

DAFTAR PUSTAKA

- Abd Ghafar SZ, Muthukrishnan S, Zolkeflee NKZ, *et al* (2025) Identification of Metabolites From *Halamphora* sp. and Its Correlation With Quorum Sensing Inhibitory Activity via UHPLC-ESI-MS/MS-Based Metabolomics and Molecular Networking. *Chemistry & Biodiversity* 22:e202402282. <https://doi.org/10.1002/cbdv.202402282>
- Abdelaleem ER, Samy MN, Rateb ME, *et al* (2023) Metabolomic profiling and biological evaluations of *Spongia irregularis*-associated actinomycetes supported by multivariate statistical analysis. *J Appl Microbiol* 134:lxad120. <https://doi.org/10.1093/jambio/lxad120>
- Abdel-Aziz MS, Ghareeb MA, Hamed AA, *et al* (2021) Ethyl acetate extract of *Streptomyces* spp. isolated from Egyptian soil for management of *Fusarium oxysporum*: The causing agent of wilt disease of tomato. *Biocatalysis and Agricultural Biotechnology* 37:102185. <https://doi.org/10.1016/j.bcab.2021.102185>
- Abdella B, Abdella M, ElSharif HA, *et al* (2023) Identification of potent anti-*Candida* metabolites produced by the soft coral associated *Streptomyces* sp. HC14 using chemoinformatics. *Sci Rep* 13:12564. <https://doi.org/10.1038/s41598-023-39568-7>
- Abdelmohsen UR, Bayer K, Hentschel U (2014) Diversity, abundance and natural products of marine sponge-associated actinomycetes. *Nat Prod Rep* 31:381–399. <https://doi.org/10.1039/C3NP70111E>
- Abdelrahman SM, Dosoky NS, Hanora AM, Lopanik NB (2022) Metabolomic Profiling and Molecular Networking of Nudibranch-Associated *Streptomyces* sp. SCSIO 001680. *Molecules* 27:4542. <https://doi.org/10.3390/molecules27144542>
- Aboualigalehdari E, Tahmasebi Birgani M, Fatahinia M, Hosseinzadeh M (2021) Transcription Factors of CAT1, EFG1, and BCR1 Are Effective in Persister Cells of *Candida albicans*-Associated HIV-Positive and Chemotherapy Patients. *Frontiers in Microbiology* 12: <https://doi.org/10.3389/fmicb.2021.651221>
- Adeyemo OM, Ja'afaru MI, Adams FV (2021) Isolation, characterization, antimicrobial and other bioactivity profiles of three *Streptomyces* strains isolated from Lake Gerio, Yola, Adamawa State, Nigeria. *Bulletin of the National Research Centre* 45:147. <https://doi.org/10.1186/s42269-021-00606-x>
- Afzal M, Saccenti E, Madsen MB, *et al* (2020) Integrated Univariate, Multivariate, and Correlation-Based Network Analyses Reveal Metabolite-Specific

Effects on Bacterial Growth and Biofilm Formation in Necrotizing Soft Tissue Infections. *J Proteome Res* 19:688–698. <https://doi.org/10.1021/acs.jproteome.9b00565>

Ait Assou S, El Hassouni M (2025) New *Streptomyces*-Derived Antibacterial Compounds Targeting Gram-Positive Bacteria: A Systematic Review. *The Scientific World Journal* 2025:6659874. <https://doi.org/10.1155/tswj/6659874>

Ait Assou S, Grafov A, Bousta D, *et al* (2024) Unveiling the anti-*Candida albicans* activity of bioactive fractions from mining soil-dwelling *Streptomyces* sp. DS104. *Scientific African* 25:e02292. <https://doi.org/10.1016/j.sciaf.2024.e02292>

Alam K, Hao J, Zhong L, *et al* (2022a) Complete genome sequencing and *in silico* genome mining reveal the promising metabolic potential in *Streptomyces* strain CS-7. *Front Microbiol* 13:. <https://doi.org/10.3389/fmicb.2022.939919>

Alam K, Mazumder A, Sikdar S, *et al* (2022b) *Streptomyces*: The biofactory of secondary metabolites. *Front Microbiol* 13:968053. <https://doi.org/10.3389/fmicb.2022.968053>

Alamgir ANM (2018) Secondary Metabolites: Secondary Metabolic Products Consisting of C and H; C, H, and O; N, S, and P Elements; and O/N Heterocycles. In: Alamgir ANM (ed) *Therapeutic Use of Medicinal Plants and their Extracts: Volume 2: Phytochemistry and Bioactive Compounds*. Springer International Publishing, Cham, pp 165–309

Al-Ansari M, Kalaiyarasi M, Almalki MA, Vijayaraghavan P (2020) Optimization of medium components for the production of antimicrobial and anticancer secondary metabolites from *Streptomyces* sp. AS11 isolated from the marine environment. *Journal of King Saud University - Science* 32:1993–1998. <https://doi.org/10.1016/j.jksus.2020.02.005>

Alcàcer-Almansa J, Arévalo-Jaimes BV, Blanco-Cabra N, Torrents E (2023) Chapter 7 - Methods for studying biofilms: Microfluidics and translation in the clinical context. In: Gurtler V, Patrauchan M (eds) *Methods in Microbiology*. Academic Press, pp 195–233

Alhameed RA, Semreen MH, Hamad M, *et al* (2023) Multi-Omics Profiling of *Candida albicans* Grown on Solid Versus Liquid Media. *Microorganisms* 11:2831. <https://doi.org/10.3390/microorganisms11122831>

Alhindi Z (2024) Identification of phytochemicals as potential inhibitors of *Candida albicans* SAP3: An *in silico* approach. *Advancements in Life Sciences* 11:679–683. <https://doi.org/10.62940/als.v11i3.3218>

- Alimuddin A, Widada J, Asmara W, Mustofa M (2011) Antifungal Production of a Strain of Actinomycetes spp Isolated from the Rhizosphere of Cajuput Plant: Selection and Detection of Exhibiting Activity Against Tested Fungi. Indonesian Journal of Biotechnology 16:.. <https://doi.org/10.22146/ijbiotech.7829>
- Almolhim H, Elhassanny AEM, Abutaleb NS, *et al* (2023) Substituted salicylic acid analogs offer improved potency against multidrug-resistant *Neisseria gonorrhoeae* and good selectivity against commensal vaginal bacteria. *Sci Rep* 13, 14468 (2023). <https://doi.org/10.1038/s41598-023-41442-5>
- Alomeir N, Zeng Y, Fadaak A, *et al* (2023) Effect of Nystatin on *Candida albicans* - *Streptococcus mutans* Duo-species Biofilms. *Arch Oral Biol* 145:105582. <https://doi.org/10.1016/j.archoralbio.2022.105582>
- Alves V, Zamith-Miranda D, Frases S, Nosanchuk JD (2025) Fungal Metabolomics: A Comprehensive Approach to Understanding Pathogenesis in Humans and Identifying Potential Therapeutics. *Journal of Fungi* 11:93. <https://doi.org/10.3390/jof11020093>
- Anand R, Kashif M, Pandit A, *et al* (2023) Reprogramming in *Candida albicans* Gene Expression Network under Butanol Stress Abrogates Hyphal Development. *Int J Mol Sci* 24:17227. <https://doi.org/10.3390/ijms242417227>
- Anderson FM, Visser ND, Amses KR, *et al* (2023) *Candida albicans* selection for human commensalism results in substantial within-host diversity without decreasing fitness for invasive disease. *PLOS Biology* 21:e3001822. <https://doi.org/10.1371/journal.pbio.3001822>
- Andriambeloson HO, Rafalisoa BL, Andrianantenaina R, *et al* (2019) Effect of *Streptomyces* sp 3400 JX826625 Metabolites on Multidrug Resistant *Candida albicans* Development and Chemical Characterization of Antifungal Metabolites. *Am J Biomed Life Sci* 7:164–173. <https://doi.org/10.11648/j.ajbls.20190706.17>
- Angiolella L, Rojas F, Giammarino A, *et al* (2024) Identification of Virulence Factors in Isolates of *Candida haemulonii*, *Candida albicans* and *Clavispora lusitaniae* with Low Susceptibility and Resistance to Fluconazole and Amphotericin B. *Microorganisms* 12:212. <https://doi.org/10.3390/microorganisms12010212>
- Anne G, Waturangi DE (2023) Supernatant of Actinomycetes isolates with antiquorum sensing and antibiofilm activity against food spoilage bacteria. *Biodiversitas* 24:5189–5197. <https://doi.org/10.13057/biodiv/d240963>

- Antony RAS, Alejandro AHM, Norberto S-C, Corina-Diana C (2023) Genome mining of *Streptomyces* for the discovery of low-resistance antibiotics. bioRxiv. 12.28.573565; doi: <https://doi.org/10.1101/2023.12.28.573565>
- Araújo D, Gonçalves B, Vilas Boas D, *et al* (2023) Combined Application of Antisense Oligomers to Control Transcription Factors of *Candida albicans* Biofilm Formation. Mycopathologia 188:231–241. <https://doi.org/10.1007/s11046-023-00734-0>
- Araújo D, Henriques M, Silva S (2017) Portrait of Candida Species Biofilm Regulatory Network Genes. Trends in Microbiology 25:62–75. <https://doi.org/10.1016/j.tim.2016.09.004>
- Arkowitz RA, Bassilana M (2019) Recent advances in understanding *Candida albicans* hyphal growth
- Aryal N, Chen J, Bhattarai K, *et al* (2022) High Plasticity of the Amicetin Biosynthetic Pathway in *Streptomyces* sp. SHP 22-7 Led to the Discovery of Streptocytosine P and Cytosaminomycins F and G and Facilitated the Production of 12F-Plicacetin. J Nat Prod 85:530–539. <https://doi.org/10.1021/acs.jnatprod.1c01051>
- Ashok GC, Prakash Pradhan S, Kumar Karki K, *et al* (2023) Antioxidant and Enzyme Inhibitory Potential of *Streptomyces* sp. G-18 Grown in Various Media. International Journal of Microbiology 2023:1–9. <https://doi.org/10.1155/2023/6439466>
- Asril M, Astuti RI, Rusmana I, *et al* (2024) Characterization and antioxidant activity of eumelanin produced by *Streptomyces lasalocidi* NTB 42. Biocatalysis and Agricultural Biotechnology 61:103361. <https://doi.org/10.1016/j.bcab.2024.103361>
- Atiencia MB, Cabezas-Mera FS, Tejera E, Machado A (2022) Prevalence of biofilms in Candida spp. bloodstream infections: A meta-analysis. PLoS ONE 17:e0263522. <https://doi.org/10.1371/journal.pone.0263522>
- Atriwal T, Azeem K, Husain FM, *et al* (2021) Mechanistic Understanding of *Candida albicans* Biofilm Formation and Approaches for Its Inhibition. Front Microbiol 12:638609. <https://doi.org/10.3389/fmicb.2021.638609>
- Avramova MM, Stevenson CEM, Chandra G, *et al* (2023) Global Effects of the Developmental Regulator BldB in *Streptomyces venezuelae*. Journal of Bacteriology 205:e00135-23. <https://doi.org/10.1128/jb.00135-23>
- Awla HK, Kadir J, Othman R, *et al* (2016) Bioactive Compounds Produced by *Streptomyces* sp. Isolate UPMRS4 and Antifungal Activity against

Pyricularia oryzae. *American Journal of Plant Sciences* 7:1077–1085.
<https://doi.org/10.4236/ajps.2016.77103>

Aziz RK, Bartels D, Best AA, *et al* (2008) The RAST Server: Rapid Annotations using Subsystems Technology. *BMC Genomics* 9:75.
<https://doi.org/10.1186/1471-2164-9-75>

Baba MS, Mohamad Zin N, Ahmad SJ, *et al* (2021) Antibiotic Biosynthesis Pathways from Endophytic *Streptomyces* SUK 48 through Metabolomics and Genomics Approaches. *Antibiotics* 10:969.
<https://doi.org/10.3390/antibiotics10080969>

Balducci E, Papi F, Capialbi DE, Del Bino L (2023) Polysaccharides' Structures and Functions in Biofilm Architecture of Antimicrobial-Resistant (AMR) Pathogens. *International Journal of Molecular Sciences* 24:4030.
<https://doi.org/10.3390/ijms24044030>

Ball B, Langille M, Geddes-McAlister J (2020) Fun(gi)omics: Advanced and Diverse Technologies to Explore Emerging Fungal Pathogens and Define Mechanisms of Antifungal Resistance. *mBio* 11:e01020-20.
<https://doi.org/10.1128/mBio.01020-20>

Baltz RH (2021) Genome mining for drug discovery: progress at the front end. *J Ind Microbiol Biotechnol* 48:kuab044.
<https://doi.org/10.1093/jimb/kuab044>

Baltz RH (2017) Gifted microbes for genome mining and natural product discovery. *J Ind Microbiol Biotechnol* 44:573–588. <https://doi.org/10.1007/s10295-016-1815-x>

Banerjee P, Kemmler E, Dunkel M, Preissner R (2024) ProTox 3.0: a webserver for the prediction of toxicity of chemicals. *Nucleic Acids Res* 52:W513–W520. <https://doi.org/10.1093/nar/gkae303>

Banga J, Praveen V, Singh V, *et al* (2008) Studies on medium optimization for the production of antifungal and antibacterial antibiotics from a bioactive soil actinomycete. *Med Chem Res* 17:425–436. <https://doi.org/10.1007/s00044-007-9077-9>

Bapat P, Singh G, Nobile CJ (2021) Visible Lights Combined with Photosensitizing Compounds Are Effective against *Candida albicans* Biofilms. *Microorganisms* 9:500. <https://doi.org/10.3390/microorganisms9030500>

Barros PP, Rossoni RD, De Souza CM, *et al* (2020) *Candida* Biofilms: An Update on Developmental Mechanisms and Therapeutic Challenges. *Mycopathologia* 185:415–424. <https://doi.org/10.1007/s11046-020-00445-w>

