/10.3389/fpls.2024.1407625

Jildeh, Z. B., Wagner, P. H., & Schöning, M. J. (2021). Sterilization of Objects, Products, and Packaging Surfaces and Their Characterization in Different Fields of Industry: The Status in 2020. *Physica Status Solidi (A) Applications and Materials Science*, *218*(13). https://doi.org/10.1002/pssa.202000732

Jin, L., Yang, L., Li, W., Xu, D., Yang, N., Li, G., & Wan, P. (2021). Diversity and Biocontrol Potential of Culturable Endophytic Fungi in Cotton. *Frontiers in Microbiology*, *12*(August), 1–15. https://doi.org/10.3389/fmicb.2021.698930

Jin, X., Zhang, L., Cao, Y., Dai, Z., Ge, X., Cai, R., Wang, R., & Hu, Z. (2024). Antibiotic resistance characterization, virulence factors and molecular characteristics of Bacillus species isolated from probiotic preparations in China. *Journal of Global Antimicrobial Resistance*, *43*, 35–39. https://doi.org/10.1016/j.jgar.2024.06.015

Jomova, K., Alomar, S. Y., Alwasel, S. H., Nepovimova, E., Kuca, K., & Valko, M. (2024). Several lines of antioxidant defense against oxidative stress: antioxidant enzymes, nanomaterials with multiple enzyme-mimicking activities, and low-molecular-weight antioxidants. In *Archives of Toxicology* (Vol. 98, Issue 5). Springer Berlin Heidelberg. https://doi.org/10.1007/s00204-024-03696-4

Ju, M., Zhang, Q., Wang, R., Yan, S., Zhang, Q., Li, P., Hao, F., & Gu, P. (2024). Community ecological succession of endophytic fungi associates with medicinal compound accumulation in Sophora alopecuroides . *Microbiology Spectrum*, *12*(2), 1–18. https://doi.org/10.1128/spectrum.03076-23

Kalinga, J., Samarakoon, K., Siriwardhane, U., Yakandawala, D., Adikaram, N., Jayasinghe, L., Araya, H., & Fujimoto, Y. (2025). α-Glucosidase inhibitor and phytotoxic metabolite produced by an endophytic fungus Diaporthe melonis isolated from Acalypha indica L. *Vegetos*. https://doi.org/10.1007/s42535-025-01313-y

Kalogerakou, T., & Antoniadou, M. (2024). The Role of Dietary Antioxidants, Food Supplements and Functional Foods for Energy Enhancement in Healthcare Professionals. *Antioxidants*, *13*(12), 1–37. https://doi.org/10.3390/antiox13121508

Kamran, F., Phillips, M., Harman, D. G., & Reddy, N. (2023). Antioxidant activities of lupin (Lupinus angustifolius) protein hydrolysates and their potential for nutraceutical and functional foods. *Food Chem. Adv*, *2*(May), 100297. https://doi.org/10.1016/j.focha.2023.100297

Kapoor, M. P., Sugita, M., Fukuzawa, Y., Timm, D., & Ozeki, M. (2021). Green Tea Catechin Association with Ultraviolet. *Molecules*, *26*(3702), 1–20. https://doi.org/10.3390/molecules26123702

Kastanis, G. J., Santana-Quintero, L. V., Sanchez-Leon, M., Lomonaco, S., Brown, E. W., & Allard, M. W. (2019). In-depth comparative analysis of Illumina ® MiSeq run metrics: Development of a wet-lab quality assessment tool. *Molecular Ecology Resources*, *19*(2), 377–387. https://doi.org/10.1111/1755-0998.12973

Kauffmann, A. C., & Castro, V. S. (2023). Phenolic Compounds in Bacterial Inactivation: A Perspective from Brazil. *Antibiotics*, *12*(4), 1–24. https://doi.org/10.3390/antibiotics12040645

Kaur, H., Jamir, I., Yangzes, S., Ahmad, H., Agnihotri, S., Gupta, S., Ghosh, A., & Rudramurthy, S. (2024). Papulaspora equi keratitis in an infant. *Indian Journal of Medical Microbiology*, *52,* 100748. https://doi.org/10.1016/j.ijmmb.2024.100748

Khadiri, M., Boubaker, H., Lahmamsi, H., Taoussi, M., Ezzouggari, R., Askarne, L., Farhaoui, A., Barka, E. A., & Lahlali, R. (2024). Challenges in apple preservation: Fungicide resistance and emerging biocontrols. *Physiological and Molecular Plant Pathology*, *129*(October 2023), 102205. https://doi.org/10.1016/j.pmpp.2023.102205

Khan, M. A. (2022). Pathogenic Bacteria and Medical Treatment Abstract. *Archives of Clinical Microbiology*, *13*(8), 7–9. https://doi.org/10.36648/1989-8436X.22.16.8.200

Khan, M. A. B., Hashim, M. J., King, J. K., Govender, R. D., Mustafa, H., & Kaabi, J. Al. (2020). Epidemiology of Type 2 Diabetes – Global Burden of Disease and Forecasted Trends. *Journal of Epidemiology and Global Health*, *10*(1), 107–111. https://doi.org/10.3109/9780849379581-6

Khan, M., & Shamim, S. (2022). Understanding the Mechanism of Antimicrobial Resistance and Pathogenesis of Salmonella enterica Serovar Typhi. *Microorganisms*, *10*(10). https://doi.org/10.3390/microorganisms10102006

Khan, R., Anwar, F., & Ghazali, F. M. (2024). A comprehensive review of mycotoxins: Toxicology, detection, and effective mitigation approaches. *Heliyon*, *10*(8), e28361. https://doi.org/10.1016/j.heliyon.2024.e28361

Kheir, E. A. M., Elhussein, A. A., & Yagi, M. (2023). *endophytic fungi isolates inhabited Acacia nilotica*. 4–9.

Kim, Y., & Kim, Y. (2024). Synthesis of Penta- and Tetrasubstituted Quercetins and Their Fluorescent Properties. *European Journal of Organic Chemistry*, *27*(2), e202300807. https://doi.org/https://doi.org/10.1002/ejoc.202300807

Kirit, H. A., Bollback, J. P., & Lagator, M. (2022). The Role of the Environment in Horizontal Gene Transfer. *Molecular Biology and Evolution*, *39*(11), 1–11. https://doi.org/10.1093/molbev/msac220

Ko, Y. C., Choi, H. S., Liu, R., & Lee, D. S. (2021). Physalin a, 13,14-seco-16, 24-

cyclo-steroid, inhibits stemness of breast cancer cells by regulation of hedgehog signaling pathway and yes-associated protein 1 (Yap1). *International Journal of Molecular Sciences*, *22*(16). https://doi.org/10.3390/ijms22168718

Kozlov, A. V., Javadov, S., & Sommer, N. (2024). Cellular ROS and Antioxidants: Physiological and Pathological Role. *Antioxidants*, *13*(5), 1–11. https://doi.org/10.3390/antiox13050602

Krawczyk, S. J., Leśniczak-Staszak, M., Gowin, E., & Szaflarski, W. (2024). Mechanistic Insights into Clinically Relevant Ribosome-Targeting Antibiotics. *Biomolecules*, *14*(10), 1–13. https://doi.org/10.3390/biom14101263

Kremer, M. L. (2023). Initial Steps in the Reaction of H2O2 with Fe2+ and Fe3+ Ions: Inconsistency in the Free Radical Theory. *Reactions*, *4*(1), 171–175. https://doi.org/10.3390/reactions4010010

Kruk, J., Aboul-Enein, H. Y., Kładna, A., & Bowser, J. E. (2019). Oxidative stress in biological systems and its relation with pathophysiological functions: the effect of physical activity on cellular redox homeostasis. *Free Radical Research*, *53*(5), 497–521. https://doi.org/10.1080/10715762.2019.1612059

Krzyżek, P. (2019). Challenges and limitations of anti-quorum sensing therapies. *Frontiers in Microbiology*, *10*(OCT). https://doi.org/10.3389/fmicb.2019.02473

Kubayi, S., Makola, R. T., & Dithebe, K. (2025). Exploring the Antimicrobial, Antioxidant and Extracellular Enzymatic Activities of Culturable Endophytic Fungi Isolated from the Leaves of Kirkia acuminata Oliv. *Microorganisms*, *13*(3), 1–17. https://doi.org/10.3390/microorganisms13030692

Kumar, N., & Goel, N. (2019). Phenolic acids: Natural versatile molecules with promising therapeutic applications. *Biotechnology Reports*, *24*, e00370. https://doi.org/10.1016/j.btre.2019.e00370

Kumar, S., Abedin, M. M., Singh, A. K., & Das, S. (2020). Role of Phenolic Compounds in Plant-Defensive Mechanisms. *Plant Phenolics in Sustainable Agriculture*, *1*, 1–594. https://doi.org/10.1007/978-981-15-4890-1

Kumar, V., Kumar, H., Vishal, V., & Lal, S. (2023). Studies on the morphology, phylogeny, and bioremediation potential of Penicillium citrinum and Paecilomyces variotii (Eurotiales) from oil-contaminated areas. *Archives of Microbiology*, *205*(1), 50. https://doi.org/10.1007/s00203-022-03383-x

Kumara, P., K, S., & Kumar B, A. (2018). Determination of DPPH Free Radical Scavenging Activity by RP-HPLC, Rapid Sensitive Method for the Screening of Berry Fruit Juice Freeze Dried Extract. *Natural Products Chemistry & Research*, *06*(05). https://doi.org/10.4172/2329-6836.1000341

Kumari, P., Deepa, N., Trivedi, P. K., Singh, B. K., Srivastava, V., & Singh, A. (2023). Plants and endophytes interaction: a "secret wedlock" for sustainable biosynthesis of pharmaceutically important secondary metabolites. *Microbial Cell Factories*, *22*(1), 1–19. https://doi.org/10.1186/s12934-023-02234-8

Kuru, E., Radkov, A., Meng, X., Egan, A., Alvarez, L., Dowson, A., Booher, G., Breukink, E., Roper, D. I., Cava, F., Vollmer, W., Brun, Y., & Vannieuwenhze, M. S. (2019). Mechanisms of Incorporation for D -Amino Acid Probes That Target Peptidoglycan Biosynthesis. *ACS Chemical Biology*, *14*(12), 2745–2756. https://doi.org/10.1021/acschembio.9b00664

Kusumah, D., Wakui, M., Murakami, M., Xie, X., Yukihito, K., & Maeda, I. (2020). Linoleic acid, α-linolenic acid, and monolinolenins as antibacterial substances in the heat-processed soybean fermented with Rhizopus oligosporus. *Bioscience, Biotechnology and Biochemistry*, *84*(6), 1285–1290. https://doi.org/10.1080/09168451.2020.1731299

Kuźniar, A., Kruczyńska, A., Włodarczyk, K., Vangronsveld, J., & Wolińska, A. (2025). Endophytes as Permanent or Temporal Inhabitants of Different Ecological Niches in Sustainable Agriculture. *Applied Sciences (Switzerland)*, *15*(3), 1–29. https://doi.org/10.3390/app15031253

Lakey-Beitia, J., Burillo, A. M., La Penna, G., Hegde, M. L., & Rao, K. S. (2021). Polyphenols as Potential Metal Chelation Compounds against Alzheimer's Disease. *Journal of Alzheimer's Disease*, *82*(s1), S335–S357. https://doi.org/10.3233/JAD-200185

Langer, P. (2021). Domino Reactions of Chromones with Heterocyclic Enamines. *Synlett*, *33*(03), 207–223. https://doi.org/10.1055/s-0040-1719830

Lautenschläger, T., Rüggeberg, M., Noack, N., Bunk, K., Mawunu, M., Speck, T., & Neinhuis, C. (2020). Functional principles of baobab fruit pedicels - Anatomy and biomechanics. *Annals of Botany*, *126*(7), 1215–1223. https://doi.org/10.1093/aob/mcaa149

Li, Q. xi, Lin, F. cheng, & Su, Z. zhu. (2025). Endophytic fungi—Big player in plant-microbe symbiosis. *Current Plant Biology*, *42*(November 2024), 100481. https://doi.org/10.1016/j.cpb.2025.100481

Li, W., Chen, H., Xu, B., Wang, Y., Zhang, C., Cao, Y., & Xing, X. (2023). Research progress on classification, sources and functions of dietary polyphenols for prevention and treatment of chronic diseases. *Journal of Future Foods*, *3*(4), 289–305. https://doi.org/10.1016/j.jfutfo.2023.03.001

Li, W., Koshkarov, A., & Tahiri, N. (2024). Comparison of phylogenetic trees defined on different but mutually overlapping sets of taxa: A review. *Ecology and Evolution*, *14*(8), 1–16. https://doi.org/10.1002/ece3.70054

Li, X. Q., Xu, K., Liu, X. M., & Zhang, P. (2020). A Systematic Review on

Secondary Metabolites of Paecilomyces Species: Chemical Diversity and Biological Activity. *Planta Medica*, *86*(12), 805–821. https://doi.org/10.1055/a-1196-1906

Li, Z., Wen, W., Qin, M., He, Y., Xu, D., & Li, L. (2022). Biosynthetic Mechanisms of Secondary Metabolites Promoted by the Interaction Between Endophytes and Plant Hosts. *Frontiers in Microbiology*, *13*(July). https://doi.org/10.3389/fmicb.2022.928967

Li, Z., Xiong, K., Wen, W., Li, L., & Xu, D. (2023). Functional Endophytes Regulating Plant Secondary Metabolism: Current Status, Prospects and Applications. *International Journal of Molecular Sciences*, *24*(2). https://doi.org/10.3390/ijms24021153

Liang, Y., Liang, L., Shi, R., Luo, R., Yue, Y., Yu, J., Wang, X., Lin, J., Zhou, T., Yang, M., Zhong, L., Wang, Y., & Shu, Z. (2024). Genus Physalis L.: A review of resources and cultivation, chemical composition, pharmacological effects and applications. *Journal of Ethnopharmacology*, *324*(August 2023), 117736. https://doi.org/10.1016/j.jep.2024.117736