- Bergh VJV, Bruzell E, Hegge AB, Tønnesen HH (2015) Influence of formulation on photoinactivation of bacteria by lumichrome. *Pharmazie* 70:574–580
- Barry CP, Gillane R, Talbo GH, *et al* (2022) Multi-omic characterisation of *Streptomyces hygroscopicus* NRRL 30439: detailed assessment of its secondary metabolic potential. *Mol Omics* 18:226–236. <https://doi.org/10.1039/d1mo00150g>
- Baskaran SP, Sahoo AK, Chivukula N, *et al* (2023) Cheminformatics analysis of multi-target structure-activity landscape of environmental chemicals binding to human endocrine receptors. *ACS Omega*. 8(51):49383-49395. <https://doi.org/10.1021/acsomega.3c07920>
- Basnet A, Tamang B, Shrestha MR, *et al* (2023) Assessment of four *in vitro* phenotypic biofilm detection methods in relation to antimicrobial resistance in aerobic clinical bacterial isolates. *PLOS ONE* 18:e0294646. <https://doi.org/10.1371/journal.pone.0294646>
- Bassi RC, Boriollo MFG (2022) Amphotericin B, fluconazole, and nystatin as development inhibitors of *Candida albicans* biofilms on a dental prosthesis relined material: Analytical models *in vitro*. *The Journal of Prosthetic Dentistry* 127:320–330. <https://doi.org/10.1016/j.prosdent.2020.10.018>
- Bauermeister A, Pereira F, Grilo IR, *et al* (2019) Intra-clade metabolomic profiling of MAR4 *Streptomyces* from the Macaronesia Atlantic region reveals a source of anti-biofilm metabolites. *Environmental Microbiology* 21:1099–1112. <https://doi.org/10.1111/1462-2920.14529>
- Beck C, Gren T, Ortiz-López FJ, *et al* (2021) Activation and Identification of a Griseusin Cluster in *Streptomyces* sp. CA-256286 by Employing Transcriptional Regulators and Multi-Omics Methods. *Molecules* 26:6580. <https://doi.org/10.3390/molecules26216580>
- Begum N, Lee S, Portlock TJ, *et al* (2022) Integrative functional analysis uncovers metabolic differences between *Candida* species. *Commun Biol* 5:1–12. <https://doi.org/10.1038/s42003-022-03955-z>
- Beld J, Lee DJ, Burkart MD (2014) Fatty acid biosynthesis revisited: structure elucidation and metabolic engineering. *Mol Biosyst* 11:38–59. <https://doi.org/10.1039/C4MB00443D>
- Belknap KC, Park CJ, Barth BM, Andam CP (2020) Genome mining of biosynthetic and chemotherapeutic gene clusters in *Streptomyces* bacteria. *Sci Rep* 10:2003. <https://doi.org/10.1038/s41598-020-58904-9>
- Benjamin I, Louis H, O. Ekpen F, *et al* (2023) Modeling the anti-Methicillin-Resistant *Staphylococcus aureus* (MRSA) Activity of (E)-6-chloro-N2-

phenyl-N4-(4-Phenyl-5-(Phenyl Diazinyl)-2λ3, 3 λ2- Thiazol-2-yl)-1, 3, 5-Triazine-2,4- Diamine. Polycyclic Aromatic Compounds 43:7942–7969. <https://doi.org/10.1080/10406638.2022.2160773>

Bérdy J (2005) Bioactive Microbial Metabolites: A Personal View. J Antibiot 58:1–26. <https://doi.org/10.1038/ja.2005.1>

Berkow EL, Lockhart SR, Ostrosky-Zeichner L (2020) Antifungal Susceptibility Testing: Current Approaches. Clin Microbiol Rev 33:e00069-19. <https://doi.org/10.1128/CMR.00069-19>

Berman HM, Westbrook J, Feng Z, *et al* (2000) The Protein Data Bank. Nucleic Acids Res 28:235–242. <https://doi.org/10.1093/nar/28.1.235>

Bérouti M, Wagner M, Greulich W, *et al* (2025) Pseudouridine RNA avoids immune detection through impaired endolysosomal processing and TLR engagement. Cell 188:4880-4895.e15. <https://doi.org/10.1016/j.cell.2025.05.032>

Bhandari S, Bhattarai BR, Adhikari A, *et al* (2022) Characterization of *Streptomyces* Species and Validation of Antimicrobial Activity of Their Metabolites through Molecular Docking. Processes 10:2149. <https://doi.org/10.3390/pr10102149>

Bhat AM, Haneen MA, Hussain A, *et al* (2024) Comparative genomics studies provide insights into the taxonomic classification and secondary metabolic potential of five bioactive *Streptomyces* species isolated from the North-Western Himalaya. bioRxiv. 05.28.596145; doi:<https://doi.org/10.1101/2024.05.28.596145>.

Bhattarai BR, Khadayat K, Aryal N, *et al* (2022) Untargeted Metabolomics of *Streptomyces* Species Isolated from Soils of Nepal. Processes 10:1173. <https://doi.org/10.3390/pr10061173>

Bhavini K, Fernandes A, Ravichandran V, *et al* (2023) Antimicrobial Peptides: Sources, Types, and Antibiofilm Activity. In: Natural Products. CRC Press

Bibb MJ (2005) Regulation of secondary metabolism in streptomycetes. Curr Opin Microbiol 8:208–215. <https://doi.org/10.1016/j.mib.2005.02.016>

Birková A, Hubková B, Bolerázská B, *et al* (2020) Caffeic acid: a brief overview of its presence, metabolism, and bioactivity. Bioactive Compounds in Health and Disease - Online ISSN: 2574-0334; Print ISSN: 2769-2426 3:74–81. <https://doi.org/10.31989/bchd.v3i4.692>

Blin K, Shaw S, Medema MH, Weber T (2023) The antiSMASH database version 4: additional genomes and BGCs, new sequence-based searches and more. Nucleic Acids Res 52:D586–D589. <https://doi.org/10.1093/nar/gkad984>

- Blin K, Shaw S, Vader L, *et al* (2025) antiSMASH 8.0: extended gene cluster detection capabilities and analyses of chemistry, enzymology, and regulation. *Nucleic Acids Research* gkaf334. <https://doi.org/10.1093/nar/gkaf334>
- Boahen A, Than LTL, Loke Y-L, Chew SY (2022) The Antibiofilm Role of Biotics Family in Vaginal Fungal Infections. *Front Microbiol* 13:. <https://doi.org/10.3389/fmicb.2022.787119>
- Bobek J, Filipová E, Bergman N, *et al* (2022) Polyenic Antibiotics and Other Antifungal Compounds Produced by Hemolytic *Streptomyces* Species. *International Journal of Molecular Sciences* 23:15045. <https://doi.org/10.3390/ijms232315045>
- Boby F, Bhuiyan MNH, Saha BK, *et al* (2023) *In silico* exploration of *Serratia* sp. BRL41 genome for detecting prodigiosin Biosynthetic Gene Cluster (BGC) and *in vitro* antimicrobial activity assessment of secreted prodigiosin. *PLOS ONE* 18:e0294054. <https://doi.org/10.1371/journal.pone.0294054>
- Boldt J, Lukoševičiūtė L, Fu C, *et al* (2023) Bursts in biosynthetic gene cluster transcription are accompanied by surges of natural compound production in the myxobacterium *Sorangium* sp. *Microbial Biotechnology* 16:1054–1068. <https://doi.org/10.1111/1751-7915.14246>
- Boltz TA, Devkota P, Wuchty S (2019) Collective influencers in protein interaction networks. *Sci Rep* 9:3948. <https://doi.org/10.1038/s41598-019-40410-2>
- Bora PS, Kumar A, Singh AK, *et al* (2023) Molecular Docking and QSAR Studies of Indole Derivatives as Antifungal Agents. *Current Chinese Chemistry* 3:1–12. <https://doi.org/10.2174/2666001603666230328181833>
- Borgio JF, Alhujaily R, Alquwaie R, *et al* (2023) Mining the nanotube-forming *Bacillus amyloliquefaciens* MR14M3 genome for determining anti-*Candida auris* and anti-*Candida albicans* potential by pathogenicity and comparative genomics analysis. *Computational and Structural Biotechnology Journal* 21:4261–4276. <https://doi.org/10.1016/j.csbj.2023.08.031>
- Boruta T, Ścigaczewska A, Bizukojć M (2022) Production of secondary metabolites in stirred tank bioreactor co-cultures of *Streptomyces noursei* and *Aspergillus terreus*. *Front Bioeng Biotechnol* 10:1011220. <https://doi.org/10.3389/fbioe.2022.1011220>
- Boruta T, Ścigaczewska A, Bizukojć M (2023) Investigating the Stirred Tank Bioreactor Co-Cultures of the Secondary Metabolite Producers *Streptomyces noursei* and *Penicillium rubens*. *Biomolecules* 13:1748. <https://doi.org/10.3390/biom13121748>

- Böttcher B, Hoffmann B, Garbe E, *et al* (2020) The Transcription Factor Stp2 Is Important for *Candida albicans* Biofilm Establishment and Sustainability. *Front Microbiol* 11:. <https://doi.org/10.3389/fmicb.2020.00794>
- Branco J, Martins-Cruz C, Rodrigues L, *et al* (2021) The transcription factor Ndt80 is a repressor of *Candida parapsilosis* virulence attributes. *Virulence* 12:601–614. <https://doi.org/10.1080/21505594.2021.1878743>
- Brettin T, Davis JJ, Disz T, *et al* (2015) RASTtk: a modular and extensible implementation of the RAST algorithm for building custom annotation pipelines and annotating batches of genomes. *Sci Rep* 5:8365. <https://doi.org/10.1038/srep08365>
- Bruna P, Núñez-Montero K, Contreras MJ, *et al* (2024) Biosynthetic gene clusters with biotechnological applications in novel Antarctic isolates from Actinomycetota. *Appl Microbiol Biotechnol* 108:325. <https://doi.org/10.1007/s00253-024-13154-x>
- Bunet R, Riclea R, Laureti L, *et al* (2014) A Single Sfp-Type Phosphopantetheinyl Transferase Plays a Major Role in the Biosynthesis of PKS and NRPS Derived Metabolites in *Streptomyces ambofaciens* ATCC23877. *PLOS ONE* 9:e87607. <https://doi.org/10.1371/journal.pone.0087607>
- Bushman TJ, Cunneely Q, Ciesla L (2023) Extraction, isolation, and Biological activity of natural cyclic dipeptides. In: *Studies in Natural Products Chemistry*. Elsevier, pp 75–99
- Caesar LK, Montaser R, Keller NP, Kelleher NL (2021) Metabolomics and Genomics in Natural Products Research: Complementary Tools for Targeting New Chemical Entities. *Nat Prod Rep* 38:2041–2065. <https://doi.org/10.1039/d1np00036e>
- Caicedo-Montoya C, Manzo-Ruiz M, Ríos-Estapa R (2021) Pan-Genome of the Genus *Streptomyces* and Prioritization of Biosynthetic Gene Clusters With Potential to Produce Antibiotic Compounds. *Front Microbiol* 12:. <https://doi.org/10.3389/fmicb.2021.677558>
- Carvalho MP de, Abraham W-R (2012) Antimicrobial and Biofilm Inhibiting Diketopiperazines. *Current Medicinal Chemistry* 19:3564–3577. <https://doi.org/10.2174/092986712801323243>
- Casagrande Pierantoni D, Corte L, Casadevall A, *et al* (2021) How does temperature trigger biofilm adhesion and growth in *Candida albicans* and two non-*Candida albicans* *Candida* species? *Mycoses* 64:1412–1421. <https://doi.org/10.1111/myc.13291>

- Chakraborty T, Chakraborty T (2024) Anti-Biofilm Potential of Secondary Metabolites from Microbes: A clinical approach. *IJERA* 14:142–150. <https://doi.org/10.9790/9622-1406142150>
- Chalén-Alvarado B, Quiroz-Moreno C, Mogollón N, *et al* (2019) Estudio Del Metaboloma En El Antagonismo Microbiano A Través De Cromatografía Líquida Con Algoritmos Quimiométricos. *Perfiles* 2:20–25. <https://doi.org/10.47187/perf.v2i22.50>
- Challa A, Maras JS, Nagpal S, *et al* (2024) Multi-omics analysis identifies potential microbial and metabolite diagnostic biomarkers of bacterial vaginosis. *Journal of the European Academy of Dermatology and Venereology* 38:1152–1165. <https://doi.org/10.1111/jdv.19805>
- Chandra, J., & Mukherjee, P. K. (2015). *Candida* biofilms: development, architecture, and resistance. *Microbiology Spectrum*, 3(4).
- Chater KF (2006) *Streptomyces* inside-out: a new perspective on the bacteria that provide us with antibiotics. *Philos Trans R Soc Lond B Biol Sci* 361:761–768. <https://doi.org/10.1098/rstb.2005.1758>
- Chater KF (2016) Recent advances in understanding *Streptomyces*. *F1000Res* 5:2795. <https://doi.org/10.12688/f1000research.9534.1>
- Chen M, Cui Y, Su J, *et al* (2025) Analysis of Non-volatile Component Differences and Metabolic Pathways in Various Forms of *Dracaena cochinchinensis* Resin-Containing drugs Using Untargeted Metabolomics and Molecular Networking
- Chen S, Kinney WA, Van Lanen S (2017) Nature’s combinatorial biosynthesis and recently engineered production of nucleoside antibiotics in *Streptomyces*. *World J Microbiol Biotechnol* 33:66. <https://doi.org/10.1007/s11274-017-2233-6>
- Chetty A, Blekhman R (2024) Multi-omic approaches for host-microbiome data integration. *Gut Microbes* 16:2297860. <https://doi.org/10.1080/19490976.2023.2297860>
- Chevrette MG, Carlson CM, Ortega HE, *et al* (2019) The antimicrobial potential of *Streptomyces* from insect microbiomes. *Nat Commun* 10:516. <https://doi.org/10.1038/s41467-019-08438-0>
- Choi SY, Park J, Kim J, *et al* (2021) Investigation of Chemical Profiles of Different Parts of *Morus alba* Using a Combination of Molecular Networking Methods with Mass Spectral Data from Two Ionization Modes of LC/MS. *Plants* 10:1711. <https://doi.org/10.3390/plants10081711>

- Chong J, Soufan O, Li C, *et al* (2018) MetaboAnalyst 4.0: towards more transparent and integrative metabolomics analysis. *Nucleic Acids Res* 46:W486–W494. <https://doi.org/10.1093/nar/gky310>
- Christie L, Rutherford S, Palmer DS, *et al* (2024) Bioprocess monitoring applications of an innovative ATR-FTIR spectroscopy platform. *Front Bioeng Biotechnol* 12:. <https://doi.org/10.3389/fbioe.2024.1349473>
- Chu F, Wu H, Li C, *et al* (2025) Transcriptomics analysis reveals the effect of *Pulsatilla* decoction butanol extract on endoplasmic reticulum and peroxisome function of *Candida albicans* in hyphal state. *Journal of Ethnopharmacology* 337:118826. <https://doi.org/10.1016/j.jep.2024.118826>
- Chudzik-Rząd B, Zalewski D, Kasela M, *et al* (2023) The Landscape of Gene Expression during Hyperfilamentous Biofilm Development in Oral *Candida albicans* Isolated from a Lung Cancer Patient. *International Journal of Molecular Sciences* 24:368. <https://doi.org/10.3390/ijms24010368>
- Chung Y-H, Kim H, Ji C-H, *et al* (2021) Comparative Genomics Reveals a Remarkable Biosynthetic Potential of the *Streptomyces* Phylogenetic Lineage Associated with Rugose-Ornamented Spores. *mSystems* 6:10.1128/msystems.00489-21. <https://doi.org/10.1128/msystems.00489-21>
- Cibichakravarthy B, Jose PA (2021) Biosynthetic Potential of *Streptomyces* Rationalizes Genome-Based Bioprospecting. *Antibiotics (Basel)* 10:873. <https://doi.org/10.3390/antibiotics10070873>
- Ciurea CN, Kosovski I-B, Mare AD, *et al* (2020) *Candida* and Candidiasis—Opportunism Versus Pathogenicity: A Review of the Virulence Traits. *Microorganisms* 8:857. <https://doi.org/10.3390/microorganisms8060857>
- Córdova-Dávalos L, Escobedo-Chávez K, Evangelista-Martínez Z (2018) Inhibition of *Candida albicans* cell growth and biofilm formation by a bioactive extract produced by soil *Streptomyces* strain GCAL-25. *Arch biol sci (Beogr)* 70:387–396. <https://doi.org/10.2298/ABS170908057C>
- Cravener MV, Do E, May G, *et al* (2023) Reinforcement amid genetic diversity in the *Candida albicans* biofilm regulatory network. *PLOS Pathogens* 19:e1011109. <https://doi.org/10.1371/journal.ppat.1011109>
- Crivello G, Fracchia L, Ciardelli G, *et al* (2023) *In vitro* Models of Bacterial Biofilms: Innovative Tools to Improve Understanding and Treatment of Infections. *Nanomaterials (Basel)* 13:904. <https://doi.org/10.3390/nano13050904>