Lin, Y.-H., Hsiao, Y.-H., Ng, K.-L., Kuo, Y.-H., Lim, Y.-P., & Hsieh, W.-T. (2020). Physalin A attenuates inflammation through down-regulating c-Jun NH2 kinase phosphorylation/Activator Protein 1 activation and up-regulating the antioxidant activity. *Toxicology and Applied Pharmacology*, *402*, 115115. https://doi.org/https://doi.org/10.1016/j.taap.2020.115115

Liu, H. Y., Luo, D., Huang, H. L., & Yang, Q. (2024). Two new species of Diaporthe (Diaporthaceae, Diaporthales) associated with Camellia oleifera leaf spot disease in Hainan Province, China. *MycoKeys*, *102*(2024), 225–243. https://doi.org/10.3897/mycokeys.102.113412

Liu, W., Zhang, H., Wan, H., Hou, J., Lee, D., Xu, J., & Guo, Y. (2022). Anti-inflammatory withanolides from the aerial parts of Physalis minima. *Phytochemistry*, *202*, 113301. https://doi.org/https://doi.org/10.1016/j.phytochem.2022.113301

Liu, X., Zhou, Z. Y., Cui, J. L., Wang, M. L., & Wang, J. H. (2021). Biotransformation ability of endophytic fungi: from species evolution to industrial applications. *Applied Microbiology and Biotechnology*, *105*(19), 7095–7113. https://doi.org/10.1007/s00253-021-11554-x

Lobatto, V. L., García, M. E., Nicotra, V. E., Orozco, C. I., & Casero, C. N. (2023). Antibacterial activity of withanolides and their structure-activity relationship. *Steroids*, *199*(June), 109297. https://doi.org/10.1016/j.steroids.2023.109297

Lobiuc, A., Pavăl, N. E., Mangalagiu, I. I., Gheorghiță, R., Teliban, G. C., Amăriucăi-Mantu, D., & Stoleru, V. (2023). Future Antimicrobials: Natural and Functionalized Phenolics. *Molecules*, *28*(3). https://doi.org/10.3390/molecules28031114

Lombardi, N., Caira, S., Troise, A. D., Scaloni, A., Vitaglione, P., Vinale, F., Marra, R., Salzano, A. M., Lorito, M., & Woo, S. L. (2020). Trichoderma Applications on Strawberry Plants Modulate the Physiological Processes Positively Affecting Fruit Production and Quality. *Frontiers in Microbiology*, *11*(July), 1–17. https://doi.org/10.3389/fmicb.2020.01364

Lončarić, A., Šarkanj, B., Gotal, A. M., Kovač, M., Nevistić, A., Fruk, G., Babojelić, M. S., Babić, J., Miličević, B., & Kovač, T. (2021). Penicillium expansum impact and patulin accumulation on conventional and traditional apple cultivars. *Toxins*, *13*(10). https://doi.org/10.3390/toxins13100703

Lu, L., Karunarathna, S. C., Hyde, K. D., Suwannarach, N., Elgorban, A. M., Stephenson, S. L., Al-Rejaie, S., Jayawardena, R. S., & Tibpromma, S. (2022). Endophytic Fungi Associated with Coffee Leaves in China Exhibited In Vitro Antagonism against Fungal and Bacterial Pathogens. *Journal of Fungi*, *8*(7), 1–21. https://doi.org/10.3390/jof8070698

Lü, Z. W., Liu, H. Y., Wang, C. L., Chen, X., Huang, Y. X., Zhang, M. M., Huang, Q. L., & Zhang, G. F. (2023). Isolation of endophytic fungi from Cotoneaster multiflorus and screening of drought-tolerant fungi and evaluation of their growth-promoting effects. *Frontiers in Microbiology*, *14*. https://doi.org/10.3389/fmicb.2023.1267404

Lucini, F., de Andrade, G. A. K., Victoria, F. de C., & de Albuquerque, M. P. (2022). Impact of the Temperature in Endophytic Ascomycota Isolated from Antarctic Hair-Grass. *Life*, *12*(10). https://doi.org/10.3390/life12101501

Luo, M., Guo, W., Zhao, M., Manawasinghe, I. S., Guarnaccia, V., Liu, J., Hyde, K. D., Dong, Z., & You, C. (2022). Endophytic Diaporthe Associated with Morinda officinalis in China. *Journal of Fungi*, *8*(8). https://doi.org/10.3390/jof8080806

MacDonald, B. L., Stalla, D., He, X., Rahemtulla, F., Emerson, D., Dube, P. A., Maschmann, M. R., Klesner, C. E., & White, T. A. (2019). Hunter-Gatherers Harvested and Heated Microbial Biogenic Iron Oxides to Produce Rock Art Pigment. *Scientific Reports*, *9*(1), 1–13. https://doi.org/10.1038/s41598-019-53564-w

Magagula, M., Motaung, T. E., Mbita, Z., & Dithebe, K. (2025). Investigating the antimicrobial and anticancer potential of culturable fungal endophytes isolated from the stems of Kirkia acuminata Oliv. *BMC Microbiology*, *25*(1). https://doi.org/10.1186/s12866-025-03964-y

Mahadevakumar, S., Joy, J., Bhanu, L. S. M., Sharvani, K. A., Sowmya, R., & Raj, S. N. (2023). *Disease Note*. *January*, 2023.

Mahardhika, W. A., Isworo Rukmi, M. G., & Pujiyanto, S. (2021). Isolasikapangendofitdaritanaman ciplukan(Physalis angulataL.) dan potensi antibakteri terhadapEscherichia colidanStaphylococcus aureus. *NICHE J Trop*

Bio, *4*(1), 33–39. https://ejournal2.undip.ac.id/index.php/niche

Mahfouz, M. (2023). Cold Plasma in The Control of Paecilomyces Variotii Isolated from Fruit Juice Processing Lines. *Anais Do 15° SLACAN - Simpósio Latino Americano de Ciência de Alimentos e Nutrição*.

Mahklouf, M. H. (2019). The first record of Physalis angulata L. (Solanaceae) for the flora of Libya . *Biodiversity Research and Conservation*, *53*(1), 67–71. https://doi.org/10.2478/biorc-2019-0004

MAHMUD, Y., ROMANTIS, C., & ZAM, S. I. (2020). EFEKTIVITAS Trichoderma virens DALAM MENGENDALIKAN Ganoderma boninense DI PRE NURSERY KELAPA SAWIT PADA MEDIUM GAMBUT. *Jurnal Agroteknologi*, *11*(1), 11. https://doi.org/10.24014/ja.v11i1.8751

Makarewicz, M., Drożdż, I., Tarko, T., & Duda-Chodak, A. (2021). The interactions between polyphenols and microorganisms, especially gut microbiota. *Antioxidants*, *10*(2), 1–70. https://doi.org/10.3390/antiox10020188

Manichart, N., Laosinwattana, C., Somala, N., Teerarak, M., & Chotsaeng, N. (2023). Physiological mechanism of action and partial separation of herbicide–active compounds from the Diaporthe sp. extract on Amaranthus tricolor L. *Scientific Reports*, *13*(1), 1–12. https://doi.org/10.1038/s41598-023-46201-0

Manieri, T. M., Sensi, S. L., Squitti, R., & Cerchiaro, G. (2021). Structural effects of stabilization and complexation of a zinc-deficient superoxide dismutase. *Heliyon*, *7*(1), e06100. https://doi.org/10.1016/j.heliyon.2021.e06100

Manzar, N., Kashyap, A. S., Goutam, R. S., Rajawat, M. V. S., Sharma, P. K., Sharma, S. K., & Singh, H. V. (2022). Trichoderma: Advent of Versatile Biocontrol Agent, Its Secrets and Insights into Mechanism of Biocontrol Potential. *Sustainability (Switzerland)*, *14*(19), 1–32. https://doi.org/10.3390/su141912786

Mao, Z., Zhang, W., Wu, C., Feng, H., Peng, Y., Shahid, H., Cui, Z., Ding, P., & Shan, T. (2021). Diversity and antibacterial activity of fungal endophytes from Eucalyptus exserta. *BMC Microbiology*, *21*(1), 1–12. https://doi.org/10.1186/s12866-021-02229-8

Martin, M., Saparrat, M., Barrera, V., & Gasoni, L. (2019). Mini-review: Cladorrhinum species, their diversity and application in biotechnology. *Nova Hedwigia*, *108*(3–4), 489–503. https://doi.org/10.1127/nova_hedwigia/2018/0516

Martinelli, L., Redou, V., Cochereau, B., Delage, L., Hymery, N., Poirier, E., Le Meur, C., Le Foch, G., Cladiere, L., Mehiri, M., Demont-Caulet, N., & Meslet-Cladiere, L. (2020). Identification and Characterization of a New Type III Polyketide Synthase from a Marine Yeast, Naganishia uzbekistanensis.

Marine Drugs, *18*(12). https://doi.org/10.3390/md18120637

Martinvalet, D., & Walch, M. (2022). Editorial: The Role of Reactive Oxygen Species in Protective Immunity. *Frontiers in Immunology*, *12*(January), 10–13. https://doi.org/10.3389/fimmu.2021.832946

Masenga, S. K., Kabwe, L. S., Chakulya, M., & Kirabo, A. (2023). Mechanisms of Oxidative Stress in Metabolic Syndrome. *International Journal of Molecular Sciences*, *24*(9). https://doi.org/10.3390/ijms24097898

Matevosyan, L., Bazukyan, I., & Trchounian, A. (2019). Comparative analysis of the effect of Ca and Mg ions on antibacterial activity of lactic acid bacteria isolates and their associations depending on cultivation conditions. *AMB Express*, *9*(1). https://doi.org/10.1186/s13568-019-0758-9

Matsue, M., Mori, Y., Nagase, S., Sugiyama, Y., Hirano, R., Ogai, K., Ogura, K., Kurihara, S., & Okamoto, S. (2019). Measuring the Antimicrobial Activity of Lauric Acid against Various Bacteria in Human Gut Microbiota Using a New Method. *Cell Transplantation*, *28*(12), 1528–1541. https://doi.org/10.1177/0963689719881366

Matušinsky, P., Florová, V., Sedláková, B., Mlčoch, P., & Bleša, D. (2024). Colonization dynamic and distribution of the endophytic fungus Microdochium bolleyi in plants measured by qPCR. *PLoS ONE*, *19*(1 January), 1–14. https://doi.org/10.1371/journal.pone.0297633

Mazlan, N. W., Tate, R., Yusoff, Y. M., Clements, C., & Edrada-Ebel, R. (2020). Metabolomics-Guided Isolation of Anti-Trypanosomal Compounds from Endophytic Fungi of the Mangrove plant *Avicennia Lanata*. In *Current Medicinal Chemistry* (Vol. 27, Issue 11, pp. 1815–1835). https://doi.org/http://dx.doi.org/10.2174/0929867326666190704130105

Mcmurry, J. (2023). *Organic Chemistry: 10th Edition*. OpenStax.

Medina, S., Torres, M., Durán, Y., Ramírez, R., Herrera, J., & Ramírez, P. (2012). Degradación de tiocianato por hongos aislados de ambientes mineros y evaluación de su capacidad degradativa. *Revista Peruana de Biologia*, *19*(1), 81–88. https://doi.org/10.15381/rpb.v19i1.791

Meira, C. S., Soares, J. W. C., dos Reis, B. P. Z. C., Pacheco, L. V., Santos, I. P., Silva, D. K. C., de Lacerda, J. C., Daltro, S. R. T., Guimarães, E. T., & Soares, M. B. P. (2022). Therapeutic Applications of Physalins: Powerful Natural Weapons. *Frontiers in Pharmacology*, *13*(April), 1–14. https://doi.org/10.3389/fphar.2022.864714

Mejía-Bautista, M. A., Cristóbal-Alejo, J., Tun-Suárez, J. M., & Reyes-Ramírez, A. (2016). Actividad in vitro de Bacillus spp. en la inhibición de crecimiento micelial de Fusarium equiseti y Fusarium solani aislado de chile habanero (Capsicum chinense Jacq.). *Agrociencia*, *50*(8), 1123–1135.

Meressa, E. W., & Tseha, B. A. (2024). Horizontal gene transfer - The hidden hazards of genetic engineering. *Journal of Life Science and Biomedicine*, *14*(4), 99–108.

Metwally, R. A., Abdelhameed, R. E., Soliman, S. A., & Al-Badwy, A. H. (2022). Potential use of beneficial fungal microorganisms and C-phycocyanin extract for enhancing seed germination, seedling growth and biochemical traits of Solanum lycopersicum L. *BMC Microbiology*, *22*(1), 1–17. https://doi.org/10.1186/s12866-022-02509-x

Mickymaray, S., Alfaiz, F. A., & Paramasivam, A. (2020). Efficacy and mechanisms of flavonoids against the emerging opportunistic nontuberculous mycobacteria. *Antibiotics*, *9*(8), 1–34. https://doi.org/10.3390/antibiotics9080450

Mikulska, P., Malinowska, M., Ignacyk, M., Szustowski, P., Nowak, J., Pesta, K., Szeląg, M., Szklanny, D., Judasz, E., Kaczmarek, G., Ejiohuo, O. P., Paczkowska-Walendowska, M., Gościniak, A., & Cielecka-Piontek, J. (2023). Ashwagandha (Withania somnifera)—Current Research on the Health-Promoting Activities: A Narrative Review. *Pharmaceutics*, *15*(4). https://doi.org/10.3390/pharmaceutics15041057

Miyano, R., Matsuo, H., Mokudai, T., Noguchi, Y., Higo, M., Nonaka, K., Niwano, Y., Sunazuka, T., Shiomi, K., Takahashi, Y., Ōmura, S., & Nakashima, T. (2020). Trichothioneic acid, a new antioxidant compound produced by the fungal strain Trichoderma virens FKI-7573. *Journal of Bioscience and Bioengineering*, *129*(4), 508–513. https://doi.org/10.1016/j.jbiosc.2019.11.007

Mokoroane, K. T., Pillai, M. K., & Magama, S. (2020). 2,2-diphenyl-1-picrylhydrazyl (Dpph) radical scavenging activity of extracts from aloiampelos striatula. *Food Research*, *4*(6), 2062–2066. https://doi.org/10.26656/fr.2017.4(6).241

Monteiro Espíndola, K. M., Ferreira, R. G., Mosquera Narvaez, L. E., Rocha Silva Rosario, A. C., Machado Da Silva, A. H., Bispo Silva, A. G., Oliveira Vieira, A. P., & Chagas Monteiro, M. (2019). Chemical and pharmacological aspects of caffeic acid and its activity in hepatocarcinoma. *Frontiers in Oncology*, *9*(JUN), 3–5. https://doi.org/10.3389/fonc.2019.00541

Moraes, M. R. de, Ryan, S. M., Godoy, H. T., Thomas, A. L., Maia, J. G. S., Richards, K. M., Tran, K., & Smith, R. E. (2020). Phenolic Compounds and Metals in Some Edible Annonaceae Fruits. *Biological Trace Element Research*, *197*(2), 676–682. https://doi.org/10.1007/s12011-019-02005-w

Morales-Vargas, A. T., López-Ramírez, V., Álvarez-Mejía, C., & Vázquez-Martínez, J. (2024). Endophytic Fungi for Crops Adaptation to Abiotic Stresses. *Microorganisms*, *12*(7). https://doi.org/10.3390/microorganisms12071357

Moreno-Gavíra, A., Diánez, F., Sánchez-Montesinos, B., & Santos, M. (2020). Paecilomyces variotii as a plant-growth promoter in horticulture. *Agronomy*, *10*(4). https://doi.org/10.3390/AGRONOMY10040597

Moreno-Gavíra, A., Huertas, V., Diánez, F., Santos, M., & Sánchez-Montesinos, B. (2020). Paecilomyces and its importance in the biological control of agricultural pests and diseases. *Plants*, *9*(12), 1–28. https://doi.org/10.3390/plants9121746

Morsy, M., Ahmed, A., Awad, M. F., El-shenawy, F. S., Mohamed, A., & El-bondkly, A. (2021). Saudi Journal of Biological Sciences antiproliferative activities of extracellular L-asparaginase produced by Fusarium equiseti AHMF4. *Saudi Journal of Biological Sciences*, *28*(4), 2540–2548. https://doi.org/10.1016/j.sjbs.2021.01.058

Moubareck, C. A. (2020). Polymyxins and bacterial membranes: A review of antibacterial activity and mechanisms of resistance. *Membranes*, *10*(8), 1–30. https://doi.org/10.3390/membranes10080181

Moussa, Z., & Al-Mamary, M. A. (2021). *Antioxidant Activity: The Presence and Impact of Hydroxyl Groups in Small Molecules of Natural and Synthetic Origin* (V. Y. Waisundara (ed.)). IntechOpen. https://doi.org/10.5772/intechopen.95616

Muhammad Abdul Kadar, N. N., Ahmad, F., Teoh, S. L., & Yahaya, M. F. (2021). Caffeic Acid on Metabolic Syndrome: A Review. *Molecules (Basel, Switzerland)*, *26*(18), 1–14. https://doi.org/10.3390/molecules26185490

Muhibuddin, A., Salsabila, S., & Sektiono, A. W. (2021). KEMAMPUAN ANTAGONIS Tricoderma harzianum TERHADAP BEBERAPA JAMUR PATOGEN PENYAKIT TANAMAN. *Agrosaintifika*, *4*(1), 225–233. https://doi.org/10.32764/agrosaintifika.v4i1.2371

Mulder, M., Verbon, A., Lous, J., Goessens, W., & Stricker, B. H. (2019). Use of other antimicrobial drugs is associated with trimethoprim resistance in patients with urinary tract infections caused by E. coli. *European Journal of Clinical Microbiology and Infectious Diseases*, *38*(12), 2283–2290. https://doi.org/10.1007/s10096-019-03672-2

Munawir, A. M., & Basir, A. A. (2023). The Activity of Salmonella Typhii in Milkfish (Chanos chanos) with Invitro. *International Journal of Applied Biology*, *7*(1), 26–34.

Munteanu, I. G., & Apetrei, C. (2021). Analytical methods used in determining antioxidant activity: A review. *International Journal of Molecular Sciences*, *22*(7). https://doi.org/10.3390/ijms22073380

Muronetz, V. I., Barinova, K., Kudryavtseva, S., Medvedeva, M., Melnikova, A., Sevostyanova, I., Semenyuk, P., Stroylova, Y., & Sova, M. (2020). Natural and synthetic derivatives of hydroxycinnamic acid modulating the pathological transformation of amyloidogenic proteins. *Molecules*, *25*(20). https://doi.org/10.3390/molecules25204647

Musa, M., Jan, F. G., Hamayun, M., Jan, G., Khan, S. A., Rehman, G., Ali, S., & Lee, I. J. (2023). An Endophytic Fungal Isolate Paecilomyces lilacinus Produces Bioactive Secondary Metabolites and Promotes Growth of Solanum lycopersicum under Heavy Metal Stress. *Agronomy*, *13*(3). https://doi.org/10.3390/agronomy13030883

Muteeb, G., Rehman, M. T., Shahwan, M., & Aatif, M. (2023). Origin of Antibiotics and Antibiotic Resistance, and Their Impacts on Drug Development: A Narrative Review. *Pharmaceuticals*, *16*(11), 1–54. https://doi.org/10.3390/ph16111615

Nabavi, S. M., Šamec, D., Tomczyk, M., Milella, L., Russo, D., Habtemariam, S., Suntar, I., Rastrelli, L., Daglia, M., Xiao, J., Giampieri, F., Battino, M., Sobarzo-Sanchez, E., Nabavi, S. F., Yousefi, B., Jeandet, P., Xu, S., & Shirooie, S. (2020). Flavonoid biosynthetic pathways in plants: Versatile targets for metabolic engineering. *Biotechnology Advances*, *38*(June 2018), 107316. https://doi.org/10.1016/j.biotechadv.2018.11.005

Nagel, R., Schmidt, A., & Peters, R. J. (2019). Isoprenyl diphosphate synthases: the chain length determining step in terpene biosynthesis. *Planta*, *249*(1), 9–20. https://doi.org/10.1007/s00425-018-3052-1

Naha, A., Kumar Miryala, S., Debroy, R., Ramaiah, S., & Anbarasu, A. (2020). Elucidating the multi-drug resistance mechanism of Enterococcus faecalis V583: A gene interaction network analysis. *Gene*, *748*(April), 144704. https://doi.org/10.1016/j.gene.2020.144704

Naik, B. S. (2019). Developments in taxol production through endophytic fungal biotechnology: a review. *Oriental Pharmacy and Experimental Medicine*, *19*(1), 1–13. https://doi.org/10.1007/s13596-018-0352-8

Najjar, A. A. (2025). Therapeutic Potential of Endophytic Microbes: Emphasizing Both Fungal and Bacterial Endophytes. *Applied Microbiology (Switzerland)*, *5*(1). https://doi.org/10.3390/applmicrobiol5010005

Nandika, D., Karlinasari, L., Arinana, A., Batubara, I., Sitanggang, P. S., Santoso, D., Witasari, L. D., Rachmayanti, Y., Firmansyah, D., Sudiana, I. K., & Hertanto, D. M. (2021). Chemical components of fungus comb from Indo-Malayan termite macrotermes gilvus hagen mound and its bioactivity against wood-staining fungi. *Forests*, *12*(11), 1–17. https://doi.org/10.3390/f12111591

Nasution, R., Muhabbah, N., Helwati, H., Bahi, M., Marianne, M., & Amna, U. (2020). Isolation of lupeol acetate from fruit peels of Artocarpus camansi. *Journal of Advanced Pharmaceutical Technology and Research*, *11*(3), 148–

156. https://doi.org/10.4103/japtr.JAPTR_6_20

Nazir, A., Puthuveettil, A. R., Hussain, F. H. N., Hamed, K. E., & Munawar, N. (2024). Endophytic fungi: nature's solution for antimicrobial resistance and sustainable agriculture. *Frontiers in Microbiology*, *15*(December), 1–8. https://doi.org/10.3389/fmicb.2024.1461504

Nemeth, V., & Pfleghaar, N. (2025). *Diarrhea*. 1–11.

Ng uni, T., Thato, M., Raymond, D., Jeremy, K., & Burtram, C. F. (2015). Additive antibacterial activity of naringenin and antibiotic combinations against multidrug resistant Staphylococcus aureus. *African Journal of Microbiology Research*, *9*(23), 1513–1518. https://doi.org/10.5897/ajmr2015.7514

Nguyen, K.-N. H., Nguyen, N.-V. T., & Kim, K. H. (2021). Determination of phenolic acids and flavonoids in leaves, calyces, and fruits of Physalis angulata L. in Viet Nam. *Pharmacia*, *68*(2), 501–509. https://doi.org/https://doi.org/10.3897/pharmacia.68.e66044

Nguyen, T. H., Helm, B., Hettiarachchi, H., Caucci, S., & Krebs, P. (2020). Quantifying the information content of a water quality monitoring network using principal component analysis: A case study of the freiberger mulde river basin, Germany. *Water (Switzerland)*, *12*(2). https://doi.org/10.3390/w12020420

Nikolic, P., & Mudgil, P. (2023). The Cell Wall, Cell Membrane and Virulence Factors of Staphylococcus aureus and Their Role in Antibiotic Resistance. *Microorganisms*, *11*(2). https://doi.org/10.3390/microorganisms11020259

Nischitha, R., & Shivanna, M. B. (2022). Screening of secondary metabolites and antioxidant potential of endophytic fungus Penicillium citrinum and host Digitaria bicornis by spectrophotometric and electrochemical methods. *Archives of Microbiology*, *204*(4), 206. https://doi.org/10.1007/s00203-022-02795-z

Nitbani, F. O., Tjitda, P. J. P., Nitti, F., Jumina, J., & Detha, A. I. R. (2022). Antimicrobial Properties of Lauric Acid and Monolaurin in Virgin Coconut Oil: A Review. *ChemBioEng Reviews*, *9*(5), 442–461. https://doi.org/https://doi.org/10.1002/cben.202100050

Nolfi-Donegan, D., Braganza, A., & Shiva, S. (2020). Mitochondrial electron transport chain: Oxidative phosphorylation, oxidant production, and methods of measurement. *Redox Biology*, *37*, 101674. https://doi.org/10.1016/j.redox.2020.101674

Nongthombam, K. S., Mutum, S. S., & Pandey, R. R. (2024). Distribution, Diversity and Biochemical Analysis of Endophytic Fungi Associated with Chromolaena odorata. *Journal of Applied Life Sciences International*, *27*(1), 17–29. https://doi.org/10.9734/jalsi/2024/v27i1634

Nouri, A., Heibati, F., & Heidarian, E. (2021). Gallic acid exerts anti-inflammatory, anti-oxidative stress, and nephroprotective effects against paraquat-induced renal injury in male rats. *Naunyn-Schmiedeberg's Archives of Pharmacology*, *394*(1), 1–9. https://doi.org/10.1007/s00210-020-01931-0

Novitasari, A., Rohmawaty, E., & Rosdianto, A. M. (2024). Physalis angulata Linn. as a medicinal plant (Review). *Biomed Rep*, *20*(3). https://doi.org/10.3892/br.2024.1735

Nuaimy, M. A. A. A., & Hawar, S. N. (2024). Antagonistic Activity of Endophytic Fungi Isolated From Aloe Vera Leaves Against Some Plant Pathogenic Fungi. *Iraqi Journal of Agricultural Sciences*, *55*(Special Issue), 63–79. https://doi.org/10.36103/ijas.v55iSpecial.1886

Nuez, L., Durand, S., Melelli, A., Berrin, J. G., Haon, M., Drula, E., Beaugrand, J., D'Arras, P., Bourmaud, A., & Baley, C. (2022). Exploring the impact of Verticillium wilt disease on the mechanical properties of elementary flax (Linum usitatissimum L.) fibres. *Industrial Crops and Products*, *182*(March), 114900. https://doi.org/10.1016/j.indcrop.2022.114900

Nuraini, F. R., Setyaningsih, R., & Susilowati, A. (2019). Antioxidant activity of bioactive compound produced by endophytic fungi isolated from endemic plant of South Kalimantan Mangifera casturi Kosterm. *AIP Conference Proceedings*, *2120*. https://doi.org/10.1063/1.5115751

Obidiegwu, O. C., Adione, N. M., Onyeka, I. P., & Eze, P. M. (2024). *Antioxidant and cytotoxicity evaluation of the Endophytic Fungus , Fusarium equiseti , isolated from the leaves of Ocimum gratissimum Antioxidant and cytotoxicity evaluation of the Endophytic Fungus , Fusarium equiseti , isolated from the leaves of Ocimum*. *May*. https://doi.org/10.30574/msarr.2024.10.2.0009

Odelade, K. A., & Babalola, O. O. (2019). Bacteria, fungi and archaea domains in rhizospheric soil and their effects in enhancing agricultural productivity. *International Journal of Environmental Research and Public Health*, *16*(20). https://doi.org/10.3390/ijerph16203873

Odusina, B. O., & and Onocha, P. A. (2022). A new squalene derivative from Physalis angulata L. (Solanaceae). *Natural Product Research*, *36*(8), 2154–2157. https://doi.org/10.1080/14786419.2020.1844691

Oktiansyah, R., Elfita, E., Widjajanti, H., Setiawan, A., Mardiyanto, M., & Nasution, S. S. A. (2023). Antioxidant and Antibacterial Activity of Endophytic Fungi Isolated from The Leaves of Sungkai (Peronema canescens). *Tropical Journal of Natural Product Research*, *7*(3), 2596–2604. https://doi.org/10.26538/tjnpr/v7i3.20

Oktiansyah, R., Widjajanti, H., Setiawan, A., Nasution, S. S. A., Mardiyanto, & Elfita. (2023). Antibacterial and Antioxidant Activity of Endophytic Fungi Extract Isolated from Leaves of Sungkai (Peronema canescens). *Science and*

Technology Indonesia, *8*(2), 170–177. https://doi.org/10.26554/sti.2023.8.2.170-177

Olchowik-Grabarek, E., Sękowski, S., Kwiatek, A., Płaczkiewicz, J., Abdulladjanova, N., Shlyonsky, V., Swiecicka, I., & Zamaraeva, M. (2022). The Structural Changes in the Membranes of Staphylococcus aureus Caused by Hydrolysable Tannins Witness Their Antibacterial Activity. *Membranes*, *12*(11). https://doi.org/10.3390/membranes12111124

Omeike, S. O., Kareem, S. O., & Lasisi, A. A. (2019). Potential antibiotic-producing fungal strains isolated from pharmaceutical waste sludge. *Beni-Suef University Journal of Basic and Applied Sciences*, *8*(1). https://doi.org/10.1186/s43088-019-0026-8

Ortega, H. E., Torres-Mendoza, D., & Cubilla-Ríos, L. (2025). Antibacterial Compounds Isolated from Endophytic Fungi Reported from 2021 to 2024. *Antibiotics*, *14*(7), 644. https://doi.org/10.3390/antibiotics14070644

Owusu, E. O., Kwoseh, C. K., Osekre, E., & Akromah, R. (2023). Incidence, diversity and distribution of *Fusarium wilt* pathogens of eggplant in some major growing areas of Ashanti, Eastern and Volta Regions of Ghana. *Ghana Journal of Agricultural Science*, *58*(1), 118–127. https://doi.org/10.4314/gjas.v58i1.11

Pachauri, S., Zaid, R., Sherkhane, P. D., Easa, J., Viterbo, A., & Chet, I. (2023). Comparative Phenotypic, Genomic, and Transcriptomic Analyses of Two Contrasting Strains of the Plant Beneficial Fungus Trichoderma virens. *American Society For Microbiology*, *11*.