- Cruz-Morales P (2022) Functional and evolutionary genomics of the *Streptomyces* metabolism
- Cuervo L, Malmierca MG, García-Salcedo R, *et al* (2023) Co-Expression of Transcriptional Regulators and Housekeeping Genes in *Streptomyces* spp.: A Strategy to Optimize Metabolite Production. *Microorganisms* 11:1585. <https://doi.org/10.3390/microorganisms11061585>
- Cuozzo S, de Moreno de LeBlanc A, LeBlanc JG, *et al* (2023) *Streptomyces* genus as a source of probiotics and its potential for its use in health. *Microbiol Res* 266:127248. <https://doi.org/10.1016/j.micres.2022.127248>
- Czechowicz P, Nowicka J, Gościński G (2022) Virulence Factors of *Candida* spp. and Host Immune Response Important in the Pathogenesis of Vulvovaginal Candidiasis. *International Journal of Molecular Sciences* 23:5895. <https://doi.org/10.3390/ijms23115895>
- Dai J-K, Dan W-J, Wan J-B (2022) Natural and synthetic β -carboline as a privileged antifungal scaffolds. *European Journal of Medicinal Chemistry* 229:114057. <https://doi.org/10.1016/j.ejmech.2021.114057>
- Dallakyan S, Olson AJ (2015) Small-molecule library screening by docking with PyRx. *Methods Mol Biol* 1263:243–250. https://doi.org/10.1007/978-1-4939-2269-7_19
- Damayanti E, Lisdiyanti P, Sundowo A, *et al* (2021) Antiplasmodial activity, biosynthetic gene clusters diversity, and secondary metabolite constituent of selected Indonesian *Streptomyces*. *Biodiversitas Journal of Biological Diversity* 22:.. <https://doi.org/10.13057/biodiv/d220657>
- Damont A, Olivier M-F, Warnet A, *et al* (2019) Proposal for a chemically consistent way to annotate ions arising from the analysis of reference compounds under ESI conditions: A prerequisite to proper mass spectral database constitution in metabolomics. *J Mass Spectrom* 54:567–582. <https://doi.org/10.1002/jms.4372>
- D'Aquila P, De Rose E, Sena G, *et al* (2024) Quorum Quenching Approaches against Bacterial-Biofilm-Induced Antibiotic Resistance. *Antibiotics* 13:619. <https://doi.org/10.3390/antibiotics13070619>
- Darlami J, Sharma S (2024) The role of physicochemical and topological parameters in drug design. *Front Drug Discov* 4:.. <https://doi.org/10.3389/fddsv.2024.1424402>
- Dat TTH, Steinert G, Cuc NTK, *et al* (2023) Diversity of Bacterial Secondary Metabolite Biosynthetic Gene Clusters in Three Vietnamese Sponges. *Marine Drugs* 21:29. <https://doi.org/10.3390/md21010029>

- de Souza CM, dos Santos MM, Furlaneto-Maia L, Furlaneto MC (2023) Adhesion and biofilm formation by the opportunistic pathogen *Candida tropicalis*: what do we know? *Can J Microbiol* 69:207–218. <https://doi.org/10.1139/cjm-2022-0195>
- Delaney C, Short B, Rajendran R, *et al* (2023) An integrated transcriptomic and metabolomic approach to investigate the heterogeneous *Candida albicans* biofilm phenotype. *Biofilm* 5:100112. <https://doi.org/10.1016/j.biofilm.2023.100112>
- Deng K, Jiang W, Jiang Y, *et al* (2021) ALS3 Expression as an Indicator for *Candida albicans* Biofilm Formation and Drug Resistance. *Front Microbiol* 12:. <https://doi.org/10.3389/fmicb.2021.655242>
- Deng L, Zhao Z, Liu L, *et al* (2023) Dissection of 3D chromosome organization in *Streptomyces coelicolor* A3(2) leads to biosynthetic gene cluster overexpression. *Proc Natl Acad Sci U S A* 120:e2222045120. <https://doi.org/10.1073/pnas.2222045120>
- Denning, D. W. (2024). Global incidence and mortality of severe fungal disease. *The Lancet Infectious Diseases*, 24(7), e428–e438.
- Denofrio MP, Paredes JM, Yañuk JG, *et al* (2023) Photosensitizing properties and subcellular localisation of 3,4-dihydro- β -carboline harmaline and harmalol. *Photochem Photobiol Sci* 22:487–501. <https://doi.org/10.1007/s43630-022-00328-7>
- Desrini S, Ducloux J, Hamion G, *et al* (2023) Antibiofilm Activity of Invasive Plants against *Candida albicans*: Focus on *Baccharis halimifolia* Essential Oil and Its Compounds. *Chemistry & Biodiversity* 20:e202300130. <https://doi.org/10.1002/cbdv.202300130>
- Dev M, Mukadam M (2025) Functional group profiling of medicinal plants using FTIR spectroscopy. *World Journal of Biology Pharmacy and Health Sciences* 21:243–249. <https://doi.org/10.30574/wjbphs.2025.21.1.0039>
- Dhingra S, Rahman NAA, Peile E, *et al* (2020) Microbial Resistance Movements: An Overview of Global Public Health Threats Posed by Antimicrobial Resistance, and How Best to Counter. *Front Public Health* 8:535668. <https://doi.org/10.3389/fpubh.2020.535668>
- Díaz-García J, Marcos-Zambrano LJ, Muñoz P, *et al* (2019) Does the composition of polystyrene trays affect *Candida* spp. biofilm formation? *Medical Mycology* 57:504–509. <https://doi.org/10.1093/mmy/myy064>

- Ding L, Huang G, Wang Q, *et al* (2023) Antibacterial and antibiofilm activities of the metabolites isolated from a sponge-associated strain of *Streptomyces* sp. NBU3429
- Ding N, Jiang Y, Han L, *et al* (2016) Bafilomycins and Odoriferous Sesquiterpenoids from *Streptomyces* albolongus Isolated from *Elephas maximus* Feces. *Journal of Natural Products* 79:. <https://doi.org/10.1021/acs.jnatprod.5b00827>
- Djati F, Agustina D, Mustofa M, *et al* (2023) *In silico* Destruction of *Porphyromonas gingivalis* Fimbriae by *Streptomyces* sp. Strain GMY02. *BIO Web of Conferences* 75:. <https://doi.org/10.1051/bioconf/20237502004>
- Djinni I, Djoudi W, Boumezoued C, *et al* (2023) Statistical Medium Optimization for the Production of Anti-Methicillin-Resistant *Staphylococcus aureus* Metabolites from a Coal-Mining-Soil-Derived *Streptomyces rochei* CMB47. *Fermentation* 9:381. <https://doi.org/10.3390/fermentation9040381>
- Do E, Cravener MV, Huang MY, *et al* (2022) Collaboration between Antagonistic Cell Type Regulators Governs Natural Variation in the *Candida albicans* Biofilm and Hyphal Gene Expression Network. *mBio* 13:e01937-22. <https://doi.org/10.1128/mbio.01937-22>
- Dobson LF, O’Cleirigh CC, O’Shea DG (2008) The influence of morphology on geldanamycin production in submerged fermentations of *Streptomyces hygroscopicus* var. *geldanus*. *Appl Microbiol Biotechnol* 79:859–866. <https://doi.org/10.1007/s00253-008-1493-3>
- Donald L, Pipite A, Subramani R, *et al* (2022) *Streptomyces*: Still the Biggest Producer of New Natural Secondary Metabolites, a Current Perspective. *Microbiology Research* 13:418–465. <https://doi.org/10.3390/microbiolres13030031>
- Dow L, Gallart M, Ramarajan M, *et al* (2023) *Streptomyces* and their specialised metabolites for phytopathogen control – comparative *in vitro* and in planta metabolic approaches. *Front Plant Sci* 14:1151912. <https://doi.org/10.3389/fpls.2023.1151912>
- Dror B, Wang Z, Brady SF, *et al* (2020) Elucidating the Diversity and Potential Function of Nonribosomal Peptide and Polyketide Biosynthetic Gene Clusters in the Root Microbiome. *mSystems* 5:10.1128/msystems.00866-20. <https://doi.org/10.1128/msystems.00866-20>
- Du J, Yuan M, Shen A, Wang M (2025) PPDock: Pocket Prediction-Based Protein–Ligand Blind Docking. *J Chem Inf Model* 65:554–562. <https://doi.org/10.1021/acs.jcim.4c01373>

- Du Y, Han W, Hao P, *et al* (2024) A Genomics-Based Discovery of Secondary Metabolite Biosynthetic Gene Clusters in the Potential Novel Strain *Streptomyces* sp. 21So2-11 Isolated from Antarctic Soil. *Microorganisms* 12:1228. <https://doi.org/10.3390/microorganisms12061228>
- Dullweber F, Sevenich FW, Klebe G (2000) Determination of Accurate Thermodynamics of Binding for Proteinase-Inhibitor Interactions. In: Gundertofte K, Jørgensen FS (eds) *Molecular Modeling and Prediction of Bioactivity*. Springer US, Boston, MA, pp 495–496
- Dyson P (2019) *Streptomyces*☆. In: Schmidt TM (ed) *Encyclopedia of Microbiology* (Fourth Edition). Academic Press, Oxford, pp 334–345
- El Hage K, Zoete V (2019) Strong Enrichment of Aromatic and Sulfur-Containing Residues in Ligand–Protein Binding Sites. *J Chem Inf Model* 59:4921–4928. <https://doi.org/10.1021/acs.jcim.9b00582>
- ElAhwany AMD, Ghozlan HA, ElSharif HA, Sabry SA (2015) Phylogenetic diversity and antimicrobial activity of marine bacteria associated with the soft coral *Sarcophyton glaucum*. *J Basic Microbiol* 55:2–10. <https://doi.org/10.1002/jobm.201300195>
- Elias F, Muddada S, Muleta D, Tefera B (2022) Purification and Characterization of Bioactive Metabolite from *Streptomyces monomycini* RVE129 Derived from the Rift Valley Soil of Hawassa, Ethiopia. *BioMed Research International* 2022:7141313. <https://doi.org/10.1155/2022/7141313>
- Elisabeth ZM (2022) The Mechanisms of Bacterial Biofilm Inhibition and Eradication: The Search for Alternative Antibiofilm Agents. In: *Focus on Bacterial Biofilms*. IntechOpen
- Ellepola K, Truong T, Liu Y, *et al* (2019) Multi-omics Analyses Reveal Synergistic Carbohydrate Metabolism in *Streptococcus mutans*-*Candida albicans* Mixed-Species Biofilms. *Infect Immun* 87:e00339-19. <https://doi.org/10.1128/IAI.00339-19>
- El-Sawy ER, Abdel-Aziz MS, Abdelmegeed H, Kirsch G (2024) Coumarins: Quorum Sensing and Biofilm Formation Inhibition. *Molecules* 29:4534. <https://doi.org/10.3390/molecules29194534>
- Estrela AB, Abraham W-R (2016) Fungal Metabolites for the Control of Biofilm Infections. *Agriculture* 6:37. <https://doi.org/10.3390/agriculture6030037>
- Faheem, Kumar BK, Sekhar KVGC, *et al* (2021) Recent Update on the Anti-infective Potential of β -carboline Analogs. <http://www.eurekaselect.com> 21:398–425

- Fallah S, Duncan D, Reichl KD, *et al* (2024) A chemical screen identifies structurally diverse metal chelators with activity against the fungal pathogen *Candida albicans*. *Microbiology Spectrum* 12:e04095-23. <https://doi.org/10.1128/spectrum.04095-23>
- Farah N, Lim CW, Chin VK, *et al* (2024) Photoactivated riboflavin inhibits planktonic and biofilm growth of *Candida albicans* and non-*albicans* *Candida* species. *Microbial Pathogenesis* 191:106665. <https://doi.org/10.1016/j.micpath.2024.106665>
- Farida Y, Widada J, Meiyanto E (2007) Combination Methods for Screening Marine Actinomycetes Producing Potential Compounds as Anticancer. *Indonesian Journal of Biotechnology* 12:. <https://doi.org/10.22146/ijbiotech.7772>
- Fatimah A-O (2019) Antifungal Activity and Fourier Transform Infrared Spectrometric Characterization of Aqueous Extracts of *Acacia senegal* and *Acacia tortilis* on Phytopathogenic Fungi. *Journal of Pharmaceutical Research International* 1–11. <https://doi.org/10.9734/jpri/2019/v31i230295>
- Fattah CH, Shekhany KAM, Rachid S (2024) Efficacy of Crude Extract from *Streptomyces cellulosa* Against Biofilm-Related Genes of *Candida albicans*. *Jundishapur J Microbiol* 17:. <https://doi.org/10.5812/jjm-145959>
- Fernández-Fernández R, Elsherbini AMA, Lozano C, *et al* (2025) Genomic Analysis of Bacteriocin-Producing Staphylococci: High Prevalence of Lanthipeptides and the Micrococцин P1 Biosynthetic Gene Clusters. *Probiotics & Antimicro Prot* 17:159–174. <https://doi.org/10.1007/s12602-023-10119-w>
- Ferreira C, Gonçalves B, Vilas Boas D, *et al* (2016) *Candida tropicalis* biofilm and human epithelium invasion is highly influenced by environmental pH. *Pathogens and Disease* 74:ftw101. <https://doi.org/10.1093/femspd/ftw101>
- Flärdh K, Buttner MJ (2009) *Streptomyces* morphogenetics: dissecting differentiation in a filamentous bacterium. *Nat Rev Microbiol* 7:36–49. <https://doi.org/10.1038/nrmicro1968>
- Florova G, Kazanina G, Reynolds KA (2002) Enzymes Involved in Fatty Acid and Polyketide Biosynthesis in *Streptomyces glaucescens*: Role of FabH and FabD and Their Acyl Carrier Protein Specificity. *Biochemistry* 41:10462–10471. <https://doi.org/10.1021/bi0258804>
- Fortuin S, Soares NC (2022) The Integration of Proteomics and Metabolomics Data Paving the Way for a Better Understanding of the Mechanisms Underlying Microbial Acquired Drug Resistance. *Front Med (Lausanne)* 9:849838. <https://doi.org/10.3389/fmed.2022.849838>