Palupi, K. D., Ilyas, M., & Agusta, A. (2021). Endophytic fungi inhabiting Physalis angulata L. plant: Diversity, antioxidant, and antibacterial activities of their ethyl acetate extracts. *J Basic Clin Physiol Pharmacol*, *32*(4), 823–829. https://doi.org/10.1515/jbcpp-2020-0479

Pan, F., Yang, N., Zhu, X., Yu, C., Jiang, M., Jiang, Y., Liu, S., Wu, W., & Liu, Y. (2023). Discovery of a Natural Hybrid Polyketide Produced by Endophytic Cladosporium sphaerospermum for Biocontrol of Phytopathogenic Fungus Botrytis cinerea. *Journal of Agricultural and Food Chemistry*, *71*(32), 12190–12202. https://doi.org/10.1021/acs.jafc.3c02408

Pancu, D. F., Scurtu, A., Macasoi, I. G., Marti, D., Mioc, M., Soica, C., Coricovac, D., Horhat, D., Poenaru, M., & Dehelean, C. (2021). Antibiotics: Conventional therapy and natural compounds with antibacterial activity-a pharmaco-toxicological screening. *Antibiotics*, *10*(4). https://doi.org/10.3390/antibiotics10040401

Pandey, S., Doo, H., Keum, G. B., Kim, E. S., Kwak, J., Ryu, S., Choi, Y., Kang, J., Kim, S., Lee, N. R., Oh, K. K., Lee, J. H., & Kim, H. B. (2024). Antibiotic resistance in livestock, environment and humans: One Health perspective.

Journal of Animal Science and Technology, *62*(2), 266–278. https://doi.org/10.5187/JAST.2023.E129

Papilaya, F. B., Wahyuningsih, M. S. H., & Syarif, R. A. (2025). Active fraction of Ciplukan (Physalis angulata L.) increases phosphorylation on IRS-1 Tyr-612 and Akt Ser-473 in 24-hour incubation time. *Journal of Applied Pharmaceutical Science*, *15*(5), 121–128. https://doi.org/10.7324/JAPS.2025.225043

Pasin, T. M., Moreira, E. A., Benassi, V. M., Spencer, P. V.D., Peres, N. T. A., Cereia, M., & Polizeli, M. de L. T. M. (2022). Effects of Ultraviolet Exposure on the Tropical Fungi Aspergillus carbonarius and Aspergillus japonicus: Survival, Amylase Production, and Thermostability. *Tropical Conservation Science*, *15*, 1–7. https://doi.org/10.1177/19400829221092638

Patangia, D. V., Anthony Ryan, C., Dempsey, E., Paul Ross, R., & Stanton, C. (2022). Impact of antibiotics on the human microbiome and consequences for host health. *MicrobiologyOpen*, *11*(1), 1–23. https://doi.org/10.1002/mbo3.1260

Patel, K., Bunachita, S., Agarwal, A. A., Bhamidipati, A., & Patel, U. K. (2021). A Comprehensive Overview of Antibiotic Selection and the Factors Affecting It. *Cureus*, *13*(3). https://doi.org/10.7759/cureus.13925

Patel, P., Wermuth, H. R., Calhoun, C., & Hall, G. A. (2023). Antibiotics. In *NCBI Bookshelf. A service of the National Library of Medicine, National Institute of Health.* (pp. 3–5).

Pazo-Cepeda, M. V., Aspromonte, S. G., & Alonso, E. (2021). Extraction of ferulic acid and feruloylated arabinoxylo-oligosaccharides from wheat bran using pressurized hot water. *Food Bioscience*, *44*(PA), 101374. https://doi.org/10.1016/j.fbio.2021.101374

Pereira-Dias, L., Oliveira-Pinto, P. R., Fernandes, J. O., Regalado, L., Mendes, R., Teixeira, C., Mariz-Ponte, N., Gomes, P., & Santos, C. (2023). Peptaibiotics: Harnessing the potential of microbial secondary metabolites for mitigation of plant pathogens. *Biotechnology Advances*, *68*(July). https://doi.org/10.1016/j.biotechadv.2023.108223

Periferakis, A. T., Periferakis, A., Periferakis, K., Caruntu, A., Badarau, I. A., Savulescu-Fiedler, I., Scheau, C., & Caruntu, C. (2023). Antimicrobial Properties of Capsaicin: Available Data and Future Research Perspectives. *Nutrients*, *15*(19), 1–27. https://doi.org/10.3390/nu15194097

Permana, R. C. E., Habibi, M., & Gunawan, E. (2021). Jamur Paecilomyces dari Leang Pettae di kawasan karst Maros dan saran pelestarian gambar cadasnya. *Berkala Arkeologi*, *41*(1), 1–16. https://doi.org/10.30883/jba.v41i1.602

Phillips, A. J. L., Alves, A., Abdollahzadeh, J., Slippers, B., Wingfield, M. J., Groenewald, J. Z., & Crous, P. W. (2013). The Botryosphaeriaceae: Genera and species known from culture. *Studies in Mycology*, *76*, 51–167. https://doi.org/10.3114/sim0021

Pillai, J. R., Wali, A. F., Menezes, G. A., Rehman, M. U., Wani, T. A., Arafah, A., Zargar, S., & Mir, T. M. (2022). Chemical Composition Analysis, Cytotoxic, Antimicrobial and Antioxidant Activities of Physalis angulata L.: A Comparative Study of Leaves and Fruit. *Molecules*, *27*(5). https://doi.org/10.3390/molecules27051480

Plunkert, M. L., Martínez-Gómez, J., Madrigal, Y., Hernández, A. I., & Tribble, C. M. (2024). Tuber, or not tuber: Molecular and morphological basis of underground storage organ development. *Current Opinion in Plant Biology*, *80*, 102544. https://doi.org/https://doi.org/10.1016/j.pbi.2024.102544

Podbielska, M., Kus-Li Skiewicz, M., Jagusztyn, B., Piechowicz, B., Sadło, S., Słowik-Borowiec, M., Twaru zek, M., & Szpyrka, E. (2020). Influence of bacillus subtilis and trichoderma harzianum on penthiopyrad degradation under laboratory and field studies. *Molecules*, *25*(6), 1–16. https://doi.org/10.3390/molecules25061421

Prachya, S., Wattanasiri, C., & Pansanit, A. (2020). Cytotoxic endophyte from Camellia oleifera Abel - Penicillium chermesinum NR121310. *Mycology*, *11*(4), 316–321. https://doi.org/10.1080/21501203.2019.1705928

Prajapati, C., Rai, S. N., Singh, A. K., Chopade, B. A., Singh, Y., Singh, S. K., Haque, S., Prieto, M. A., & Ashraf, G. M. (2025). An Update of Fungal Endophyte Diversity and Strategies for Augmenting Therapeutic Potential of their Potent Metabolites: Recent Advancement. In *Applied Biochemistry and Biotechnology* (Vol. 197, Issue 5). Springer US. https://doi.org/10.1007/s12010-024-05098-9

Purbaya, S. (2023). Aktivitas Antioksidan Senyawa 6-propil-5,6-dihidro-2h-piran-2-on dari Jamur Endofit Fusarium oxysporum Akar Kalanchoe millotii. *Jurnal Kartika Kimia*, *6*(2), 109–115. https://doi.org/10.26874/jkk.v6i2.211

Purbaya, S., Sinaga, S. E., Safriansyah, W., Wulandari, A. P., Harneti, D., Mulyani, Y., Azhari, A., Farabi, K., Abdullah, F. F., & Supratman, U. (2024). Chemical constituents of Lasiodiplodia theobromae BPPCA 144, an endophytic fungus, isolated from Aglaia argentea Blume. *Journal of Biologically Active Products from Nature*, *14*(4), 443–454. https://doi.org/10.1080/22311866.2024.2399718

Pyrzynska, K. (2024). Ferulic Acid—A Brief Review of Its Extraction, Bioavailability and Biological Activity. *Separations*, *11*(7). https://doi.org/10.3390/separations11070204

Qin, J., Lyu, A., Zhang, Q. hua, Yang, L., Zhang, J., Wu, M. de, & Li, G. qing. (2019). Strain identification and metabolites isolation of Aspergillus capensis

CanS-34A from Brassica napus. *Molecular Biology Reports*, *46*(3), 3451–3460. https://doi.org/10.1007/s11033-019-04808-5

Rachmy, S., Anna, J., & Tambunan, M. (2021). *Pengaruh Pemberian Ekstrak Fusarium equiseti terhadap Hewan Mus musculus dengan Pendedahan Akut Melalui Subkutan*. *45*(283), 31–37.

Radzi, N. C., Kamaruzaman, M. F. M., Mustapa, A. N., & Yunus, M. A. C. (2020). Extraction of Essential Oil from Indigenous Herb Physalis angulata Linn using Microwave Assisted Extraction. *Journal of Advanced Research in Fluid Mechanics and Thermal Sciences*, *72*(1), 138–147. https://doi.org/10.37934/arfmts.72.1.138147

Rahaman, M. M., Hossain, R., Herrera-Bravo, J., Islam, M. T., Atolani, O., Adeyemi, O. S., Owolodun, O. A., Kambizi, L., Daştan, S. D., Calina, D., & Sharifi-Rad, J. (2023). Natural antioxidants from some fruits, seeds, foods, natural products, and associated health benefits: An update. *Food Science and Nutrition*, *11*(4), 1657–1670. https://doi.org/10.1002/fsn3.3217

Rahman, I. (2019). Resistensi Antibiotik terhadap Salmonella typhi pada Penyakit Demam Tifoid di Kota Makassar. *Kieraha Medical Journal*, *1*(2). https://doi.org/10.33387/kmj.v1i2.1699

Rajesh, U., & Dhanaraj, S. (2023). A critical review on quercetin bioflavonoid and its derivatives: Scope, synthesis, and biological applications with future prospects. *Arabian Journal of Chemistry*, *16*(8), 104881. https://doi.org/10.1016/j.arabjc.2023.104881

Ramadhani, S., Khairullah, A. R., Effendi, M. H., Sukmanadi, M., Tyasningsih, W., Millannia, S. K., Afnani, D. A., Moses, I. B., Thoriq Ihza Farizqi, M., & Kaben, S. E. (2024). Detection of the methicillin-resistant Staphylococcus aureus gene encoding mecA in nasal swabs of cats in Surabaya, Indonesia. *Open Veterinary Journal*, *14*(11), 3026–3036. https://doi.org/10.5455/OVJ.2024.v14.i11.31

Ramírez-Mendoza, A. A., Ramírez-Herrera, M. A., Cortez-Álvarez, C. R., Nery-Flores, S. D., Tejeda-Martínez, A. R., Romero-Prado, M. M. de J., & Mendoza-Magaña, M. L. (2022). Curcumin Modifies the Activity of Plasmatic Antioxidant Enzymes and the Hippocampal Oxidative Profile in Rats upon Acute and Chronic Exposure to Ozone. *Molecules*, *27*(14). https://doi.org/10.3390/molecules27144531

Rasmi, A. H., Ahmed, E. F., Darwish, A. M. A., & Gad, G. F. M. (2022). Virulence genes distributed among Staphylococcus aureus causing wound infections and their correlation to antibiotic resistance. *BMC Infectious Diseases*, *22*(1), 1–12. https://doi.org/10.1186/s12879-022-07624-8

Rasooly, R., Choi, H. Y., Do, P., Morroni, G., Brescini, L., Cirioni, O., Giacometti, A., & Apostolidis, E. (2020). whISOBAX^{TM} inhibits bacterial pathogenesis and enhances the effect of antibiotics. *Antibiotics*, *9*(5). https://doi.org/10.3390/antibiotics9050264

Rastogi, A. K., Taterh, S., & Kumar, B. S. (2023). Dimensionality Reduction Algorithms in Machine Learning: A Theoretical and Experimental Comparison†. *Engineering Proceedings*, *59*(1), 1–9. https://doi.org/10.3390/engproc2023059082

Rauf, A., Imran, M., Abu-Izneid, T., Iahtisham-Ul-Haq, Patel, S., Pan, X., Naz, S., Sanches Silva, A., Saeed, F., & Rasul Suleria, H. A. (2019). Proanthocyanidins: A comprehensive review. *Biomedicine and Pharmacotherapy*, *116*(May). https://doi.org/10.1016/j.biopha.2019.108999

Reis, J. B. dos A., Lorenzi, A. S., & do Vale, H. M. M. (2022). Methods used for the study of endophytic fungi: a review on methodologies and challenges, and associated tips. *Arch Microbiol*, *204*(11), 1–30. https://doi.org/10.1007/s00203-022-03283-0

Ribeiro, B. (2023). Publicación Oficial de Aepromo (Asociación Española de Profesionales Médicos en Ozonoterapia). Madrid, España Médico especialista em Medicina Desportiva. Mestrado em Medicina Desportiva. *Official Journal of Aepromo (Spanish Association of Medical Professionals in Ozone Therapy)*, *13*(1), 175–197.

Riga, R., Happyana, N., Quentmeier, A., Zammarelli, C., Kayser, O., & Hakim, E. H. (2021). Secondary metabolites from Diaporthe lithocarpus isolated from Artocarpus heterophyllus . *Natural Product Research*, *35*(14), 2324–2328. https://doi.org/10.1080/14786419.2019.1672685

Risdian, C., Mozef, T., & Wink, J. (2019). Biosynthesis of polyketides in Streptomyces. *Microorganisms*, *7*(5), 1–18. https://doi.org/10.3390/microorganisms7050124

Ritawati, A., Zuhud, E. A. M., & Hidayati, S. (2023). Analysis of the utilization of groundcherry (Physalis angulata L.) by the community around the Cibodas Resort Gunung Gede Pangrango National Park. *Jurnal Pengelolaan Sumberdaya Alam Dan Lingkungan*, *13*(4), 613–623. https://doi.org/10.29244/jpsl.13.4.613-623

Ritchie, A. M., Hua, X., Cardillo, M., Yaxley, K. J., Dinnage, R., & Bromham, L. (2021). Phylogenetic diversity metrics from molecular phylogenies: modelling expected degree of error under realistic rate variation. *Diversity and Distributions*, *27*(1), 164–178. https://doi.org/10.1111/ddi.13179

Roberts, J. M., Carvalhais, L. C., O’Dwyer, C., Rincón-Flórez, V. A., & Drenth, A. (2024). Diagnostics of Fusarium wilt in banana: Current status and challenges. *Plant Pathology*, *73*(4), 760–776. https://doi.org/10.1111/ppa.13863

Rohilla, P., Jain, H., Chhikara, A., Singh, L., & Dahiya, P. (2022). Anticancer potential of Solanaceae plants: A review. *South African Journal of Botany*, *149*, 269–289. https://doi.org/10.1016/j.sajb.2022.04.032

Rohmawaty, E., Rosdianto, A. M., Usman, H. A., Saragih, W. A. M., Zuhrotun, A., Hendriani, R., Wardhana, Y. W., Ekawardhani, S., Wiraswati, H. L., Agustanti, N., Bestari, M. B., & Dewi, S. (2021). Antifibrotic effect of the ethyl acetate fraction of ciplukan (Physalis angulata Linn.) in rat liver fibrosis induced by CCI4. *Journal of Applied Pharmaceutical Science*, *11*(12), 175–182. https://doi.org/10.7324/JAPS.2021.1101217

Romero-Luna, H. E., Colina, J., Guzmán-Rodríguez, L., Sierra-Carmona, C. G., Farías-Campomanes, Á. M., García-Pinilla, S., González-Tijera, M. M., Malagón-Alvira, K. O., & Peredo-Lovillo, A. (2023). C apsicum fruits as functional ingredients with antimicrobial activity: an emphasis on mechanisms of action. *Journal of Food Science and Technology*, *60*(11), 2725–2735. https://doi.org/10.1007/s13197-022-05578-y

Rosdee, S., Wisessombat, S., Tayeh, M., Malakul, R., Phanaksri, T., & Sianglum, W. (2025). Antibacterial activity of the endophytic fungal extracts and synergistic effects of combinations of ethylenediaminetetraacetic acid (EDTA) against Pseudomonas aeruginosa and Escherichia coli. *PeerJ*, *13*(3). https://doi.org/10.7717/peerj.19074

Rosic, N., Climstein, M., Boyle, G. M., Thanh Nguyen, D., & Feng, Y. (2023). Exploring Mycosporine-like Amino Acid UV-Absorbing Natural Products for a New Generation of Environmentally Friendly Sunscreens. *Marine Drugs*, *21*(4). https://doi.org/10.3390/md21040253

Rosmana, A., Sjam, S., Dewi, V. S., Asman, A., & Fhiqrah, M. (2022). *Root and collar rot disease: a new threat to young cacao (Theobroma cacao L.) plants in Sulawesi, Indonesia*. Springer.

Rosmini, R., Hayati, N., Nasir, B., Pasaru, F., & Lasmini, S. A. (2020). Pengaruh dekomposisi Trichoderma virens pada berbagai jenis kompos kotoran ternak untuk menekan penyakit busuk pangkal batang bawang merah. *Agromix*, *11*(2), 177–188. https://doi.org/10.35891/agx.v11i2.2081

Sadgrove, N. J., Oliveira, T. B., Khumalo, G. P., van Vuuren, S. F., & van Wyk, B. E. (2020). Antimicrobial isoflavones and derivatives from erythrina (Fabaceae): Structure activity perspective (SAR & QSAR) on experimental and mined values against staphylococcus aureus. *Antibiotics*, *9*(5), 1–18. https://doi.org/10.3390/antibiotics9050223

Sadiyah, H., Soegianto, A., Waluyo, B., & Ashari, S. (2020). Short communication: Preliminary characterization of groundcherry (physalis angulata) from east Java Province, Indonesia based on morpho-agronomic traits. *Biodiversitas*, *21*(2), 759–769. https://doi.org/10.13057/biodiv/d210244

Sadowska-Bartosz, I., & Bartosz, G. (2024). Antioxidant Activity of Anthocyanins and Anthocyanidins: A Critical Review. *International Journal of Molecular Sciences*, *25*(22). https://doi.org/10.3390/ijms252212001

Safaie, N., Salehi, M., Felegari, M., Farhadi, S., Karimzadeh, S., Asadi, S., Yang, J. L., & Naghavi, M. R. (2024). Culture-based diversity of endophytic fungi of three species of Ferula grown in Iran. *Frontiers in Microbiology*, *15*(May), 1–13. https://doi.org/10.3389/fmicb.2024.1363158

Sahu, P., Tilgam, J., Mishra, S., Baba, S., Gupta, A., Krishnappa, J., Verma, S. K., & Kharwar, R. (2022). Surface sterilization for isolation of endophytes: Ensuring what (not) to grow. *Journal of Basic Microbiology*, *62*. https://doi.org/10.1002/jobm.202100462

Sahu, R., Mandal, S., Das, P., Ashraf, G. J., Dua, T. K., Paul, P., Nandi, G., & Khanra, R. (2023). The bioavailability, health advantages, extraction method, and distribution of free and bound phenolics of rice, wheat, and maize: A review. *Food Chemistry Advances*, *3*(October), 100484. https://doi.org/10.1016/j.focha.2023.100484

Saif, F. A., Yaseen, S. A., Alameen, A. S., Mane, S. B., & Undre, P. B. (2021). Identification and characterization of Aspergillus species of fruit rot fungi using microscopy, FT-IR, Raman and UV–Vis spectroscopy. *Spectrochimica Acta - Part A: Molecular and Biomolecular Spectroscopy*, *246*. https://doi.org/10.1016/j.saa.2020.119010

Salehi, B., Azzini, E., Zucca, P., Varoni, E. M., Kumar, N. V. A., Dini, L., Panzarini, E., Rajkovic, J., Fokou, P. V. T., Peluso, I., Mishra, A. P., Nigam, M., Rayess, Y. El, Beyrouthy, M. El, Setzer, W. N., Polito, L., Iriti, M., Sureda, A., Quetglas-Llabrés, M. M., … Sharifi-Rad, J. (2020). Plant-derived bioactives and oxidative stress-related disorders: A key trend towards healthy aging and longevity promotion. *Applied Sciences (Switzerland)*, *10*(3). https://doi.org/10.3390/app10030947

Salem, S. H., El-Maraghy, S. S., Abdel-Mallek, A. Y., Abdel-Rahman, M. A. A., Hassanein, E. H. M., Al-Bedak, O. A., & El-Aziz, F. E. Z. A. A. (2022). The antimicrobial, antibiofilm, and wound healing properties of ethyl acetate crude extract of an endophytic fungus Paecilomyces sp. (AUMC 15510) in earthworm model. *Scientific Reports*, *12*(1), 1–17. https://doi.org/10.1038/s41598-022-23831-4

Salgado, E. R., & Arana, G. V. (2013). Physalis angulata L. (Bolsa Mullaca): A Review of its Traditional Uses, Chemistry and Pharmacology. *Boletín Latinoamericano y Del Caribe de Plantas Medicinales y Aromáticas*, *12*(5), 431–445. http://www.redalyc.org/articulo.oa?id=85628390001

Salvatore, M. M., Alves, A., & Andolfi, A. (2020). Secondary metabolites of lasiodiplodia theobromae: Distribution, chemical diversity, bioactivity, and implications of their occurrence. *Toxins*, *12*(7). https://doi.org/10.3390/toxins12070457

Samet, J. M., Chen, H., Pennington, E. R., & Bromberg, P. A. (2020). Non-redox cycling mechanisms of oxidative stress induced by PM metals. *Free Radical Biology and Medicine*, *151*(December 2019), 26–37. https://doi.org/10.1016/j.freeradbiomed.2019.12.027

Sandeep, A., Selvaraj, K., Kalleshwaraswamy, C. M., Hanumanthaswamy, B. C., & Mallikarjuna, H. B. (2022). Field efficacy of Isaria fumosorosea alone and in combination with insecticides against Aleurodicus rugioperculatus on coconut. *Egyptian Journal of Biological Pest Control*, *32*(1). https://doi.org/10.1186/s41938-022-00600-z

Sanders, E. R. (2012). Aseptic laboratory techniques: Plating methods. *Journal of Visualized Experiments*, *63*, 1–18. https://doi.org/10.3791/3064

Sandra, F. K., Nurhasanah, Y. S., MUTAQIN, K., Wiyono, S., & Tondok, E. T. (2021). Keragaman Morfologi dan Molekuler Lasiodiplodia theobromae dari Tanaman Jeruk, Kakao, Karet, Manggis, dan Pisang. *Jurnal Fitopatologi Indonesia*, *17*(2), 58–66. https://doi.org/10.14692/jfi.17.2.58-66

Saraswathi, M., Meshram, S. H., Siva, B., Misra, S., & Suresh Babu, K. (2022). Isolation, purification and structural elucidation of Mellein from endophytic fungus Lasiodiplodia theobromae strain (SJF-1) and its broad-spectrum antimicrobial and pharmacological properties. *Letters in Applied Microbiology*, *75*(6), 1475–1485. https://doi.org/10.1111/lam.13813

Saraswati, E., & Wijaya, A. S. (2019). Antibacterial activities of Physalis angulata herb extract on white feces diseases (WFD) in Litopenaeus shrimp vannamei. *IOP Conference Series: Earth and Environmental Science*, *236*(1). https://doi.org/10.1088/1755-1315/236/1/012103

Sarli, S., Kalani, M. R., & Moradi, A. (2020). A potent and safer anticancer and antibacterial taxus-based green synthesized silver nanoparticle. *International Journal of Nanomedicine*, *15*, 3791–3801. https://doi.org/10.2147/IJN.S251174

Sato, S., Sofian, F. F., Suehiro, W., Harneti, D., Maharani, R., Supratman, U., Abdullah, F. F., Salam, S., Koseki, T., & Shiono, Y. (2021). β-Resorcylic Acid Derivatives, with Their Phytotoxic Activities, from the Endophytic Fungus Lasiodiplodia theobromae in the Mangrove Plant Xylocarpus granatum. *Chemistry & Biodiversity*, *18*(3), e2000928. https://doi.org/https://doi.org/10.1002/cbdv.202000928

Satriawan, H., Zaimi, N. A., Eriadi, A., Efdi, M., Tallei, T. E., Andayani, R., & Handayani, D. (2025). Isolation and evaluation of the antimicrobial activity of endophytic fungi from Orthosiphon aristatus. *Biodiversitas*, *26*(2), 963–970. https://doi.org/10.13057/biodiv/d260245

Saxena, S., Dufossé, L., Deshmukh, S. K., Chhipa, H., & Gupta, M. K. (2024). Endophytic Fungi: A Treasure Trove of Antifungal Metabolites. In

Microorganisms (Vol. 12, Issue 9). https://doi.org/10.3390/microorganisms12091903

Schneewind, O., & Missiakas, D. M. (2019). Staphylococcal protein secretion and envelope assembly. *Gram-Positive Pathogens*, *7*(4), 592–598. https://doi.org/10.1128/9781683670131.ch37

Shahlal, M., Mahmud, A., Bairagi, R. D., Debnath, D., & Nipa, B. S. (2024). Evaluation of Therapeutic Activity of Physalis angulata (In Vitro Studies). *Journal of Medicinal Natural Products*, *1*(1).