- Frändberg E, Petersson C, Lundgren L, Schnürer J (2000) *Streptomyces* halstedii K122 produces the antifungal compounds bafilomycin B1 and C1. Canadian journal of microbiology 46:753–8. <https://doi.org/10.1139/w00-050>
- Freire F, de Barros PP, Pereira CA, *et al* (2018) Photodynamic inactivation in the expression of the *Candida albicans* genes ALS3, HWP1, BCR1, TEC1, CPH1, and EFG1 in biofilms. Lasers Med Sci 33:1447–1454. <https://doi.org/10.1007/s10103-018-2487-8>
- Fydrych D, Jeziurska J, Welna J, Kwiecińska-Piróg J (2025) Potential Use of Selected Natural Compounds with Anti-Biofilm Activity. International Journal of Molecular Sciences 26:607. <https://doi.org/10.3390/ijms26020607>
- Galgóczy L, Yap A, Marx F (2019) Cysteine-Rich Antifungal Proteins from Filamentous Fungi are Promising Bioactive Natural Compounds in Anti-*Candida* Therapy. Israel Journal of Chemistry 59:360–370. <https://doi.org/10.1002/ijch.201800168>
- Galen C van, Barnard DT, Stanley RJ (2020) Stark Spectroscopy of Lumichrome: A Possible Candidate for Stand-Off Detection of Bacterial Quorum Sensing. J Phys Chem B 124:11835– 11842. <https://doi.org/10.1021/acs.jpcc.0c09498>
- Ganser C, Staples MI, Dowell M, *et al* (2023) Filamentation and biofilm formation are regulated by the phase-separation capacity of network transcription factors in *Candida albicans*. PLoS Pathog 19:e1011833. <https://doi.org/10.1371/journal.ppat.1011833>
- García-Pérez P, Becchi PP, Zhang L, *et al* (2024) Metabolomics and chemometrics: The next-generation analytical toolkit for the evaluation of food quality and authenticity. Trends in Food Science & Technology 147:104481. <https://doi.org/10.1016/j.tifs.2024.104481>
- Gędas A, Olszewska MA (2020) Chapter 1 - Biofilm formation and resistance. In: Simoes M, Borges A, Chaves Simoes L (eds) Recent Trends in Biofilm Science and Technology. Academic Press, pp 1–21
- Genilloud O (2018) Mining Actinomycetes for Novel Antibiotics in the Omics Era: Are We Ready to Exploit This New Paradigm? Antibiotics 7:85. <https://doi.org/10.3390/antibiotics7040085>
- Ghosh T, Zhang W, Ghosh D, Kechris K (2020) Predictive Modeling for Metabolomics Data. In: Li S (ed) Computational Methods and Data Analysis for Metabolomics. Springer US, New York, NY, pp 313–336

- Gillon A, Abdelrahman O, Abou-Mansour E, *et al* (2023) Comparative genomic and metabolomic study of three *Streptomyces* sp. differing in biological activity. *MicrobiologyOpen* 12:e1389. <https://doi.org/10.1002/mbo3.1389>
- Girardot M, and Imbert C (2016) Novel Strategies Against *Candida* Biofilms: Interest of Synthetic Compounds. *Future Microbiology* 11:69–79. <https://doi.org/10.2217/fmb.15.118>
- Girireddy M, Saiakhov R, Chakravarti S (2022) Assessment of Endocrine Disruption Potential of Chemicals Using Combined Quantitative Structure-Activity Relationship Modeling of *In vitro* and *In Vivo* Assays. *Applied In vitro Toxicology* 8:139–146. <https://doi.org/10.1089/aivt.2022.0015>
- Glazier VE, Kramara J, Ollinger T, *et al* (2023) The *Candida albicans* reference strain SC5314 contains a rare, dominant allele of the transcription factor Rob1 that modulates filamentation, biofilm formation, and oral commensalism. *mBio* 14:e01521-23. <https://doi.org/10.1128/mbio.01521-23>
- Gonçalves B, Fernandes L, Henriques M, Silva S (2020) Environmental pH modulates biofilm formation and matrix composition in *Candida albicans* and *Candida glabrata*. *Biofouling* 36:621–630. <https://doi.org/10.1080/08927014.2020.1793963>
- Gong B, Chen S, Lan W, *et al* (2018) Antibacterial and Antitumor Potential of Actinomycetes Isolated from Mangrove Soil in the Maowei Sea of the Southern Coast of China. *Iran J Pharm Res* 17:1339–1346
- Gonzalez-Silva A, San Juan-Mendo M, Delgado-Prudencio G, *et al* (2024) Comparative Genomics and Biosynthetic Cluster Analysis of Antifungal Secondary Metabolites of Three Strains of *Streptomyces albidoflavus* Isolated from Rhizospheric Soils. *Microorganisms* 12:2637. <https://doi.org/10.3390/microorganisms12122637>
- Grald A, Yargosz P, Case S, *et al* (2012) Small-molecule inhibitors of biofilm formation in laboratory and clinical isolates of *Candida albicans*. *Journal of Medical Microbiology* 61:109–114. <https://doi.org/10.1099/jmm.0.034124-0>
- Grandér D, Johnsson P (2016) Pseudogene-Expressed RNAs: Emerging Roles in Gene Regulation and Disease. In: Morris KV (ed) *Long Non-coding RNAs in Human Disease*. Springer International Publishing, Cham, pp 111–126
- Grasel F dos S, Weiler FH, Ferrão MF (2024) Methodology Development for Management of Recyclable Polymers by Fourier Transform Infrared Spectroscopy and PLS-DA

- Gu Y, Yu Z, Wang Y, *et al* (2024) admetSAR3.0: a comprehensive platform for exploration, prediction and optimization of chemical ADMET properties. *Nucleic Acids Res* 52:W432–W438. <https://doi.org/10.1093/nar/gkae298>
- Guarro J, Figueras MJ, Cano J (1989) Alterations Produced by Sertaconazole on the Morphology and Ultrastructure of *Candida albicans*: Sertaconazol-bedingte Veränderungen der Morphologie und Ultrastruktur von *Candida albicans*. *Mycoses* 32:283–295. <https://doi.org/10.1111/j.1439-0507.1989.tb02246.x>
- Guo Y, Zheng W, Rong X, Huang Y (2008) A multilocus phylogeny of the *Streptomyces griseus* 16S rRNA gene clade: use of multilocus sequence analysis for streptomycete systematics. *International Journal of Systematic and Evolutionary Microbiology* 58:149–159. <https://doi.org/10.1099/ij.s.0.65224-0>
- Gupta MSC, Gangwar P, Tripathi DT, *et al* (2023) Assessment of Volatile Compounds Variability Among Two Commiphora Species Using Gas Chromatography Coupled with Chemometric Analysis and Their Biological Activities
- Gür SD (2025) Promising Phytochemicals that Show Antibiofilm Activity at Sub-Minimum Inhibitory Concentrations: Trans-Cinnamaldehyde, Limonene, Eugenol, and Curcumin. *HJBC* 53:31–41. <https://doi.org/10.15671/hjbc.1526093>
- H. K. Aliwarga LS (2021) Multi-Response Optimization for the Production of Antifungal Compound and Decomposition of Municipal Solid Waste decomposition by *Streptomyces* Sp. GMR22. *Journal of Hunan University Natural Sciences* 48:
- Halinkovič M, Mušková K, Sloboda T, *et al* (2024) MLtox, online phototoxicity prediction webpage. *Toxicology in vitro* 94:105701. <https://doi.org/10.1016/j.tiv.2023.105701>
- Hamed AA, Mohamed OG, Aboutabl EA, *et al* (2023) Identification of Antimicrobial Metabolites from the Egyptian Soil-Derived *Amycolatopsis keratiniphila* Revealed by Untargeted Metabolomics and Molecular Docking. *Metabolites* 13:620. <https://doi.org/10.3390/metabo13050620>
- Hamion G, Aucher W, Mercier A, *et al* (2024) Insights into betulinic acid as a promising molecule to fight the interkingdom biofilm *Staphylococcus aureus*–*Candida albicans*. *International Journal of Antimicrobial Agents* 63:107166. <https://doi.org/10.1016/j.ijantimicag.2024.107166>

- Handayani I, Ratnakomala S, Lisdiyanti P, *et al* (2018a) Complete Genome Sequence of *Streptomyces* sp. Strain BSE7F, a Bali Mangrove Sediment Actinobacterium with Antimicrobial Activities. *Genome Announc* 6:e00618-18. <https://doi.org/10.1128/genomeA.00618-18>
- Handayani I, Ratnakomala S, Lisdiyanti P, *et al* (2018b) Complete Genome Sequence of *Streptomyces* sp. Strain SHP22-7, a New Species Isolated from Mangrove of Enggano Island, Indonesia. *Microbiology Resource Announcements* 7:10.1128/mra.01317-18. <https://doi.org/10.1128/mra.01317-18>
- Handayani I, Saad H, Ratnakomala S, *et al* (2021) Mining Indonesian Microbial Biodiversity for Novel Natural Compounds by a Combined Genome Mining and Molecular Networking Approach. *Marine Drugs* 19:316. <https://doi.org/10.3390/md19060316>
- Happi GM, Ntabo VK, Soh D, Wansi JD (2022) Potential of *Streptomyces* in producing antiplasmodial lead compounds. *NRFHH* 3:7–20. <https://doi.org/10.53365/nrfhh/150397>
- Hardini C, Mubarika S, Hariwiyanto B, *et al* (2017) Secondary Bioactive Metabolite Gene Clusters Identification Of Anticandida-Producing *Streptomyces* Sp. GMR22 Isolated From Wanagama Forest As Revealed By Genome Mining Approach. *Indonesian Journal of Pharmacy* 28:26. <https://doi.org/10.14499/indonesianjpharm28iss1pp26>
- Holland BR, Huber KT, Dress A, Moulton V (2002) δ Plots: A Tool for Analyzing Phylogenetic Distance Data. *Molecular Biology and Evolution* 19:2051–2059. <https://doi.org/10.1093/oxfordjournals.molbev.a004030>
- Hoskisson PA, Fernández-Martínez LT (2018) Regulation of specialised metabolites in Actinobacteria – expanding the paradigms. *Environ Microbiol Rep* 10:231–238. <https://doi.org/10.1111/1758-2229.12629>
- Hossain CM, Ryan LK, Gera M, *et al* (2022) Antifungals and Drug Resistance. *Encyclopedia* 2:1722–1737. <https://doi.org/10.3390/encyclopedia2040118>
- Hoyer LL, Oh S-H, Jones R, Cota E (2014) A proposed mechanism for the interaction between the *Candida albicans* Als3 adhesin and streptococcal cell wall proteins. *Front Microbiol* 5:. <https://doi.org/10.3389/fmicb.2014.00564>
- Hu S, Li K, Zhang Y, *et al* (2022) New Insights Into the Threshold Values of Multi-Locus Sequence Analysis, Average Nucleotide Identity and Digital DNA–DNA Hybridization in Delineating *Streptomyces* Species. *Front Microbiol* 13:. <https://doi.org/10.3389/fmicb.2022.910277>

- Hu X, Huang Y-Y, Wang Y, *et al* (2018) Antimicrobial Photodynamic Therapy to Control Clinically Relevant Biofilm Infections. *Front Microbiol* 9:1299. <https://doi.org/10.3389/fmicb.2018.01299>
- Huang C, Zabala D, de Los Santos ELC, *et al* (2023) Parallelized gene cluster editing illuminates mechanisms of epoxyketone proteasome inhibitor biosynthesis. *Nucleic Acids Res* 51:1488–1499. <https://doi.org/10.1093/nar/gkad009>
- Hube B (2022) S4.3b *Candida glabrata*-host interactions. *Medical Mycology* 60:myac072S43b. <https://doi.org/10.1093/mmy/myac072.S4.3b>
- Humphreys G, Fleck F (2016) United Nations meeting on antimicrobial resistance. *Bull World Health Organ* 94:638–639. <https://doi.org/10.2471/BLT.16.020916>
- Hussain A, Christopher JG (2023) Antibacterial Activities of Secondary Metabolites Derived from *Streptomyces* sp. VITGV38 (MCC4869) against Selected Uropathogens. *J Pure Appl Microbiol* 17:2443–2452. <https://doi.org/10.22207/JPAM.17.4.42>
- Hwang G (2022) In it together: *Candida*–bacterial oral biofilms and therapeutic strategies. *Environmental Microbiology Reports* 14:183–196. <https://doi.org/10.1111/1758-2229.13053>
- Iannucci L (2021) Chemometrics for Data Interpretation: Application of Principal Components Analysis (PCA) to Multivariate Spectroscopic Measurements. *IEEE Instrumentation & Measurement Magazine* 24:42–48. <https://doi.org/10.1109/MIM.2021.9448250>
- Idrees M, Mohammad AR, Karodia N, Rahman A (2020) Multimodal Role of Amino Acids in Microbial Control and Drug Development. *Antibiotics* 9:330. <https://doi.org/10.3390/antibiotics9060330>
- Ikhrami M, Widada J, Puspita I, Putra M (2021) The Potency Of Chitosan As An Elicitor On Antibacterial Activity Of *Streptomyces* sp. GMR-22 Against Histamine-Producing Bacteria. *International Journal of Biosciences and Biotechnology* 9:1. <https://doi.org/10.24843/IJBB.2021.v09.i01.p01>
- Islamiati ED, Widada J, Wahyuningsih TD, Widiyanto D (2022) Volatile organic compounds of *Streptomyces* sp. GMR22 inhibit growth of two plant pathogenic fungi. *Agriculture and Natural Resources* 56:899–908
- Ismail I, Pratiwi SUT, Damayanti E, *et al* (2025) Optimizing culture media for antifungal metabolite production in *Streptomyces* sp.: A chemometric approach to reveal new potentials. *Biocatalysis and Agricultural Biotechnology* 69:103814. <https://doi.org/10.1016/j.bcab.2025.103814>