Shailabi, T. I., Kabbashi, A. S., Aldeeb, O. H., Basheer, E. S., Gumaa, R. A., Younes, E. J., Mohammed, R. F., & Ismail, A. M. (2025). Antioxidant and protective effects of methanolic Solanum nigrum leaf extract against CCl4-induced hepatotoxicity and renotoxicity in albino rats. *Open Veterinary Journal*, *15*(4), 1585–1592. https://doi.org/10.5455/OVJ.2025.v15.i4.9

Shalapy, N. M., & Kang, W. (2022). Fusarium oxysporum & Fusarium solani: Identification, Characterization, and Differentiation the Fungal Phenolic Profiles by HPLC and the Fungal Lipid Profiles by GC-MS. *Journal of Food Quality*, *2022*. https://doi.org/10.1155/2022/4141480

Shamsudin, N. F., Ahmed, Q. U., Mahmood, S., Shah, S. A. A., Khatib, A., Mukhtar, S., Alsharif, M. A., Parveen, H., & Zakaria, Z. A. (2022). Antibacterial Effects of Flavonoids and Their Structure-Activity Relationship Study: A Comparative Interpretation. *Molecules*, *27*(4). https://doi.org/10.3390/molecules27041149

Sharifi-Rad, M., Anil Kumar, N. V., Zucca, P., Varoni, E. M., Dini, L., Panzarini, E., Rajkovic, J., Tsouh Fokou, P. V., Azzini, E., Peluso, I., Prakash Mishra, A., Nigam, M., El Rayess, Y., Beyrouthy, M. El, Polito, L., Iriti, M., Martins, N., Martorell, M., Docea, A. O., … Sharifi-Rad, J. (2020). Lifestyle, Oxidative Stress, and Antioxidants: Back and Forth in the Pathophysiology of Chronic Diseases. *Frontiers in Physiology*, *11*(July), 1–21. https://doi.org/10.3389/fphys.2020.00694

Sharma, S., Mohler, J., Mahajan, S. D., Schwartz, S. A., Bruggemann, L., & Aalinkeel, R. (2023). Microbial Biofilm: A Review on Formation, Infection, Antibiotic Resistance, Control Measures, and Innovative Treatment. In *Microorganisms* (Vol. 11, Issue 6). https://doi.org/10.3390/microorganisms11061614

Shen, N., Chen, Z., Cheng, G. X., Lin, W., Qin, Y., Xiao, Y., Chen, H., Tang, Z., Li, Q., Yuan, M., & Bu, T. (2023). Diversity, chemical constituents and biological activities of endophytic fungi from Alisma orientale (Sam.) Juzep. *Frontiers in Microbiology*, *14*(June), 1–16. https://doi.org/10.3389/fmicb.2023.1190624

Shen, Y., Gao, Y., Yang, G., Zhao, Z., Zhao, Y., Gao, L., Zhao, L., & Li, S. (2024).

Transformation of Ginsenosides by Lactiplantibacillus plantarum MB11 Fermentation: Minor Ginsenosides Conversion and Enhancement of Anti-Colorectal Cancer Activity. *Molecules*, *29*(1). https://doi.org/10.3390/molecules29010027

Shi, X. S., Song, Y. P., Meng, L. H., Yang, S. Q., Wang, D. J., Zhou, X. W., Ji, N. Y., Wang, B. G., & Li, X. M. (2021). Isolation and characterization of antibacterial carotane sesquiterpenes from artemisia argyi associated endophytic trichoderma virens qa-8. *Antibiotics*, *10*(2), 1–11. https://doi.org/10.3390/antibiotics10020213

Shiono, Y., Sato, S., Sofian, F. F., Koseki, T., Abdullah, F. F., Salam, S., Harneti, D., Maharani, R., & Supratman, U. (2021). Phytotoxic β-resorcylic acid derivatives from the endophytic fungus Lasiodiplodia theobromae in the mangrove plant. *Phytochemistry Letters*, *44*(February), 1–6. https://doi.org/10.1016/j.phytol.2021.05.003

Shu, Y., Wang, J. P., Li, B. X., Gan, J. L., Ding, H., Liu, R., Cai, L., & Ding, Z. T. (2022). Bioactive cytochalasans from the fungus Arthrinium arundinis DJ-13. *Phytochemistry*, *194*(November 2021), 113009. https://doi.org/10.1016/j.phytochem.2021.113009

Simon, J., Baptiste, C., Lartaud, M., Verdeil, J. L., Brunel, B., Vercambre, G., Génard, M., Cardoso, M., Alibert, E., Goze-Bac, C., & Bertin, N. (2022). Pedicel anatomy and histology in tomato vary according to genotype and water-deficit environment, affecting fruit mass. *Plant Science*, *321*(May). https://doi.org/10.1016/j.plantsci.2022.111313

Singh, A., Kukreti, R., Saso, L., & Kukreti, S. (2019). Singh, A., Kukreti, R., Saso, L., & Kukreti, S. (2019). Oxidative Stress: A Key Modulator in Neurodegenerative Diseases. Molecules (Basel, Switzerland), 24(8), 1583. https://doi.org/10.3390/molecules24081583. *Molecules*, *24*(8), 1–20.

Singh, P., Arif, Y., Bajguz, A., & Hayat, S. (2021). *Posted on Authorea 11 Feb*. 1–24. https://doi.org/10.22541/au.161306959.99455794/v1

Singla, R. K., Dubey, A. K., Garg, A., Sharma, R. K., Fiorino, M., Ameen, S. M., Haddad, M. A., & Al-Hiary, M. (2019). Natural polyphenols: Chemical classification, definition of classes, subcategories, and structures. *Journal of AOAC International*, *102*(5), 1397–1400. https://doi.org/10.5740/jaoacint.19-0133

Slika, H., Mansour, H., Wehbe, N., Nasser, S. A., Iratni, R., Nasrallah, G., Shaito, A., Ghaddar, T., Kobeissy, F., & Eid, A. H. (2022). Therapeutic potential of flavonoids in cancer: ROS-mediated mechanisms. *Biomedicine and Pharmacotherapy*, *146*, 112442. https://doi.org/10.1016/j.biopha.2021.112442

Soliman, H. M., & Abdel-Wahhab, M. A. (2024). Synthesis of Antibacterial

Bioactive Compounds Using Linoleic Acid Extracted from Melon Seeds Oil and Evaluation of Its Waste Meal Ash for Fried Oil Regeneration. *Waste and Biomass Valorization*, *15*(1), 487–499. https://doi.org/10.1007/s12649-023-02161-0

Sottorff, I., Wiese, J., Lipfert, M., Preußke, N., Sönnichsen, F. D., & Imhoff, J. F. (2019). Different secondary metabolite profiles of phylogenetically almost identical streptomyces griseus strains originating from geographically remote locations. *Microorganisms*, *7*(6). https://doi.org/10.3390/microorganisms7060166

Stompor-Gorący, M., & Machaczka, M. (2021). Recent advances in biological activity, new formulations and prodrugs of ferulic acid. *International Journal of Molecular Sciences*, *22*(23). https://doi.org/10.3390/ijms222312889

Stosic, S., Ristic, D., Savkovic, Z., Grbic, M. L., Vukojevic, J., & Zivkovic, S. (2021). Penicillium and Talaromyces Species as Postharvest Pathogens of Pear Fruit (Pyrus communis) in Serbia. *Plant Disease*, *105*(11), 3510–3521. https://doi.org/10.1094/PDIS-01-21-0037-RE

Stypułkowska, A., Kolenda, R., Carolak, E., Czajkowska, J., Dutkiewicz, A., Waszczuk, W., Bińczyk, W., Thurston, T., & Grzymajlo, K. (2025). SanA is an inner membrane protein mediating Salmonella Typhimurium infection. *Microbiology Spectrum*, e0283324. https://doi.org/10.1128/spectrum.02833-24

Su, P., Lu, Z., Tian, W., Chen, Y., & Maharachchikumbura, S. S. N. (2023). Six Additions to the Genus Periconia (Dothideomycetes: Periconiaceae) from Graminaceous Plants in China. *Journal of Fungi*, *9*(3). https://doi.org/10.3390/jof9030300

Subramani, R., Kumar, R., Prasad, P., & Aalbersberg, W. (2013). Cytotoxic and antibacterial substances against multi-drug resistant pathogens from marine sponge symbiont: Citrinin, a secondary metabolite of Penicillium sp. *Asian Pacific Journal of Tropical Biomedicine*, *3*(4), 291–296. https://doi.org/10.1016/S2221-1691(13)60065-9

Sun, Y., Ren, G., Shi, Q., Zhu, H., Zhou, N., Kong, X., Jiang, D., & Liu, C. (2023). Identification of a Novel Coumarins Biosynthetic Pathway in the Endophytic Fungus Fusarium oxysporum GU-7 with Antioxidant Activity Yifan. *Applied and Environmental Microbiology*, *89*(1).

Surya Hakim, S., & Yuwati, T. W. (2020). The Use of Fungal Endophyte Penicillium citrinum on Tree Seedling: Applicability and Limitation . *BIO Web of Conferences*, *20*, 03005. https://doi.org/10.1051/bioconf/20202003005

Sutar, N. G. (2021). Assessment and Quantification of Pharmacologically Active Marker Gallic Acid and Ellagic Acid from Leaf and Stem of Pergularia daemia Forsk. by HPTLC Method. *Technological Innovation in Pharmaceutical*

Research Vol. 1, January, 148–157. https://doi.org/10.9734/bpi/tipr/v1/7532d

Svetlov, M. S., Koller, T. O., Meydan, S., Shankar, V., Klepacki, D., Polacek, N., Guydosh, N. R., Vázquez-Laslop, N., Wilson, D. N., & Mankin, A. S. (2021). Context-specific action of macrolide antibiotics on the eukaryotic ribosome. *Nature Communications*, *12*(1), 1–14. https://doi.org/10.1038/s41467-021-23068-1

Swaminathan, C., & Pandian, K. (2021). Latest Trends in Soil Science (Volume - 1). In *Latest Trends in Soil Science (Volume - 1)* (Issue January). https://doi.org/10.22271/int.book.33

Swibawa, I. G., Fitriana, Y., Solikhin, Suharjo, R., Susilo, F. X., Rani, E. K. A., Haryani, M. S., & Wardana, R. A. (2020). Morpho-molecular identification and pathogenicity test on fungal parasites of guava root-knot nematode eggs in lampung, indonesia. *Biodiversitas*, *21*(3), 1108–1115. https://doi.org/10.13057/biodiv/d210334

Syarifah, Elfita, Widjajanti, H., Setiawan, A., & Kurniawati, A. R. (2021). Diversity of endophytic fungi from the root bark of Syzygium zeylanicum, and the antibacterial activity of fungal extracts, and secondary metabolite. *Biodiversitas*, *22*(10), 4572–4582. https://doi.org/10.13057/biodiv/d221051

Taheri, P. (2025). Endophytic fungi as regulators of phytohormones production: Cytomolecular effects on plant growth, stress protection and importance in sustainable agriculture. *Plant Stress*, *17*(February), 100978. https://doi.org/10.1016/j.stress.2025.100978

Tahmasebi, P., Kamrava, S., Bai, T., & Sahimi, M. (2020). Machine learning in geo- and environmental sciences: From small to large scale. *Advances in Water Resources*, *142*(May), 103619. https://doi.org/10.1016/j.advwatres.2020.103619

Takó, M., Kerekes, E. B., Zambrano, C., Kotogán, A., Papp, T., Krisch, J., & Vágvölgyi, C. (2020). Plant phenolics and phenolic-enriched extracts as antimicrobial agents against food-contaminating microorganisms. *Antioxidants, 9*(2). https://doi.org/10.3390/antiox9020165

Tamura, K., Stecher, G., & Kumar, S. (2021). MEGA11: Molecular Evolutionary Genetics Analysis Version 11. *Mol Biol Evol*, *38*(7), 3022–3027. https://doi.org/10.1093/molbev/msab120

Tan, G. H., Ali, A., & Siddiqui, Y. (2023). Major fungal postharvest diseases of papaya : Current and prospective diagnosis methods. *Crop Protection*, *174*(March).

Tan, Y.-H., Cai, Y.-X., Kong, M., Li, Y.-L., Yu, Z.-P., Kong, L.-Y., & Luo, J. (2023). Withanolides from Physalin angulata and Their Inhibitory Effects on Nitric Oxide Production. *Chemistry & Biodiversity*, *20*.

https://doi.org/10.1002/cbdv.202300195

Tang, M., Fan, J., Liu, X., Liu, Z., Pei, Y., & Sun, Y. (2019). *Secondary Metabolites of Endophytic Fungus Trichoderma harzianum Isolated from Physalis angulata / 中国实验方 剂学杂志 Objective : Method : Result : Conclusion : 24*, 802319.

Tang, Z., Qin, Y., Chen, W., Zhao, Z., Lin, W., Xiao, Y., Chen, H., Liu, Y., Chen, H., Bu, T., Li, Q., Cai, Y., Yao, H., & Wan, Y. (2021). Diversity, Chemical Constituents, and Biological Activities of Endophytic Fungi Isolated From Ligusticum chuanxiong Hort. *Frontiers in Microbiology*, *12*(November), 1–14. https://doi.org/10.3389/fmicb.2021.771000

Tariq, H., Asif, S., Andleeb, A., Hano, C., & Abbasi, B. H. (2023). Flavonoid Production: Current Trends in Plant Metabolic Engineering and De Novo Microbial Production. *Metabolites*, *13*(1). https://doi.org/10.3390/metabo13010124

Taufiq, M. M. J., & Darah, I. (2019). Antibacterial activity of an endophytic fungus Lasiodiplodia pseudotheobromae IBRL OS-64 residing in leaves of a medicinal herb, Ocimum sanctum linn. *Journal of Applied Biology and Biotechnology*, *7*(2), 35–41. https://doi.org/10.7324/JABB.2019.70207

Taylor, J. T., Mukherjee, P. K., Puckhaber, L. S., Dixit, K., Igumenova, T. I., Suh, C., Horwitz, B. A., & Kenerley, C. M. (2020). Deletion of the Trichoderma virens NRPS, Tex7, induces accumulation of the anti-cancer compound heptelidic acid. *Biochemical and Biophysical Research Communications*, *529*(3), 672–677. https://doi.org/10.1016/j.bbrc.2020.06.040

Teshome, B., Teklemariam, Z., Admassu Ayana, D., Marami, D., & Asaminew, N. (2019). Salmonella and Shigella among patients with diarrhea at public health facilities in Adama, Ethiopia: Prevalence, antimicrobial susceptibility pattern, and associated factors. *SAGE Open Medicine*, *7*. https://doi.org/10.1177/2050312119846041

Thi Duy Ngoc, N., Yurchenko, E. A., Thi Hoai Trinh, P., Menchinskaya, E. S., Thi Dieu, T. V., Savagina, A. D., Minin, A., Thinh, P. D., Khanh, H. H. N., Thi Thanh Van, T., & Yurchenko, A. N. (2025). Secondary metabolites of Vietnamese marine fungus Penicillium chermesinum 2104NT-1.3 and their cardioprotective activity. *Regional Studies in Marine Science*, *81*(December 2024), 104003. https://doi.org/10.1016/j.rsma.2024.104003

Thomidis, T., & Kazantzis, K. (2023). Occurrence of shoot blight disease, caused by Cylindrocarpon destructans (Zinss) Scholten, on cherry trees (Prunus avium) in Greece. *European Journal of Plant Pathology*, *166*(3), 359–367. https://doi.org/10.1007/s10658-023-02669-0

Tian, Y., & Li, Y. (2022). A Review on Bioactive Compounds from Marine-Derived Chaetomium Species. *Journal of Microbiology and Biotechnology*, *32*(5), 541–550. https://doi.org/10.4014/jmb.2201.01007

Tironi, L. S., Carletto, L. B., Silva, E. O., Schripsema, J., & Luiz, J. H. H. (2024). Endophytic Fungi Co-Culture: An Alternative Source of Antimicrobial Substances. *Microorganisms*, *12*(12), 1–22. https://doi.org/10.3390/microorganisms12122413

Tiwari, P., & Bae, H. (2020). *Horizontal Gene Transfer and Endophytes : An Implication for the Acquisition of Novel Traits*.