- Jackson SA, Crossman L, Almeida EL, *et al* (2018) Diverse and Abundant Secondary Metabolism Biosynthetic Gene Clusters in the Genomes of Marine Sponge Derived *Streptomyces* spp. Isolates. *Marine Drugs* 16:67. <https://doi.org/10.3390/md16020067>
- Jakubiec-Krzesniak K, Rajnisz-Mateusiak A, Guspiel A, *et al* (2018) Secondary Metabolites of Actinomycetes and their Antibacterial, Antifungal and Antiviral Properties. *Pol J Microbiol* 67:259–272. <https://doi.org/10.21307/pjm-2018-048>
- Janeczko M, Kochanowicz E (2024) Biochanin A Inhibits the Growth and Biofilm of *Candida* Species. *Pharmaceuticals (Basel)* 17:89. <https://doi.org/10.3390/ph17010089>
- Jarmusch SA, Schostag MD, Yang Z, *et al* (2025) Lydicamycins Induce Morphological Differentiation in Actinobacterial Interactions. *Applied and environmental microbiology*, 91(6), e0029525. <https://doi.org/10.1128/aem.00295-25>
- Jaroszewicz W, Bielańska P, Lubomska D, *et al* (2022) Antimicrobial Activities of Compounds Produced by Newly Isolated *Streptomyces* Strains from Mountain Caves. *Medical Sciences Forum* 12:7. <https://doi.org/10.3390/eca2022-12749>
- Jauhal AA, Newcomb RD (2021) Assessing genome assembly quality prior to downstream analysis: N50 versus BUSCO. *Molecular Ecology Resources* 21:1416–1421. <https://doi.org/10.1111/1755-0998.13364>
- Jena S, Dutta J, Tulsiyan KD, *et al* (2022) Noncovalent interactions in proteins and nucleic acids: beyond hydrogen bonding and π -stacking. *Chem Soc Rev* 51:4261–4286. <https://doi.org/10.1039/D2CS00133K>
- Jha M, Agarwal J, Gautam P, Kumar N (2024) Effectiveness & mechanism of phytoconstituents against *Candida* biofilm. *ECJ* 25:1127–1139. <https://doi.org/10.36953/ECJ.30601324>
- Jin X, Luan X, Xie F, *et al* (2023) Erg6 Acts as a Downstream Effector of the Transcription Factor Flo8 To Regulate Biofilm Formation in *Candida albicans*. *Microbiology Spectrum* 11:e00393-23. <https://doi.org/10.1128/spectrum.00393-23>
- Jones GH (2023) *Streptomyces* RNases – Function and impact on antibiotic synthesis. *Front Microbiol* 14:. <https://doi.org/10.3389/fmicb.2023.1096228>

- Juhás M, Zitko J (2020) Molecular Interactions of Pyrazine-Based Compounds to Proteins. *J Med Chem* 63:8901–8916. <https://doi.org/10.1021/acs.jmedchem.9b02021>
- Juvêncio da Silva L, Dias Barroso FD, Vieira LS, *et al* (2021) Diazepam's antifungal activity in fluconazole-resistant *Candida* spp. and biofilm inhibition in *C. albicans*: evaluation of the relationship with the proteins ALS3 and SAP5. *Journal of Medical Microbiology* 70:001308. <https://doi.org/10.1099/jmm.0.001308>
- Kadosh D (2013) Shaping Up for Battle: Morphological Control Mechanisms in Human Fungal Pathogens. *PLOS Pathogens* 9:e1003795. <https://doi.org/10.1371/journal.ppat.1003795>
- Kalia VC, Patel SKS, Lee J-K (2023) Bacterial biofilm inhibitors: An overview. *Ecotoxicology and Environmental Safety* 264:115389. <https://doi.org/10.1016/j.ecoenv.2023.115389>
- Kamaruzzaman ANA, Mulok TETZ, Nor NHM, Yahya MFZR (2022) FTIR SPECTRAL CHANGES IN *Candida albicans* BIOFILM FOLLOWING EXPOSURE TO ANTIFUNGALS. *Malaysian Applied Biology* 51:57–66. <https://doi.org/10.55230/mabjournal.v51i4.11>
- Karkowska-Kuleta J, Kulig K, Bras G, *et al* (2023) *Candida albicans* Biofilm-Derived Extracellular Vesicles Are Involved in the Tolerance to Caspofungin, Biofilm Detachment, and Fungal Proteolytic Activity. *J Fungi (Basel)* 9:1078. <https://doi.org/10.3390/jof9111078>
- Karray F, Darbon E, Oestreicher N, *et al* (2007) Organization of the biosynthetic gene cluster for the macrolide antibiotic spiramycin in *Streptomyces ambifaciens*. *Microbiology* 153:4111–4122. <https://doi.org/10.1099/mic.0.2007/009746-0>
- Karygianni L, Ren Z, Koo H, Thurnheer T (2020) Biofilm Matrixome: Extracellular Components in Structured Microbial Communities. *Trends in Microbiology* 28:668–681. <https://doi.org/10.1016/j.tim.2020.03.016>
- Kautsar SA, Blin K, Shaw S, *et al* (2021) BiG-FAM: the biosynthetic gene cluster families database. *Nucleic Acids Research* 49:D490–D497. <https://doi.org/10.1093/nar/gkaa812>
- Kato S, Otogi Y, Nakagawa K (2022) Lipid structure analysis using mass spectrometry with metal ion adducts. *Oleoscience* 22:287–295. <https://doi.org/10.5650/oleoscience.22.287>

- Kayikci M, Venkatakrishnan AJ, Scott-Brown J, *et al* (2018) Visualization and analysis of non-covalent contacts using the Protein Contacts Atlas. *Nat Struct Mol Biol* 25:185–194. <https://doi.org/10.1038/s41594-017-0019-z>
- Khan F, Bamunuarachchi NI, Tabassum N, *et al* (2021) Suppression of hyphal formation and virulence of *Candida albicans* by natural and synthetic compounds. *Biofouling* 37:626–655. <https://doi.org/10.1080/08927014.2021.1948538>
- Khan MSA, Ahmad I (2012) Antibiofilm activity of certain phytocompounds and their synergy with fluconazole against *Candida albicans* biofilms. *J Antimicrob Chemother* 67:618–621. <https://doi.org/10.1093/jac/dkr512>
- Khan S, Gul A, *et al* (2023) Biodiversity of Actinomycetes and Their Secondary Metabolites: A Comprehensive Review. *Journal of Advanced Biomedical and Pharmaceutical Sciences* 6:36–48. <https://doi.org/10.21608/jabps.2022.161607.1165>
- Khatoon N, Alam Z, Hussain I, *et al* (2024) Comprehensive analysis of *Seriphidium kurramense*: GC/MS profiling, antibacterial and antibiofilm activities, molecular docking study and in silico ADME profiling. *Discover Applied Sciences* 6:. <https://doi.org/10.1007/s42452-024-05761-0>
- Kher L, Santoro D (2023) Biofilm Models: Different Ways of Biofilm Characterization and Drug Discovery. *Current Protocols* 3:e894. <https://doi.org/10.1002/cpz1.894>
- Khojasteh SC, Wong H, Hop CECA (2011) ADME Properties and Their Dependence on Physicochemical Properties. In: Khojasteh SC, Wong H, Hop CECA (eds) *Drug Metabolism and Pharmacokinetics Quick Guide*. Springer, New York, NY, pp 165–181
- Khoshakhlagh A, Aghaei SS, Abroun S, *et al* (2022) Investigation of diverse biosynthetic secondary metabolites gene clusters using genome mining of indigenous *Streptomyces* strains isolated from saline soils in Iran. *Iranian Journal of Microbiology* 14:881–890. <https://doi.org/10.18502/ijm.v14i6.11263>
- Khushboo, Dhaka N, Dubey KK (2023) Effect of natural precursors and micro/macroparticles addition on the morphology modulation of *Streptomyces toxytricini* KD18 stimulates lipstatin productivity. 2023.07.02.547449
- Khutade K, Ch S, a, *et al* (2022) Evaluation of Different Phenotypic Methods for Detection of Biofilm Formation among the Clinical Isolates. *IntJCurrMicrobiolAppSci* 11:40–48. <https://doi.org/10.20546/ijemas.2022.1110.005>

Kim B-G (2020) Biological synthesis of genistein in *Escherichia coli*. 30:770–776. <https://doi.org/10.4014/jmb.1911.11009>

Kim H, Hwang J-Y, Chung B, *et al* (2019) 2-Alkyl-4-hydroxyquinolines from a Marine-Derived *Streptomyces* sp. Inhibit Hyphal Growth Induction in *Candida albicans*. *Marine Drugs* 17:133. <https://doi.org/10.3390/md17020133>

Kim S, Chen J, Cheng T, *et al* (2023) PubChem 2023 update. *Nucleic Acids Research* 51:D1373–D1380. <https://doi.org/10.1093/nar/gkac956>

Kim S, Kim E, Park M, *et al* (2024) Hidden route of protein damage through oxygen-confined photooxidation. *Nat Commun* 15:10873. <https://doi.org/10.1038/s41467-024-55168-z>

Kim W, Lee N, Hwang S, *et al* (2020) Comparative Genomics Determines Strain-Dependent Secondary Metabolite Production in *Streptomyces venezuelae* Strains. *Biomolecules* 10:864. <https://doi.org/10.3390/biom10060864>

Kim Y-G, Lee J-H, Park S, *et al* (2022) Hydroquinones Including Tetrachlorohydroquinone Inhibit *Candida albicans* Biofilm Formation by Repressing Hyphae-Related Genes. *Microbiology Spectrum* 10:e02536-22. <https://doi.org/10.1128/spectrum.02536-22>

Kioshima ES, Shinobu-Mesquita CS, Abadio AKR, *et al* (2019) Selection of potential anti-adhesion drugs by *in silico* approaches targeted to ALS3 from *Candida albicans*. *Biotechnol Lett* 41:1391–1401. <https://doi.org/10.1007/s10529-019-02747-6>

Koech SC, Paemanee A, Pathom-aree W, *et al* (2025) Untargeted Metabolomics and Antibacterial Properties of *Streptomyces* Species Sourced From Thai Mangrove. <https://doi.org/10.1155/sci5/5510017>

Komaki H, Sakurai K, Hosoyama A, *et al* (2018) Diversity of nonribosomal peptide synthetase and polyketide synthase gene clusters among taxonomically close *Streptomyces* strains. *Sci Rep* 8:6888. <https://doi.org/10.1038/s41598-018-24921-y>

Komaki H, Tamura T (2023) Profile of PKS and NRPS Gene Clusters in the Genome of *Streptomyces celostaticus* NBRC 12849T. *Fermentation* 9:924. <https://doi.org/10.3390/fermentation9110924>

Komaki H, Tamura T (2021) Differences at Species Level and in Repertoires of Secondary Metabolite Biosynthetic Gene Clusters among *Streptomyces coelicolor* A3(2) and Type Strains of *S. coelicolor* and Its Taxonomic Neighbors. *Applied Microbiology* 1:573–585. <https://doi.org/10.3390/applmicrobiol1030037>

Komaki H, Tamura T, Igarashi Y (2023) Classification and Secondary Metabolite-Biosynthetic Gene Clusters of Marine *Streptomyces* Strains Including a Lobophorin- and Divergolide-Producer. *Hydrobiology* 2:151–161. <https://doi.org/10.3390/hydrobiology2010010>

Kordjazi T, Mariniello L, Giosafatto CVL, *et al* (2024) Streptomycetes as Microbial Cell Factories for the Biotechnological Production of Melanin. *International Journal of Molecular Sciences* 25:3013. <https://doi.org/10.3390/ijms25053013>

Kornitzer D (2019) Regulation of *Candida albicans* Hyphal Morphogenesis by Endogenous Signals. *Journal of Fungi* 5:21. <https://doi.org/10.3390/jof5010021>

Kouomou PFD, Guiadem EG, Tagatsing MF, *et al* (2024) Antimicrobial, Antioxidant Activity of Ethyl Acetate Extract of *Streptomyces* sp. PERM2, its Potential Modes of Action and Bioactive Compounds. *Archives of Case Reports* 8:134–145. <https://doi.org/10.29328/journal.acr.1001113>

Kovács ÁT (2023) Colony morphotype diversification as a signature of bacterial evolution. *microLife* 4:uqad041. <https://doi.org/10.1093/femsm/luqad041>

Kovács R, Majoros L (2020) Fungal Quorum-Sensing Molecules: A Review of Their Antifungal Effect against *Candida* Biofilms. *Journal of Fungi* 6:. <https://doi.org/10.3390/jof6030099>

Kowalczyk D, Pitucha M (2019) Application of FTIR Method for the Assessment of Immobilization of Active Substances in the Matrix of Biomedical Materials. *Materials* 12:2972. <https://doi.org/10.3390/ma12182972>

Kreulen IAM, de Jonge WJ, van den Wijngaard RM, van Thiel IAM (2023) *Candida* spp. in Human Intestinal Health and Disease: More than a Gut Feeling. *Mycopathologia* 188:845–862. <https://doi.org/10.1007/s11046-023-00743-z>

Kryczyk-Poprawa A, Czarnecki G, Jaśkiewicz K (2024) Photoprotection and its implications for drug safety. *Med Pr Work Health Saf* 75:475–484. <https://doi.org/10.13075/mp.5893.01560>

Krysenko S (2024) Synthetic Biology Approaches for Engineering of Secondary Metabolism in *Streptomyces*: Manipulation of Crosstalk between Primary and Secondary Metabolism

Kum E, Ince E (2024) Metabolomics Approach to Explore Bioactive Natural Products Derived From Plant-Root-Associated *Streptomyces*. *Applied Biochemistry and Biotechnology* 196:7293–7306. <https://doi.org/10.1007/s12010-024-04905-7>

- Kumar D, Kumar A (2023) High throughput bioanalytical techniques for elucidation of *Candida albicans* biofilm architecture and metabolome. *Rend Fis Acc Lincei* 34:117–129. <https://doi.org/10.1007/s12210-022-01115-3>
- Kumar M, Kumar R, Kumar S, *et al* (2025) Important antiviral properties of *Streptomyces* species compounds. *Indian Journal of Microbiology Research* 11:3–7. <https://doi.org/10.18231/j.ijmr.2024.002>
- Kumar N, Khanna A, Kaur K, *et al* (2023) Quinoline derivatives volunteering against antimicrobial resistance: rational approaches, design strategies, structure activity relationship and mechanistic insights. *Mol Divers* 27:1905–1934. <https://doi.org/10.1007/s11030-022-10537-y>
- Kumaran S, Bharathi selvaraj, Uttra V, *et al* (2020) Bioactive metabolites produced from *Streptomyces enissocaesilis* SSASC10 against fish pathogens. *Biocatalysis and Agricultural Biotechnology* 29:101802. <https://doi.org/10.1016/j.bcab.2020.101802>
- Kumari A (2023) Chapter 5 - Fatty acid biosynthesis. In: Kumari A (ed) *Sweet Biochemistry (Second Edition)*. Academic Press, pp 31–36
- Kunyeit L, Kurrey NK, Anu-Appaiah KA, Rao RP (2021) Secondary Metabolites from Food-Derived Yeasts Inhibit Virulence of *Candida albicans*. *mBio* 12:e0189121. <https://doi.org/10.1128/mBio.01891-21>
- Labeda DP, Dunlap CA, Rong X, *et al* (2017) Phylogenetic relationships in the family Streptomycetaceae using multi-locus sequence analysis. *Antonie van Leeuwenhoek* 110:563–583. <https://doi.org/10.1007/s10482-016-0824-0>
- Labeda DP, Goodfellow M, Brown R, *et al* (2012) Phylogenetic study of the species within the family Streptomycetaceae. *Antonie van Leeuwenhoek* 101:73–104. <https://doi.org/10.1007/s10482-011-9656-0>
- Labeda DP, Rong X, Huang Y, *et al* (2016) Taxonomic evaluation of species in the *Streptomyces hirsutus* clade using multi-locus sequence analysis and proposals to reclassify several species in this clade. *International Journal of Systematic and Evolutionary Microbiology* 66:2444–2450. <https://doi.org/10.1099/ijsem.0.001017>
- Lacey HJ, Rutledge PJ (2022) Recently Discovered Secondary Metabolites from *Streptomyces* Species. *Molecules* 27:887. <https://doi.org/10.3390/molecules27030887>
- Laxmi, Singh S, Singh A, Asthana RK (2023) Molecular Biology of Non-ribosomal Peptide (NRP) and Polyketide (PK) Biosynthesis in Cyanobacteria. In: Neilan B, Passarini MRZ, Singh PK, Kumar A (eds) *Cyanobacterial Biotechnology in the 21st Century*. Springer Nature, Singapore, pp 133–147