Toghueo, R. M. K., & Boyom, F. F. (2020). Endophytic Penicillium species and their agricultural, biotechnological, and pharmaceutical applications. In *3 Biotech* (Vol. 10, Issue 3). Springer International Publishing. https://doi.org/10.1007/s13205-020-2081-1

Toppo, P., Kagatay, L. L., Gurung, A., Singla, P., Chakraborty, R., Roy, S., & Mathur, P. (2023). Endophytic fungi mediates production of bioactive secondary metabolites via modulation of genes involved in key metabolic pathways and their contribution in different biotechnological sector. In *3 Biotech* (Vol. 13, Issue 6). Springer International Publishing. https://doi.org/10.1007/s13205-023-03605-z

Tran, S. L., Lebreuilly, L., Cormontagne, D., Samson, S., Tô, T. B., Dervyn, R., Grießhammer, A., De, J., Cuesta-Zuluaga, L., Maier, L., Naas, T., Mura, S., Nicolas, J., Rognan, D., André, G., & Ramarao, N. (2025). An anti-virulence drug targeting the evolvability protein Mfd protects against infections with 1 antimicrobial resistant ESKAPE pathogens 2 3 4. *Nature Communications*. https://doi.org/10.1038/s41467-025-58282-8

Tranbarger, T. J., & Tadeo, F. R. (2025). Abscission zone metabolism impacts pre- and post-harvest fruit quality: a very attaching story. *Frontiers in Plant Science*, *15*(January), 1–20. https://doi.org/10.3389/fpls.2024.1524893

Trautmann, E., Attin, T., Mohn, D., & Zehnder, M. (2021). Hydrogen Peroxide Versus Sodium Hypochlorite: All a Matter of pH? *Journal of Endodontics*, *47*(2), 297–302. https://doi.org/10.1016/j.joen.2020.10.016

Tripathi, A., Pandey, P., Tripathi, S. N., & Kalra, A. (2025). Plant growth-promoting endophytic consortium improved artemisinin biosynthesis via modulating antioxidants, gene expression, and transcriptional profile in Artemisia annua (L.) under stressed environments. *Plant Stress*, *15*(December 2024), 100757. https://doi.org/10.1016/j.stress.2025.100757

Tsuneda, T. (2020). Fenton reaction mechanism generating no OH radicals in Nafion membrane decomposition. *Scientific Reports*, *10*(1), 1–13. https://doi.org/10.1038/s41598-020-74646-0

Tu, N. H. K., Thuy, N. T. T., Vinh, D. T. T., Anh, N. P. Q., & Ly, H. D. (2021). Detection of antimicrobial, antioxidant and cytotoxicity activities of fusarium oxysporum f01 isolated from catharanthus roseus collected in vietnam. *Journal of Pure and Applied Microbiology*, *15*(3), 1643–1654. https://doi.org/10.22207/JPAM.15.3.61

Tuan Anh, H. Le, Le Ba, V., Do, T. T., Phan, V. K., Pham Thi, H. Y., Bach, L. G., Tran, M. H., Tran Thi, P. A., & Kim, Y. H. (2021). Bioactive compounds from Physalis angulata and their anti-inflammatory and cytotoxic activities. *J Asian Nat Prod Res*, *23*(8), 809–817. https://doi.org/10.1080/10286020.2020.1825390

Tuerdibieke, M., Tian, X., An, X., Feng, Y., & Liu, W. (2024). Isolation and identification of endophytic fungi from Alhagi sparsifolia Shap. and their antibacterial activity. *Heliyon*, *10*(19), e39003. https://doi.org/10.1016/j.heliyon.2024.e39003

Tulum, I., Tahara, Y. O., & Miyata, M. (2019). Peptidoglycan layer and disruption processes in Bacillus subtilis cells visualized using quick-freeze, deep-etch electron microscopy. *Microscopy*, *68*(6), 441–449. https://doi.org/10.1093/jmicro/dfz033

Tziros, G. T., Samaras, A., & Karaoglanidis, G. S. (2022). *Fusarium equiseti as an Emerging Foliar Pathogen of Lettuce in Greece : Identification and Development of a Real-Time PCR for Quantification of Inoculum in Soil Samples*.

Ujamp, N. T., Ezep, P. M., Ejikeugwup, C., Festus, P., Okoyep, B. C., & Esimonep, C. O. (2020). Antimicrobial Activity of Metabolites of Lasiodiplodia theobromae isolated from Psiduim guajava. *IJISET-International Journal of Innovative Science, Engineering & Technology*, *7*(2), 123–129. www.ijiset.com

Ushie, O. A., Iyen, S. I., Abeng, F. E., Azuaga, T. ., Okpaegbe, U. C., & Aikhoje, E. F. (2019). Quantification of Alkaloids , Flavonoids and Saponins in Physalis angulata and Mucuna Pruriens. *FRsCS*, *1*(02), 86–89.

van den Brule, T., Punt, M., Teertstra, W., Houbraken, J., Wösten, H., & Dijksterhuis, J. (2020). The most heat-resistant conidia observed to date are formed by distinct strains of Paecilomyces variotii. *Environmental Microbiology*, *22*(3), 986–999. https://doi.org/10.1111/1462-2920.14791

van der Vaart, T. W., Prins, J. M., Soetekouw, R., van Twillert, G., Veenstra, J., Herpers, B. L., Rozemeijer, W., Jansen, R. R., Bonten, M. J. M., & van der Meer, J. T. M. (2022). All-Cause and Infection-Related Mortality in Staphylococcus aureus Bacteremia, a Multicenter Prospective Cohort Study. *Open Forum Infectious Diseases*, *9*(12), 1–9. https://doi.org/10.1093/ofid/ofac653

Van Hung, P. (2016). Phenolic Compounds of Cereals and Their Antioxidant Capacity. *Critical Reviews in Food Science and Nutrition*, *56*(1), 25–35.

https://doi.org/10.1080/10408398.2012.708909

Vargas-Arana, G., Torres-Benítez, A., Ortega-Valencia, J. E., Merino-Zegarra, C., Carranza-Rosales, P., & Simirgiotis, M. J. (2025). Untargeted Chemical Profile, Antioxidant, and Enzyme Inhibition Activity of Physalis angulata L. from the Peruvian Amazon: A Contribution to the Validation of Its Pharmacological Potential. *Antioxidants*, *14*(3). https://doi.org/10.3390/antiox14030246

Vaz, C., Nascimento, M., Carriço, J. A., Rocher, T., & Francisco, A. P. (2021). Distance-based phylogenetic inference from typing data: A unifying view. *Briefings in Bioinformatics*, *22*(3), 1–16. https://doi.org/10.1093/bib/bbaa147

Vázquez de Aldana, B. R., Arellano, J. B., Cuesta, M. J., Mellado-Ortega, E., González, V., & Zabalgogeazcoa, I. (2021). Screening fungal endophytes from a wild grass for growth promotion in tritordeum, an agricultural cereal. *Plant Science*, *303*(July 2020). https://doi.org/10.1016/j.plantsci.2020.110762

Verma, A., Shameem, N., Jatav, H. S., Sathyanarayana, E., Parray, J. A., Poczai, P., & Sayyed, R. Z. (2022). Fungal Endophytes to Combat Biotic and Abiotic Stresses for Climate-Smart and Sustainable Agriculture. *Frontiers in Plant Science*, *13*(July), 1–16. https://doi.org/10.3389/fpls.2022.953836

Verma, S. C., Qian, Z., & Adhya, S. L. (2019). Architecture of the Escherichia coli nucleoid. In *PLoS Genetics* (Vol. 15, Issue 12). https://doi.org/10.1371/journal.pgen.1008456

Vieceli, P. S., Juiz, P. J. L., Lauria, P. S. S., Couto, R. D., Tomassini, T. C. B., Ribeiro, I. M., Soares, M. B. P., & Villarreal, C. F. (2021). Physalis angulata reduces the progression of chronic experimental periodontitis by immunomodulatory mechanisms. *Journal of Ethnopharmacology*, *273*(July 2020). https://doi.org/10.1016/j.jep.2021.113986

Viogenta, P., Susanti, L., & Megasari, L. (2023). Antibacterial Activity and Bioautography of the Chloroform Fraction of Morel Berry (Physalis angulata L.) Root Against Staphylococcus epidermidis and Pseudomonas aeruginosa. *Journal of Multidisciplinary Applied Natural Science*, *3*(1), 90–99. https://doi.org/10.47352/jmans.2774-3047.148

Vuolo, M. M., Lima, V. S., & Maróstica Junior, M. R. (2019). Phenolic Compounds. In *Bioactive Compounds: Health Benefits and Potential Applications*. Elsevier Inc. https://doi.org/10.1016/B978-0-12-814774-0.00002-5

Wahyudi, B. E., Elfita, Widjajanti, H., Salni, Eliza, Julinar, & Musifa, E. (2025a). Diversity and bioactivity of endophytic fungi isolated from various fruit organs of Physalis angulata. *Biodiversitas*, *26*(3), 1485–1499. https://doi.org/10.13057/biodiv/d260349

Wahyudi, B. E., Widjajanti, H., & Oktiansyah, R. (2025b). Bioactive Compound from the Endophytic Fungus Paecilomyces variotii Isolated from the Stems of Physalis angulata L . *Trends Sci*, *22*(1), 1–16.

Wahyuningsih, S. (2019). Biodegradation of pulp sludge by Phanerochaete chrysosporium, penicillium oxalicum and penicillium citrinum after six months incubation. *Indonesian Journal of Forestry Research*, *6*(2), 95–105. https://doi.org/10.20886/IJFR.2019.6.2.95-105

Wang, B., Cai, J., Huang, L., Chen, Y., Wang, R., Luo, M., Yang, M., Zhang, M., Nasihat, Chen, G., Huang, G., & Zheng, C. (2024). Significance of research on natural products from marine-derived Aspergillus species as a source against pathogenic bacteria. *Frontiers in Microbiology*, *15*(September). https://doi.org/10.3389/fmicb.2024.1464135

Wang, J., Ma, W., & Wang, X. (2021). Insights into the structure of Escherichia coli outer membrane as the target for engineering microbial cell factories. *Microbial Cell Factories*, *20*(1), 1–17. https://doi.org/10.1186/s12934-021-01565-8

Wang, L., Lu, S., Wang, L., Xin, M., Xu, Y., Wang, G., Chen, D., Chen, L., Liu, S., & Zhao, F. (2021). Anti-inflammatory effects of three withanolides isolated from Physalis angulata L. in LPS-activated RAW 264.7 cells through blocking NF-κB signaling pathway. *Journal of Ethnopharmacology*, *276*, 114186. https://doi.org/https://doi.org/10.1016/j.jep.2021.114186

Wang, P., Yang, X.-M., Hu, Z.-X., Li, Y.-N., Yang, J., Hao, X.-J., Yuan, C.-M., & Yi, P. (2023). UPLC-Q-Orbitrap-MS/MS-Guided Isolation of Bioactive Withanolides from the Fruits of Physalis angulata. *Journal of Agricultural and Food Chemistry*, *71*(44), 16581–16592. https://doi.org/10.1021/acs.jafc.3c04311

Wang, S., Li, Y., He, L., Yang, J., Fernie, A. R., & Luo, J. (2022). Natural variance at the interface of plant primary and specialized metabolism. *Current Opinion in Plant Biology*, *67*, 102201. https://doi.org/https://doi.org/10.1016/j.pbi.2022.102201

Wang, W., † Z., Wu, C., Shahid, H., Wang, S., & Shan, T. (2021). Diversity and Antibacterial and Antioxidant Activities of Fungal Endophytes from the Roots of Eucalyptus deglupta. *Sains Malaysiana*, *51*, 1687–1696. https://doi.org/10.17576/jsm-2022-5106-07

Wang, X., Wang, X., Yao, Y., Chen, B., Zhang, M., Zhang, M., Liu, Z., Wang, Q., Wang, Q., & Ma, J. (2020). Paecilomyces variotii Extracts and Controlled-Release Urea Synergistically Increased Nitrogen Use Efficiency and Rice Yield. *ACS Omega*, *5*(22), 13303–13311. https://doi.org/10.1021/acsomega.0c01348

Wang, Y., Li, Z., Xu, M., Xiao, Z., Liu, C., Du, B., Xu, D., & Li, L. (2023). Signal

Molecules Regulate the Synthesis of Secondary Metabolites in the Interaction between Endophytes and Medicinal Plants. *Processes*, *11*(3). https://doi.org/10.3390/pr11030849

Wei, W., Khan, B., Dai, Q., Lin, J., Kang, L., Rajput, N. A., Yan, W., & Liu, G. (2023). Potential of Secondary Metabolites of Diaporthe Species Associated with Terrestrial and Marine Origins. *Journal of Fungi*, *9*(4). https://doi.org/10.3390/jof9040453