- Le VH, King T, Wuerzberger B, *et al* (2025) Metabolites derived from bacterial isolates of the human skin microbiome inhibit *Staphylococcus aureus* biofilm formation. *Microbiology Spectrum* 13:e01306-25. <https://doi.org/10.1128/spectrum.01306-25>
- Lee LC, Jemain AA (2019) Predictive modelling of colossal ATR-FTIR spectral data using PLS-DA: empirical differences between PLS1-DA and PLS2-DA algorithms. *Analyst* 144:2670–2678. <https://doi.org/10.1039/C8AN02074D>
- Lee Y, Hwang S, Kim W, *et al* (2024) CRISPR-aided genome engineering for secondary metabolite biosynthesis in *Streptomyces*. *J Ind Microbiol Biotechnol* 51:kuae009. <https://doi.org/10.1093/jimb/kuae009>
- Lenchenko E, Blumenkrants D, Ponomarev V, *et al* (2022) METHODOLOGICAL ASPECTS OF RESEARCH OF COMPOSITION OF BIOFILMS *in vitro*, *ex vivo*, *in vivo*. Problems of veterinary sanitation, hygiene and ecology 1:73–82. <https://doi.org/10.36871/vet.san.hyг.ecol.202201009>
- Lertcanawanichakul M, Sahabuddeen T (2023) Characterization of *Streptomyces* sp. KB1 and its cultural optimization for bioactive compounds production. *PeerJ* 11:e14909. <https://doi.org/10.7717/peerj.14909>
- Li F, Hu H, Zhang J, *et al* (2025a) Nucleoside Derivatives Target Magnaporthe oryzae Appressoria Function and Nucleotide Metabolism for Fungal Disease Control. *J Agric Food Chem* 73:16229–16241. <https://doi.org/10.1021/acs.jafc.5c04638>
- Li H, Miao M, Jia C, *et al* (2022a) Interactions between *Candida albicans* and the resident microbiota. *Front Microbiol* 13:. <https://doi.org/10.3389/fmicb.2022.930495>
- Li J, Wu Y, Zhang Q, *et al* (2022b) Optimization of environmental factors in a dual *in vitro* biofilm model of *Candida albicans*–*Streptococcus mutans*. *Letters in Applied Microbiology* 75:869–880. <https://doi.org/10.1111/lam.13761>
- Li L, Wang J, Zhou Y, *et al* (2019) *Streptomyces reniochalinae* sp. nov. and *Streptomyces diacarni* sp. nov., from marine sponges. *International Journal of Systematic and Evolutionary Microbiology* 69:99–104. <https://doi.org/10.1099/ijsem.0.003109>
- Li X, Ren W, Li Y, *et al* (2022c) Production of chain-extended cinnamoyl compounds by overexpressing two adjacent cluster-situated LuxR regulators in *Streptomyces globisporus* C-1027. *Front Microbiol* 13:. <https://doi.org/10.3389/fmicb.2022.931180>

- Li X, Tian X, Yan X, *et al* (2023) Lumichrome from the photolytic riboflavin acts as an electron shuttle in microbial photoelectrochemical systems. *Bioelectrochemistry* 152:108439. <https://doi.org/10.1016/j.bioelechem.2023.108439>
- Li Y, Bedi RK, Wiedmer L, *et al* (2021) Atomistic and Thermodynamic Analysis of N6-Methyladenosine (m6A) Recognition by the Reader Domain of YTHDC1. *J Chem Theory Comput* 17:1240–1249. <https://doi.org/10.1021/acs.jctc.0c01136>
- Li Y, Shi Z-M, He Y, *et al* (2025b) Inosine, AMP, and Vidarabine: Network Pharmacology and LC-MS Reveal Key Bioactive Compounds in *Periplaneta americana* for Ulcerative Colitis Management. *International Journal of Molecular Sciences* 26:5446. <https://doi.org/10.3390/ijms26125446>
- Liao Z, Zhu Z, Li L, *et al* (2019) Metabonomics on *Candida albicans* indicate the excessive H3K56ac is involved in the antifungal activity of Shikonin. *Emerg Microbes Infect* 8:1243–1253. <https://doi.org/10.1080/22221751.2019.1657362>
- Lim Y, Jung ES, Lee JH, *et al* (2018) Non-targeted metabolomics unravels a media-dependent prodiginines production pathway in *Streptomyces coelicolor* A3(2). *PLOS ONE* 13:e0207541. <https://doi.org/10.1371/journal.pone.0207541>
- Lima GS, Lima NM, Roque JV, *et al* (2022) LC-HRMS/MS-Based Metabolomics Approaches Applied to the Detection of Antifungal Compounds and a Metabolic Dynamic Assessment of Orchidaceae. *Molecules* 27:7937. <https://doi.org/10.3390/molecules27227937>
- Lima SMA, Pereira PS, Silva BIM da, *et al* (2021) Antioxidant, antimicrobial and cytotoxic activities of secondary metabolites from *Streptomyces* sp. isolated of the Amazon-Brazil region. *Research, Society and Development* 10:e366101018974–e366101018974. <https://doi.org/10.33448/rsd-v10i10.18974>
- Lin C-C, Hoo SY, Lin C, *et al* (2021) Multi-omics approach to identify bacterial polyynes and unveil their antifungal mechanism against *Candida albicans*. *bioRxiv* 2021.03.30.437786; doi: <https://doi.org/10.1101/2021.03.30.437786>
- Liu H, Xie R, Dai Q, *et al* (2023a) Exploring the mechanism underlying hyperuricemia using comprehensive research on multi-omics. *Sci Rep* 13:7161. <https://doi.org/10.1038/s41598-023-34426-y>

- Liu J-R, Gao Y, Jin B, *et al* (2023b) Design, Synthesis, Antifungal Activity, and Molecular Docking of Streptochlorin Derivatives Containing the Nitrile Group. *Marine Drugs* 21:103. <https://doi.org/10.3390/md21020103>
- Liu M, Wang Y, Jiang H, *et al* (2023c) Synthetic Multienzyme Assemblies for Natural Product Biosynthesis. *ChemBioChem* 24:e202200518. <https://doi.org/10.1002/cbic.202200518>
- Liu R-H, Shang Z-C, Li T-X, *et al* (2017) *In vitro* Antibiofilm Activity of Eucarobustol E against *Candida albicans*. *Antimicrobial Agents and Chemotherapy* 61:10.1128/aac.02707-16. <https://doi.org/10.1128/aac.02707-16>
- Liu T, Ren Z, Chunyu W-X, *et al* (2022a) Exploration of Diverse Secondary Metabolites From *Streptomyces* sp. YINM00001, Using Genome Mining and One Strain Many Compounds Approach. *Front Microbiol* 13:. <https://doi.org/10.3389/fmicb.2022.831174>
- Liu X, Liu S, Wang Y, *et al* (2024) New insights into the antibiofilm activity and mechanism of Mannosylerythritol Lipid-A against *Listeria monocytogenes* EGD-e. *Biofilm* 7:100201. <https://doi.org/10.1016/j.bioflm.2024.100201>
- Liu X, Zhuo J, Chen Z, *et al* (2026) Research and Application of the Polyene Macrolide Antibiotic Nystatin. *Molecules*, 31(2), 330. <https://doi.org/10.3390/molecules31020330>
- Liu Y, Cao Y (2024) Protein-Ligand Blind Docking Using CB-Dock2. *Methods Mol Biol* 2714:113–125. https://doi.org/10.1007/978-1-0716-3441-7_6
- Liu Y, Yang X, Gan J, *et al* (2022b) CB-Dock2: improved protein-ligand blind docking by integrating cavity detection, docking and homologous template fitting. *Nucleic Acids Res* 50:W159–W164. <https://doi.org/10.1093/nar/gkac394>
- Liu Z, MacAlpine J, Robbins N, Cowen LE (2023d) Construction of *Candida albicans* Strains with ATP-Analog-Sensitive Protein Kinase A and Hog1. *mSphere* 8:e00095-23. <https://doi.org/10.1128/msphere.00095-23>
- Lockhart, S. R., Chowdhary, A., & Gold, J. A. (2023). The rapid emergence of antifungal-resistant human-pathogenic fungi. *Nature Reviews Microbiology*, 21(12), 818–832.
- Lohit N, Singh AK, Kumar A, *et al* (2024) Description and *In silico* ADME Studies of US-FDA Approved Drugs or Drugs under Clinical Trial which Violate the Lipinski's Rule of 5. *Letters in Drug Design & Discovery* 21:1334–1358. <https://doi.org/10.2174/1570180820666230224112505>

- Lohse MB, Gulati M, Johnson AD, Nobile CJ (2018) Development and regulation of single- and multi-species *Candida albicans* biofilms. *Nat Rev Microbiol* 16:19–31. <https://doi.org/10.1038/nrmicro.2017.107>
- Lopes JP, Lionakis MS (2022) Pathogenesis and virulence of *Candida albicans*. *Virulence* 13:89–121. <https://doi.org/10.1080/21505594.2021.2019950>
- Lu H, Que Y, Wu X, *et al* (2019) Metabolomics Deciphered Metabolic Reprogramming Required for Biofilm Formation. *Sci Rep* 9:13160. <https://doi.org/10.1038/s41598-019-49603-1>
- Lu Q-P, Huang Y-M, Liu S-W, *et al* (2021) Metabolomics Tools Assisting Classic Screening Methods in Discovering New Antibiotics from Mangrove Actinomycetia in Leizhou Peninsula. *Marine Drugs* 19:688. <https://doi.org/10.3390/md19120688>
- Luís Â, Silva F, Sousa S, *et al* (2014) Antistaphylococcal and biofilm inhibitory activities of gallic, caffeic, and chlorogenic acids. *Biofouling* 30:69–79. <https://doi.org/10.1080/08927014.2013.845878>
- Lyu X, Zhao C, Hua H, Yan Z (2016) Efficacy of nystatin for the treatment of oral candidiasis: A systematic review and meta-analysis. *Drug Design, Development and Therapy* 10:1161. <https://doi.org/10.2147/DDDT.S100795>
- Madhaiyan M, Saravanan VS, See-Too W-S (2020a) Genomic and phylogenomic insights into the family Streptomycetaceae lead to proposal of Charcoactinosporaceae fam. nov. and 8 novel genera with emended descriptions of *Streptomyces calvus*. *International Journal of Systematic and Evolutionary Microbiology*, 72(10), 10.1099/ijsem.0.005570. <https://doi.org/10.1099/ijsem.0.005570>
- Madhaiyan M, Saravanan VS, See-Too W-S (2020b) Genome-based analyses reveal the presence of 12 heterotypic synonyms in the genus *Streptomyces* and emended descriptions of *Streptomyces bottropensis*, *Streptomyces celluloflavus*, *Streptomyces fulvissimus*, *Streptomyces glaucescens*, *Streptomyces murinus*, and *Streptomyces variegatus*. *International Journal of Systematic and Evolutionary Microbiology*, 70:3924–3929. <https://doi.org/10.1099/ijsem.0.004217>
- Magar RT, Sohng JK (2024) Natural products with γ -pyrone scaffold from *Streptomyces*. *Appl Microbiol Biotechnol* 108:471. <https://doi.org/10.1007/s00253-024-13296-y>
- Magnano San Lio R, Favara G, Maugeri A, *et al* (2023) How Antimicrobial Resistance Is Linked to Climate Change: An Overview of Two Intertwined

Global Challenges. *Int J Environ Res Public Health* 20:1681.
<https://doi.org/10.3390/ijerph20031681>

Mahieu B, Qannari EM, Jaillais B (2023) Extension and significance testing of Variable Importance in Projection (VIP) indices in Partial Least Squares regression and Principal Components Analysis. *Chemometrics and Intelligent Laboratory Systems* 242:104986.
<https://doi.org/10.1016/j.chemolab.2023.104986>

Mahmood KI, Najmuldeen HH, Ali KM, *et al* (2025) Isolation of *Streptomyces* spp. Exhibiting Potent Antibiofilm Activity Against Clinically Isolated Bacterial Strains. *International Journal of Microbiology* 2025:4796619.
<https://doi.org/10.1155/ijm/4796619>

Maione A, Imparato M, Buonanno A, *et al* (2023) Anti-Biofilm Activity of Phenyllactic Acid against Clinical Isolates of Fluconazole-Resistant *Candida albicans*. *Journal of Fungi* 9:355.
<https://doi.org/10.3390/jof9030355>

Malinovská Z, Čonková E, Váczi P (2023) Biofilm Formation in Medically Important *Candida* Species. *Journal of Fungi* 9:955.
<https://doi.org/10.3390/jof9100955>

Managamuri U, Vijayalakshmi M, Poda S, *et al* (2020) Bioactive Metabolites from *Streptomyces nanhaiensis* VSM-1: Polyphasic Taxonomy, Optimization, and Evaluation of Antimicrobial Metabolites by GC-MS Analysis. In: Khasim SM, Long C, Thammasiri K, Lutken H (eds) *Medicinal Plants: Biodiversity, Sustainable Utilization and Conservation*. Springer, Singapore, pp 621–655

Mancuso G, Midiri A, Gerace E, Biondo C (2021) Bacterial Antibiotic Resistance: The Most Critical Pathogens. *Pathogens* 10:1310.
<https://doi.org/10.3390/pathogens10101310>

Manen-Freixa L, Antolin AA (2024) Polypharmacology prediction: the long road toward comprehensively anticipating small-molecule selectivity to de-risk drug discovery. *Expert Opinion on Drug Discovery* 19:1043–1069.
<https://doi.org/10.1080/17460441.2024.2376643>

Manteca Á, Yagüe P (2018) *Streptomyces* Differentiation in Liquid Cultures as a Trigger of Secondary Metabolism. *Antibiotics (Basel)* 7:41.
<https://doi.org/10.3390/antibiotics7020041>

Marc G, Araniciu C, Oniga SD, *et al* (2018) New N-(oxazolylmethyl)-thiazolidinedione Active against *Candida albicans* Biofilm: Potential Als Proteins Inhibitors. *Molecules* 23:2522.
<https://doi.org/10.3390/molecules23102522>