Wen, J., Okyere, S. K., Wang, S., Wang, J., Xie, L., Ran, Y., & Hu, Y. (2022). Endophytic Fungi: An Effective Alternative Source of Plant-Derived Bioactive Compounds for Pharmacological Studies. *J Fungi*, *8*(2). https://doi.org/10.3390/jof8020205

Wen, L., Chen, G., She, Z., Yan, C., Cai, J., & Mu, L. (2010). Two new paeciloxocins from a mangrove endophytic fungus Paecilomyces sp. *Russian Chemical Bulletin*, *59*(8), 1656–1659. https://doi.org/10.1007/s11172-010-0290-1

Wen, Q. H., Wang, R., Zhao, S. Q., Chen, B. R., & Zeng, X. A. (2021). Inhibition of biofilm formation of foodborne staphylococcus aureus by the citrus flavonoid naringenin. *Foods*, *10*(11). https://doi.org/10.3390/foods10112614

Weng, W., He, M., Zheng, Z., Lin, T., Lai, Z., Zheng, S., & Wu, X. (2024). Tomato Pedicel Physical Characterization for Fruit-Pedicel Separation Tomato Harvesting Robot. *Agronomy*, *14*(10), 1–20. https://doi.org/10.3390/agronomy14102274

Wiraswati, H., Ekawardhani, S., Rohmawaty, E., Laelalugina, A., Zuhrotun, A., Hendriani, R., Wardhana, Y., Bestari, M., Sahirdjan, E., & Dewi, S. (2024). Antioxidant, Antiinflammation, and Antifibrotic Activity of Ciplukan (Physalis angulata L). Extract. *Journal of Inflammation Research*, *Volume 17*(September), 6297–6306. https://doi.org/10.2147/jir.s470318

Wong, H. J., Mohamad-Fauzi, N., Rizman-Idid, M., Convey, P., & Alias, S. A. (2019). Protective mechanisms and responses of micro-fungi towards ultraviolet-induced cellular damage. *Polar Science*, *20*(September 2018), 19–34. https://doi.org/10.1016/j.polar.2018.10.001

Wu, J., Zhao, J., Zhang, T., Gu, Y., Khan, I. A., Zou, Z., & Xu, Q. (2021). Naturally occurring physalins from the genus Physalis: A review. *Phytochemistry*, *191*(June). https://doi.org/10.1016/j.phytochem.2021.112925

Wu, Y. M., Zhou, Q. Y., Yang, X. Q., Luo, Y. J., Qian, J. J., Liu, S. X., Yang, Y. Bin, & Ding, Z. T. (2019). Induction of Antiphytopathogenic Metabolite and Squalene Production and Phytotoxin Elimination by Adjustment of the Mode of Fermentation in Cocultures of Phytopathogenic Nigrospora oryzae and Irpex lacteus. *Journal of Agricultural and Food Chemistry*. https://doi.org/10.1021/acs.jafc.9b04209

Wulandari, S. L., Kaloik, P., Lakobal, P., & Wenda, N. (2021). *Isolasi dan Seleksi Mikrob Penghasil Asam Sitrat dari Buah-buahan Busuk*. *1*(1), 9–12.

Xiao, J., Huang, J., Xiao, K., Li, G., Yang, S., & He, Y. (2024). How different of the rhizospheric and endophytic microbial compositions in watermelons with different fruit shapes. *PLoS ONE*, *19*(5 May), 1–15. https://doi.org/10.1371/journal.pone.0302462

Xiao, Y., Liang, W., Zhang, Z., Wang, Y., Zhang, S., Liu, J., Chang, J., Ji, C., & Zhu, D. (2022). Polyketide Derivatives from the Endophytic Fungus Phaeosphaeria sp. LF5 Isolated from Huperzia serrata and Their Acetylcholinesterase Inhibitory Activities. *Journal of Fungi*, *8*(3). https://doi.org/10.3390/jof8030232

Xu, K., Li, X. Q., Zhao, D. L., & Zhang, P. (2021). Antifungal Secondary Metabolites Produced by the Fungal Endophytes: Chemical Diversity and Potential Use in the Development of Biopesticides. *Frontiers in Microbiology*, *12*(June), 1–17. https://doi.org/10.3389/fmicb.2021.689527

Xu, W., Shi, D., Chen, K., & Popovich, D. G. (2024). TLC-Bioautography-Guided Isolation and Assessment of Antibacterial Compounds from Manuka (Leptospermum scoparium) Leaf and Branch Extracts. *Molecules*, *29*(717), 1–13.

Yan, F., Li, K., Xing, W., Dong, M., Yi, M., & Zhang, H. (2022). Role of Iron-Related Oxidative Stress and Mitochondrial Dysfunction in Cardiovascular Diseases. *Oxidative Medicine and Cellular Longevity*, *2022*. https://doi.org/10.1155/2022/5124553

Yan, J., Manawasinghe, I., Jayawardena, R., Hl, L., Yy, Z., Zhang, W., Phillips, A., Wanasinghe, D., Dissanayake, A., Xh, L., Yh, L., Kd, H., & Jy, Y. (2021). Microfungi associated with Camellia sinensis: A case study of leaf and shoot necrosis on Tea in Fujian, China. *Mycosphere*, *12*, 430– 518. https://doi.org/10.5943/mycosphere/12/1/6

Yap, P. S. X., Yusoff, K., Lim, S. H. E., Chong, C. M., & Lai, K. S. (2021). Membrane disruption properties of essential oils-a double-edged sword? *Processes*, *9*(4), 1–11. https://doi.org/10.3390/pr9040595

Yapıcı, İ., Altay, A., Öztürk Sarıkaya, B., Korkmaz, M., Atila, A., Gülçin, İ., & Köksal, E. (2021). In vitro Antioxidant and Cytotoxic Activities of Extracts of Endemic Tanacetum erzincanense Together with Phenolic Content by LC-ESI-QTOF-MS. *Chemistry and Biodiversity*, *18*(3). https://doi.org/10.1002/cbdv.202000812

Yavuz, O., Dincel, G. C., Yildirim, S., El-Ashram, S., & Al-Olayan, E. (2024). Impact of apoptosis and oxidative stress on pancreatic beta cell pathophysiology in streptozotocin-induced Type 1 diabetes mellitus. *Tissue and Cell*, *91*, 102552.

https://doi.org/https://doi.org/10.1016/j.tice.2024.102552

Yehia, R. S. (2023). Multi-Function of a New Bioactive Secondary Metabolite Derived from Endophytic Fungus Colletotrichum acutatum of Angelica sinensis. *Journal of Microbiology and Biotechnology*, *33*(6), 806–822. https://doi.org/10.4014/jmb.2206.06010

Yin, W., Wei, Y., Li, G., Wang, Y., Lou, Y., Pan, H., Yang, Q., Hu, G., Wang, H., & Zhuge, Y. (2023). Low concentration of Paecilomyces variotii extracts promote the growth and disease resistance of pepper. *Cogent Food and Agriculture*, *9*(1). https://doi.org/10.1080/23311932.2023.2195975

Yip, D. W., & Gerriets, V. (2024). *Penicillin* (pp. 1–8). StatPearls Publishing.

Yohanna, C., Kwaji, A., & Atiko, R. (2021). Antibacterial Activity, Antioxidant Potential and Stigmasterol Isolation from Laggera aurita Linn (Asteraceae). *International Journal of Biochemistry Research & Review*, *30*(9), 24–39. https://doi.org/10.9734/ijbcrr/2021/v30i930288

Yoshikawa, T., & You, F. (2024). *Oxidative Stress and Bio-Regulation*. 1–17.

Yu, J., & Yin, C. (2025). *Community Structure Diversity of Endophytic Fungi in Cissampelos pareira from Different Habitats and Their α -Glucosidase Inhibitory Activity*. 1–19.

Yu, X., Müller, W. E. G., Frank, M., Gao, Y., Guo, Z., Zou, K., Proksch, P., & Liu, Z. (2023). Caryophyllene-type sesquiterpenes from the endophytic fungus Pestalotiopsis lespedezae through an OSMAC approach. *Frontiers in Microbiology*, *14*(January), 1–9. https://doi.org/10.3389/fmicb.2023.1248896

Zahra, Z. S. A. (2024). Nuclear Magnetic Resonance (NMR): Principle, Applications, Types, and Uses in Metabolite Identification and Medical Biotechnology. *Current Clinical and Medical Education*, *02*(May), 33–48.

Zaid, R., Koren, R., Kligun, E., Gupta, R., Leibman-Markus, M., Mukherjee, P. K., Kenerley, C. M., Bar, M., & Horwitz, B. A. (2022). Gliotoxin, an Immunosuppressive Fungal Metabolite, Primes Plant Immunity: Evidence from Trichoderma virens-Tomato Interaction. *MBio*, *13*(4), 1–19. https://doi.org/10.1128/mbio.00389-22

Zainudin, N. A. I. M., Murad, N. B. A., Aris, A., & Hussain, N. H. (2023). Disease Note: Diseases Caused by Fungi and Fungus-Like Organisms First. *Plant Disease*. https://doi.org/10.13039/501100003093

Zakaria, L. (2024). An Overview of Aspergillus Species Associated with Plant Diseases. *Pathogens*, *13*(9). https://doi.org/10.3390/pathogens13090813

Zakariyah, R. F., Ajijolakewu, K. A., Ayodele, A. J., Folami-A, B. I., Samuel, E. P., Otuoze, S. O., Abdulrauf, L. B., & Ahmed, R. N. (2024). Progress in endophytic fungi secondary metabolites: biosynthetic gene cluster reactivation and advances in metabolomics. *Bulletin of the National Research Centre*, *48*(1). https://doi.org/10.1186/s42269-024-01199-x

Zambrano, C., Kerekes, E. B., Kotogán, A., Papp, T., Vágvölgyi, C., Krisch, J., & Takó, M. (2019). Antimicrobial activity of grape, apple and pitahaya residue extracts after carbohydrase treatment against food-related bacteria. *LWT*, *100*, 416–425. https://doi.org/https://doi.org/10.1016/j.lwt.2018.10.044

Zaritsky, A., Vollmer, W., Männik, J., & Liu, C. (2019). Does the nucleoid determine cell dimensions in Escherichia coli? *Frontiers in Microbiology*, *10*(JULY). https://doi.org/10.3389/fmicb.2019.01717

Zeece, M. (2020). *Chapter Five - Vitamins and minerals* (M. B. T.-I. to the C. of F. Zeece (ed.); pp. 163–212). Academic Press. https://doi.org/https://doi.org/10.1016/B978-0-12-809434-1.00005-0

Zehiroglu, C., & Ozturk Sarikaya, S. B. (2019). The importance of antioxidants and place in today's scientific and technological studies. *Journal of Food Science and Technology*, *56*(11), 4757–4774. https://doi.org/10.1007/s13197-019-03952-x

Zeliger, H. I. (2023). *Chapter 18 - Free radicals* (H. I. B. T.-O. S. Zeliger (ed.); pp. 211–226). Academic Press. https://doi.org/https://doi.org/10.1016/B978-0-323-91890-9.00019-2

Zeng, L., Zhou, X., Liao, Y., & Yang, Z. (2021). Roles of specialized metabolites in biological function and environmental adaptability of tea plant (Camellia sinensis) as a metabolite studying model. *Journal of Advanced Research*, *34*(723), 159–171. https://doi.org/10.1016/j.jare.2020.11.004

Zhang, H., Shen, X., Shen, W., Zhang, D., Huang, X., Zhu, K., Liu, J., & Li, G. (2024). Glutathione peroxidase LtGPX3 contributes to oxidative stress tolerance, virulence, and plant defense suppression in the peach gummosis fungus Lasiodiplodia theobromae. *Phytopathology Research*, *6*(1), 1–15. https://doi.org/10.1186/s42483-024-00224-1

Zhang, J., Lu, J., Zhu, Y., Shen, X., Zhu, B., & Qin, L. (2024). Roles of endophytic fungi in medicinal plant abiotic stress response and TCM quality development. *Chinese Herbal Medicines*, *16*(2), 204–213. https://doi.org/10.1016/j.chmed.2023.02.006

Zhang, T., Alexa, E.-A., Liu, G., Berisha, A., Walsh, R., & Kelleher, R. (2025). Lycium barbarum for Health and Longevity: A Review of Its Biological Significance. *Obesities*, *5*(2), 35. https://doi.org/10.3390/obesities5020035

Zhang, W., Pan, X., Fu, J., Cheng, W., Lin, H., Zhang, W., & Huang, Z. (2024). Phytochemicals derived from Nicotiana tabacum L. plant contribute to pharmaceutical development. *Frontiers in Pharmacology*, *15*(April), 1–19. https://doi.org/10.3389/fphar.2024.1372456

Zhao, L. Y., Shi, J., Xu, Z. Y., Sun, J. L., Yan, Z. Y., Tong, Z. W., Tan, R. X., Jiao, R. H., & Ge, H. M. (2024). Hybrid Type I and II Polyketide Synthases Yield Distinct Aromatic Polyketides. *Journal of the American Chemical Society*, *146*(43), 29462–29468. https://doi.org/10.1021/jacs.4c08803

Zheng, J., Wang, H., Wang, X., Zeng, S., Yuan, S., & Yin, T. (2025). Genome mining and OSMAC strategies unveil diverse secondary metabolites from the endophytic fungus Diaporthe kyushuensis ZMU-48-1 with antifungal activity. *Frontiers in Microbiology*, *16*(June). https://doi.org/10.3389/fmicb.2025.1604639

Zheng, M., Liu, Y., Zhang, G., Yang, Z., Xu, W., & Chen, Q. (2023). The Applications and Mechanisms of Superoxide Dismutase in Medicine, Food, and Cosmetics. *Antioxidants*, *12*(9). https://doi.org/10.3390/antiox12091675

Zin, N. A., & Badaluddin, N. A. (2020). Biological functions of Trichoderma spp. for agriculture applications. *Annals of Agricultural Sciences*, *65*(2), 168–178. https://doi.org/10.1016/j.aoas.2020.09.003