- Marcet-Houben M, Alvarado M, Ksiezopolska E, *et al* (2022) Chromosome-level assemblies from diverse clades reveal limited structural and gene content variation in the genome of *Candida glabrata*. *BMC Biology* 20:226. <https://doi.org/10.1186/s12915-022-01412-1>
- Marioni J, Arce JE, Cabrera JL, *et al* (2016) Reduction of *Candida tropicalis* biofilm by photoactivation of a *Heterophyllaea pustulata* extract. *Pharmaceutical Biology* 54:2791–2801. <https://doi.org/10.1080/13880209.2016.1183683>
- Marshall AP, Carlson EE (2023) Metabolomics Reveals a “Trimeric” γ -Actinorhodin from *Streptomyces coelicolor* M145. *ChemBioChem* 24:e202200757. <https://doi.org/10.1002/cbic.202200757>
- Martin H, Kavanagh K, Velasco-Torrijos T (2021) Targeting Adhesion in Fungal Pathogen *Candida albicans*. *Future Medicinal Chemistry* 13:313–334. <https://doi.org/10.4155/fmc-2020-0052>
- Martin J, Zhu W, Bergman N, Borodovsky M (2009) Assessment of Gene Annotation Accuracy by Inferring Transcripts from RNA-Seq. In: 2009 IEEE International Conference on Bioinformatics and Biomedicine. pp 54–59
- Martins N da RC, Rodrigues da Silva A, Ratcliffe N, *et al* (2023) *Streptomyces*: a natural source of anti-*Candida* agents. *J Med Microbiol* 72:. <https://doi.org/10.1099/jmm.0.001777>
- Massey J, Zarnowski R, Andes D (2023) Role of the extracellular matrix in *Candida* biofilm antifungal resistance. *FEMS Microbiology Reviews* 47:fuad059. <https://doi.org/10.1093/femsre/fuad059>
- Matos MJ, Vilar S, Kachler S, *et al* (2014) Insight into the Interactions between Novel Coumarin Derivatives and Human A3 Adenosine Receptors. *ChemMedChem* 9:2245–2253. <https://doi.org/10.1002/cmdc.201402205>
- Mebrat Y (2024) Production of secondary metabolites by Actinomycetes and their biological applications: A review. *IJSTEM* 4:154–172. <https://doi.org/10.53378/ijstem.353099>
- Medema M, Blin K, Cimermanic P, *et al* (2011) antiSMASH: rapid identification, annotation and analysis of secondary metabolite biosynthesis gene clusters in bacterial and fungal genome sequences. *Nucleic acids research* 39:W339–46. <https://doi.org/10.1093/nar/gkr466>
- Megha, Preeti, Prasad T (2021) Metabolomics: A Promising Tool to Study Disease Biomarkers and Host-Pathogen Interactions. In: Hameed S, Fatima Z (eds) *Integrated Omics Approaches to Infectious Diseases*. Springer, Singapore, pp 403–423

- Mehdiratta K, Nain S, Sharma M, *et al* (2022) Respiratory Quinone Switches from Menaquinone to Polyketide Quinone during the Development Cycle in *Streptomyces* sp. Strain MNU77. *Microbiology Spectrum* 11:e02597-22. <https://doi.org/10.1128/spectrum.02597-22>
- Meier-Kolthoff JP, Carbasse JS, Peinado-Olarte RL, Göker M (2022) TYGS and LPSN: a database tandem for fast and reliable genome-based classification and nomenclature of prokaryotes. *Nucleic Acids Research* 50:D801–D807. <https://doi.org/10.1093/nar/gkab902>
- Meier-Kolthoff JP, Göker M (2019) TYGS is an automated high-throughput platform for state-of-the-art genome-based taxonomy. *Nat Commun* 10:2182. <https://doi.org/10.1038/s41467-019-10210-3>
- Meleshko D, Mohimani H, Tracanna V, *et al* (2019) BiosyntheticSPAdes: reconstructing biosynthetic gene clusters from assembly graphs. *Genome Res* 29:1352–1362. <https://doi.org/10.1101/gr.243477.118>
- Meng L, Sun C, Zhang C, *et al* (2019) Efficacy of Compounds Isolated from *Streptomyces olivaceus* against the Morphogenesis and Virulence of *Candida albicans*. *Marine Drugs* 17:442. <https://doi.org/10.3390/md17080442>
- Mentari D, Naima M, Wulansari R, *et al* (2019) Pengaruh Perbedaan Metode Ekstraksi Metabolit Sekunder *Streptomyces* sp. GMR22 terhadap Toksisitas pada Sel BHK-21. *Pharmacon: Jurnal Farmasi Indonesia* 16:1–10. <https://doi.org/10.23917/pharmacon.v16i1.8032>
- Mentari D, Widada J, Wibawa T, Wijayanti N (2020) Penghambatan Cythopathic Effect (CPE) Pada Sel BHK-21 Yang Terinfeksi Virus Dengue Serotype 4 (DENV-4) Dengan Pemberian Ekstrak N-Heksan *Streptomyces* sp. GMR22. *BIOMA: Jurnal Biologi Makassar* 5:151–160. <https://doi.org/10.20956/bioma.v5i2.10292>
- Meylani V, Putra RR, Miftahussurur M, *et al* (2024) Computational Prediction of *Cinnamomum zeylanicum* Bioactive Compounds as Potential Antifungal by Inhibit Biofilm Formation of *Candida albicans*. *Trends in Sciences* 21:7986–7986. <https://doi.org/10.48048/tis.2024.7986>
- Millán-García A, Álvarez-Fernández L, Blanco-Paniagua E, *et al* (2024) The ABCG2 Transporter Affects Plasma Levels, Tissue Distribution and Milk Secretion of Lumichrome, a Natural Derivative of Riboflavin. *International Journal of Molecular Sciences* 25:9884. <https://doi.org/10.3390/ijms25189884>

- Miller T, Waturangi DE, Yogiara (2022) Antibiofilm properties of bioactive compounds from Actinomycetes against foodborne and fish pathogens. *Sci Rep* 12:18614. <https://doi.org/10.1038/s41598-022-23455-8>
- Milligan MJ, Lipovich L (2015) Pseudogene-derived lncRNAs: emerging regulators of gene expression. *Front Genet* 5:. <https://doi.org/10.3389/fgene.2014.00476>
- Mispelaere M, De Rop A-S, Hermans C, *et al* (2024) Whole genome-based comparative analysis of the genus *Streptomyces* reveals many misclassifications. *Appl Microbiol Biotechnol* 108:453. <https://doi.org/10.1007/s00253-024-13290-4>
- Mohamad OAA, Liu Y-H, Huang Y, *et al* (2024) Metabonomic analysis to identify exometabolome changes underlying antifungal and growth promotion mechanisms of endophytic Actinobacterium *Streptomyces albidoflavus* for sustainable agriculture practice. *Front Microbiol* 15:. <https://doi.org/10.3389/fmicb.2024.1439798>
- Mohite OS, Jørgensen TS, Booth T, *et al* (2025) Pangenome mining of the *Streptomyces* genus redefines their biosynthetic potential. *Genome biology*, 26(1), 9. <https://doi.org/10.1186/s13059-024-03471-9>
- Mondal S, Rai VR (2019) Molecular profiling of endophytic *Streptomyces cavourensis* MH16 inhabiting *Millingtonia hortensis* Linn. and influence of different culture media on biosynthesis of antimicrobial metabolites. *Sci Nat* 106:51. <https://doi.org/10.1007/s00114-019-1646-5>
- Montaser R, Kelleher NL (2020) Discovery of the Biosynthetic Machinery for Stravidins, Biotin Antimetabolites. *ACS Chem Biol* 15:1134–1140. <https://doi.org/10.1021/acschembio.9b00890>
- Moussa AY (2024) *Streptomyces* Endophytes in Edible Plants: New Insights into their Chemistry and Health Benefits. *Chemistry & Biodiversity* 21:e202400888. <https://doi.org/10.1002/cbdv.202400888>
- Mu YQ, Xie TT, Zeng H, *et al* (2020) *Streptomyces*-derived actinomycin D inhibits biofilm formation via downregulating *ica* locus and decreasing production of PIA in *Staphylococcus epidermidis*. *J Appl Microbiol* 128:1201–1207. <https://doi.org/10.1111/jam.14543>
- Nazeh M, Asmaey MA, Eladly A, Afifi MM (2024) Metabolomic Profiling of *Streptomyces griseorubens* with the Evaluation of their Antioxidant and Anticancer Potentialities. *Egyptian Journal of Chemistry* 67:251–268. <https://doi.org/10.21608/ejchem.2024.250016.8929>

- Nett JE, Andes DR (2020) Contributions of the Biofilm Matrix to *Candida* Pathogenesis. *Journal of Fungi* 6:21. <https://doi.org/10.3390/jof6010021>
- Nett M, Ikeda H, Moore BS (2009) Genomic basis for natural product biosynthetic diversity in the actinomycetes. *Nat Prod Rep* 26:1362–1384. <https://doi.org/10.1039/b817069j>
- Ng K-S, Bambace MF, Andersen EB, *et al* (2024) Environmental pH and compound structure affect the activity of short-chain carboxylic acids against planktonic growth, biofilm formation, and eradication of the food pathogen *Salmonella enterica*. *Microbiology Spectrum* 12:e01658-24. <https://doi.org/10.1128/spectrum.01658-24>
- Nguyen HT, Pokhrel AR, Nguyen CT, *et al* (2020) *Streptomyces* sp. VN1, a producer of diverse metabolites including non-natural furan-type anticancer compound. *Sci Rep* 10:1756. <https://doi.org/10.1038/s41598-020-58623-1>
- Nicault M, Tidjani A-R, Gauthier A, *et al* (2020) Mining the Biosynthetic Potential for Specialized Metabolism of a *Streptomyces* Soil Community. *Antibiotics* 9:271. <https://doi.org/10.3390/antibiotics9050271>
- Nielsen JC, Grijseels S, Prigent S, *et al* (2017) Global analysis of biosynthetic gene clusters reveals vast potential of secondary metabolite production in *Penicillium* species. *Nat Microbiol* 2:1–9. <https://doi.org/10.1038/nmicrobiol.2017.44>
- Nikolaidis M, Hesketh A, Frangou N, *et al* (2023) A panoramic view of the genomic landscape of the genus *Streptomyces*. *Microbial Genomics* 9:001028. <https://doi.org/10.1099/mgen.0.001028>
- Nirwati H, Damayanti E, Sholikhah E, *et al* (2022a) Soil-Derived *Streptomyces* sp. GMR22 Producing Antibiofilm Activity Against *Candida albicans*: Bioassay, Untargeted LC-HRMS, and Gene Cluster Analysis. *Heliyon* 8:e09333. <https://doi.org/10.1016/j.heliyon.2022.e09333>
- Nirwati H, Damayanti E, Sholikhah EN, *et al* (2022b) Potential secondary metabolite analysis of soil *Streptomyces* sp. GMR22 and antibacterial assay on *Porphyromonas gingivalis* ATCC 33277. *Journal of the Medical Sciences (Berkala Ilmu Kedokteran)* 54:.. <https://doi.org/10.19106/JMedSci005402202202>
- Núñez N, Saurina J, Núñez O (2024) Liquid Chromatography–High-Resolution Mass Spectrometry (LC-HRMS) Fingerprinting and Chemometrics for Coffee Classification and Authentication. *Molecules* 29:232. <https://doi.org/10.3390/molecules29010232>

- Nwafor IR, Alhassan Y, Udoh JI, *et al* (2024) Plant-derived Bioactive Compounds and Their Mechanistic Roles in Combating Microbial Biofilms. *Microbiology Research Journal International* 34:74–85. <https://doi.org/10.9734/mrji/2024/v34i91482>
- Ochi K, Hosaka T (2013) New strategies for drug discovery: activation of silent or weakly expressed microbial gene clusters. *Appl Microbiol Biotechnol* 97:87–98. <https://doi.org/10.1007/s00253-012-4551-9>
- Odanaka K (2022) Identification of a *Candida albicans* Biofilm Inhibitor. *American Journal of Molecular Biology* 12:23–29. <https://doi.org/10.4236/ajmb.2022.122003>
- Odularu AT, Afolayan AJ, Sadimenko AP, *et al* (2022) Multidrug-Resistant Biofilm, Quorum Sensing, Quorum Quenching, and Antibacterial Activities of Indole Derivatives as Potential Eradication Approaches. *BioMed Research International* 2022:9048245. <https://doi.org/10.1155/2022/9048245>
- Oh M, Park H-S, Um S, *et al* (2022) A comparative phytochemical study of nine Lauraceae species by using chemometric data analysis. *PLOS ONE* 17:e0273616. <https://doi.org/10.1371/journal.pone.0273616>
- Okamoto-Shibayama K, Sato Y, Azuma T (2010) Resveratrol Impaired the Morphological Transition of *Candida albicans* Under Various Hyphae-inducing Conditions. 20:942–945. <https://doi.org/10.4014/jmb.0911.11014>
- Oliva A, Miele MC, Al Ismail D, *et al* (2021) Challenges in the Microbiological Diagnosis of Implant-Associated Infections: A Summary of the Current Knowledge. *Front Microbiol* 12:. <https://doi.org/10.3389/fmicb.2021.750460>
- Oliveira LT, Medina-Alarcón KP, Singulani J de L, *et al* (2020) Dynamics of Mono- and Dual-Species Biofilm Formation and Interactions Between *Paracoccidioides brasiliensis* and *Candida albicans*. *Front Microbiol* 11:. <https://doi.org/10.3389/fmicb.2020.551256>
- Ortega HE, Ferreira LLG, Melo WGP, *et al* (2019) Antifungal compounds from *Streptomyces* associated with attine ants also inhibit *Leishmania donovani*. *PLoS Negl Trop Dis* 13:e0007643. <https://doi.org/10.1371/journal.pntd.0007643>
- Otani H, Udway DW, Mouncey NJ (2022) Comparative and pangenomic analysis of the genus *Streptomyces*. *Sci Rep* 12:18909. <https://doi.org/10.1038/s41598-022-21731-1>

- Ouchene R, Stien D, Segret J, *et al* (2022) Integrated Metabolomic, Molecular Networking, and Genome Mining Analyses Uncover Novel Angucyclines From *Streptomyces* sp. RO-S4 Strain Isolated From Bejaia Bay, Algeria. *Front Microbiol* 13:906161. <https://doi.org/10.3389/fmicb.2022.906161>
- Overbeek R, Olson R, Pusch GD, *et al* (2014) The SEED and the Rapid Annotation of microbial genomes using Subsystems Technology (RAST). *Nucleic Acids Research* 42:D206–D214. <https://doi.org/10.1093/nar/gkt1226>
- Park CJ, Caimi NA, Buecher DC, *et al* (2021) Unexpected genomic, biosynthetic and species diversity of *Streptomyces* bacteria from bats in Arizona and New Mexico, USA. *BMC Genomics* 22:247. <https://doi.org/10.1186/s12864-021-07546-w>
- Pan L, Yao Y, Zheng H, *et al* (2022) Inhibitory Effects and Mechanism of Action of Elsinochrome A on *Candida albicans* and Its Biofilm. *Journal of Fungi* 8:841. <https://doi.org/10.3390/jof8080841>
- Pascale TAM, Rosine YD, Sabine VN, *et al* (2024) Principal Component Analysis (PCA) of MALDI-TOF for the Identification of Waterborne Pathogenic Bacteria. *Microbiology Research Journal International* 34:1–16. <https://doi.org/10.9734/mrji/2024/v34i111494>
- Pathan SK, Shelar ,Amruta, Deshmukh ,Satish, *et al* (2025) Exploring antibiofilm potential of some new imidazole analogs against *C. albicans*: synthesis, antifungal activity, molecular docking and molecular dynamics studies. *Journal of Biomolecular Structure and Dynamics* 43:3099–3115. <https://doi.org/10.1080/07391102.2023.2296604>
- Pawar RP, Rohane SH (2021) Role of Autodock vina in PyRx Molecular Docking. *Asian Journal of Research in Chemistry* 14:132–134. <https://doi.org/10.5958/0974-4150.2021.00024.9>
- Peet M van der, Maas P, Wegrzyn A, *et al* (2025) mzQuality: A tool for quality monitoring and reporting of targeted mass spectrometry measurements. *bioRxiv* 2025.01.22.633547; doi: <https://doi.org/10.1101/2025.01.22.633547>
- Pereira R, Dos Santos Fontenelle RO, de Brito EHS, de Moraes SM (2021) Biofilm of *Candida albicans*: formation, regulation and resistance. *J Appl Microbiol* 131:11–22. <https://doi.org/10.1111/jam.14949>
- Perini HF, Pereira B de B, Sousa EG, *et al* (2024) Inhibitory effect of *Bacillus velezensis* 1273 strain cell-free supernatant against developing and preformed biofilms of *Staphylococcus aureus* and MRSA. *Microbial Pathogenesis* 197:107065. <https://doi.org/10.1016/j.micpath.2024.107065>

Perry AM, Hernday AD, Nobile CJ (2020) Unraveling How *Candida albicans* Forms Sexual Biofilms. *Journal of Fungi* 6:14. <https://doi.org/10.3390/jof6010014>

Pokhrel S, Boonmee N, Tulyaprawat O, *et al* (2022) Assessment of Biofilm Formation by *Candida albicans* Strains Isolated from Hemocultures and Their Role in Pathogenesis in the Zebrafish Model. *J Fungi (Basel)* 8:1014. <https://doi.org/10.3390/jof8101014>

Ponde NO, Lortal L, Ramage G, *et al* (2021) *Candida albicans* biofilms and polymicrobial interactions. *Critical Reviews in Microbiology* 47:91–111. <https://doi.org/10.1080/1040841X.2020.1843400>

Ponomareva AL, Buzoleva LS, Bogatyrenko EA (2018) Abiotic Environmental Factors Affecting the Formation of Microbial Biofilms. *Biol Bull Russ Acad Sci* 45:490–496. <https://doi.org/10.1134/S106235901805014X>

Powell LC, Adams JYM, Quoraishi S, *et al* 2023) Alginate oligosaccharides enhance the antifungal activity of nystatin against candidal biofilms. *Front Cell Infect Microbiol* 13:. <https://doi.org/10.3389/fcimb.2023.1122340>

Prastya ME, Simbolon S, Priyanto JA, *et al* (2024) Antibacterial and antibiofilm activities from soil *Streptomyces* spp. isolated from Muna Island, Indonesia against multidrug-resistant clinical isolates.

Priya R, Balachandar S, Prabhakaran N (2023) Optimization of culture conditions for the production, antifungal activity and characterization of secondary metabolites of *Trichoderma longibrachiatum*. *Journal of Biological Control* 131–144. <https://doi.org/10.18311/jbc/2023/34700>

Procópio RE de L, Silva IR da, Martins MK, *et al* (2012) Antibiotics produced by *Streptomyces*. *Braz J Infect Dis* 16:466–471. <https://doi.org/10.1016/j.bjid.2012.08.014>

Pumeesat P, Muangkaew W, Ampawong S, Luplertlop N (2017) *Candida albicans* biofilm development under increased temperature. 40:279–283

Quinn GA, Banat AM, Abdelhameed AM, Banat IM (2020) *Streptomyces* from traditional medicine: sources of new innovations in antibiotic discovery. *J Med Microbiol* 69:1040–1048. <https://doi.org/10.1099/jmm.0.001232>

Raaijmakers JM, Mazzola M (2012) Diversity and Natural Functions of Antibiotics Produced by Beneficial and Plant Pathogenic Bacteria. *Annual Review of Phytopathology* 50:403–424. <https://doi.org/10.1146/annurev-phyto-081211-172908>

Radhakrishnan EK, Benny AT (2023) Synthetic and Natural Agents as Bacterial Biofilm Inhibitors. *Frontiers in Natural Product Chemistry*

- Rai A, Misra SR, Panda S, *et al* (2022) Nystatin Effectiveness in Oral Candidiasis Treatment: A Systematic Review & Meta-Analysis of Clinical Trials. *Life* 12:1677. <https://doi.org/10.3390/life12111677>
- Ramarajan M, Devilla R, Dow L, *et al* (2024) Genomic and Untargeted Metabolomic Analysis of Secondary Metabolites in the *Streptomyces griseoaurantiacus* Strain MH191 Shows Media-Based Dependency for the Production of Bioactive Compounds with Potential Antifungal Activity. *J Agric Food Chem* 72:24432–24448. <https://doi.org/10.1021/acs.jafc.4c04989>
- Ramos LS, Mello TP, Branquinha MH, Santos ALS (2020) Biofilm Formed by *Candida haemulonii* Species Complex: Structural Analysis and Extracellular Matrix Composition. *Journal of Fungi* 6:46. <https://doi.org/10.3390/jof6020046>
- Ramunaidu A, Pavankumar P, Ragi N, *et al* (2023) Characterization of isomeric acetyl amino acids and di-acetyl amino acids by LC/MS/MS. *Journal of Mass Spectrometry* 58:e4982. <https://doi.org/10.1002/jms.4982>
- Rana PSJB, Gloag ES, Wozniak DJ (2022) Standardized *In vitro* Assays to Visualize and Quantify Interactions between Human Neutrophils and *Staphylococcus aureus* Biofilms. *J Vis Exp*. <https://doi.org/10.3791/63773>
- Rangseekaew P, Pathom-aree W (2019) Cave Actinobacteria as Producers of Bioactive Metabolites. *Frontiers in Microbiology* 10:
- Rehan M, Gueddou A, Alharbi A, Ben Abdelmalek I (2023) *In silico* Prediction of Secondary Metabolites and Biosynthetic Gene Clusters Analysis of *Streptomyces thinghirensis* HM3 Isolated from Arid Soil. *Fermentation* 9:65. <https://doi.org/10.3390/fermentation9010065>
- Ribeiro GF, Denes E, Heaney H, Childers DS (2021) What ‘Omics can tell us about antifungal adaptation. *FEMS Yeast Research* 21:foab070. <https://doi.org/10.1093/femsyr/foab070>
- Richardson JP, Brown R, Kichik N, *et al* (2022) Candidalysins Are a New Family of Cytolytic Fungal Peptide Toxins. *mBio* 13:e03510-21. <https://doi.org/10.1128/mbio.03510-21>
- Rigali S, Titgemeyer F, Barends S, *et al* (2008) Feast or famine: the global regulator DasR links nutrient stress to antibiotic production by *Streptomyces*. *EMBO Rep* 9:670–675. <https://doi.org/10.1038/embor.2008.83>
- Risdian C, Mozef T, Wink J (2019) Biosynthesis of Polyketides in *Streptomyces*. *Microorganisms* 7:124. <https://doi.org/10.3390/microorganisms7050124>

- Robertsen HL, Weber T, Kim HU, Lee SY (2018) Toward Systems Metabolic Engineering of *Streptomyces* for Secondary Metabolites Production. *Biotechnology Journal* 13:1700465. <https://doi.org/10.1002/biot.201700465>
- Robey MT, Caesar LK, Drott MT, *et al* (2021) An interpreted atlas of biosynthetic gene clusters from 1,000 fungal genomes. *Proceedings of the National Academy of Sciences* 118:e2020230118. <https://doi.org/10.1073/pnas.2020230118>
- Rodrigues CF, Černáková L (2020) Farnesol and Tyrosol: Secondary Metabolites with a Crucial quorum-sensing Role in *Candida* Biofilm Development. *Genes (Basel)* 11:444. <https://doi.org/10.3390/genes11040444>
- Rodríguez-Cerdeira C, Martínez-Herrera E, Carnero-Gregorio M, *et al* (2020) Pathogenesis and Clinical Relevance of *Candida* Biofilms in Vulvovaginal Candidiasis. *Front Microbiol* 11:544480. <https://doi.org/10.3389/fmicb.2020.544480>
- Romero-Rodríguez A, Ruiz-Villafán B, Tierrafría VH, *et al* (2016) Carbon Catabolite Regulation of Secondary Metabolite Formation and Morphological Differentiation in *Streptomyces coelicolor*. *Appl Biochem Biotechnol* 180:1152–1166. <https://doi.org/10.1007/s12010-016-2158-9>
- Romo JA, Zhang H, Cai H, *et al* (2019) Global Transcriptomic Analysis of the *Candida albicans* Response to Treatment with a Novel Inhibitor of Filamentation. *mSphere* 4:10.1128/msphere.00620-19. <https://doi.org/10.1128/msphere.00620-19>
- Rosiana S, Zhang L, Kim GH, *et al* (2021) Comprehensive genetic analysis of adhesin proteins and their role in virulence of *Candida albicans*. *Genetics* 217:iyab003. <https://doi.org/10.1093/genetics/iyab003>
- Rosseti IB, Chagas LR, Costa MS (2014) Photodynamic antimicrobial chemotherapy (PACT) inhibits biofilm formation by *Candida albicans*, increasing both ROS production and membrane permeability. *Lasers Med Sci* 29:1059–1064. <https://doi.org/10.1007/s10103-013-1473-4>
- Rout T, Mohapatra A, Kar M, *et al* (2024) Centrality Measures and Their Applications in Network Analysis: Unveiling Important Elements and Their Impact. *Procedia Computer Science* 235:2756–2765. <https://doi.org/10.1016/j.procs.2024.04.260>
- Ruiz-Perez D, Guan H, Madhivanan P, *et al* (2020) So you think you can PLS-DA? *BMC Bioinformatics* 21:2. <https://doi.org/10.1186/s12859-019-3310-7>

- Rumbaugh KP, Bjarnsholt T (2023) Microbial Primer: *In vivo* biofilm. *Microbiology* 169:001407. <https://doi.org/10.1099/mic.0.001407>
- Rumler W, Heins S (1983) Konzentrations-Zeit-Beziehungen bei der Wirkung von Nystatin auf die Vermehrung von *Candida albicans*/Concentration-Time-Relations in the Growth Inhibitory Effect of Nystatin to *Candida albicans*. *Mycoses* 26:216–220. <https://doi.org/10.1111/j.1439-0507.1983.tb03197.x>
- Sá LG do AV, da Silva CR, Neto JB de A, *et al* (2020) Antifungal activity of etomidate against growing biofilms of fluconazole-resistant *Candida* spp. strains, binding to mannoproteins and molecular docking with the ALS3 protein. *Journal of Medical Microbiology* 69:1221–1227. <https://doi.org/10.1099/jmm.0.001241>
- Salvatore MM, Maione A, Albarano L, *et al* (2021) An Integrated Analysis of Intracellular Metabolites and Virulence Gene Expression during Biofilm Development of a Clinical Isolate of *Candida tropicalis* on Distinct Surfaces. *International Journal of Molecular Sciences* 22:9038. <https://doi.org/10.3390/ijms22169038>
- Salvatore MM, Maione A, Imperato M, *et al* (2024) A metabolomics footprinting approach using GC-MS to study inhibitory effects of the fungal metabolite diplopyrone C against nosocomial pathogen biofilms. *Journal of Pharmaceutical and Biomedical Analysis* 243:116081. <https://doi.org/10.1016/j.jpba.2024.116081>
- Salwan R, Kaur R, Sharma V (2022) Genomic Organization of *Streptomyces flavotricini* NGL1 and *Streptomyces erythrochromogenes* HMS4 Reveals Differential Plant Beneficial Attributes and Laccase Production Capabilities. *Mol Biotechnol* 64:447–462. <https://doi.org/10.1007/s12033-021-00424-6>
- Salwan R, Sharma V (2020) Bioactive compounds of *Streptomyces*: Biosynthesis to applications. In: Atta-Ur-Rahman (ed) *Studies in Natural Products Chemistry*. Elsevier, pp 467–491
- Sampaio PN, Calado CCR (2024) Enhancing Bioactive Compound Classification through the Synergy of Fourier-Transform Infrared Spectroscopy and Advanced Machine Learning Methods. *Antibiotics* 13:428. <https://doi.org/10.3390/antibiotics13050428>
- Sánchez S, Chávez A, Forero A, *et al* (2010) Carbon source regulation of antibiotic production. *J Antibiot* 63:442–459. <https://doi.org/10.1038/ja.2010.78>
- Sanchez S, Demain AL (2002) Metabolic regulation of fermentation processes. *Enzyme and Microbial Technology* 31:895–906. [https://doi.org/10.1016/S0141-0229\(02\)00172-2](https://doi.org/10.1016/S0141-0229(02)00172-2)

Sanchez S, Rogers JD, Rogers AB, *et al* (2023) Expansion of novel biosynthetic gene clusters from diverse environments using SanntiS. bioRxiv; 2023.05.23.540769; DOI: 10.1101/2023.05.23.540769.

SarveAhrabi Y, Khoei SN (2023) Investigation of Some Natural Products as an Inhibitor of Agglutinin-Like Sequence (Als3) from *Candida albicans* (Skin Candidiasis): An in silico Study. J Skin Stem Cell 10:. <https://doi.org/10.5812/jssc-142360>

Schauer F, Hanschke R (1999) Zur Taxonomie und Ökologie der Gattung Candida: Taxonomy and ecology of the genus Candida. Mycoses 42:12–21. <https://doi.org/10.1111/j.1439-0507.1999.tb04521.x>

Schena NC, Baker KM, Stark AA, *et al* (2023) Constitutive ALS3 expression in *Candida albicans* enhances adhesion and biofilm formation of efg1, but not cph1 mutant strains. PLOS ONE 18:e0286547. <https://doi.org/10.1371/journal.pone.0286547>

Schiavone A, Pugliese N, Samarelli R, *et al* (2022) Factors Affecting the Quality of Bacterial Genomes Assemblies by Canu after Nanopore Sequencing. Applied Sciences 12:3110. <https://doi.org/10.3390/app12063110>

Schneider O, Ilic-Tomic T, Rückert C, *et al* (2018) Genomics-Based Insights Into the Biosynthesis and Unusually High Accumulation of Free Fatty Acids by *Streptomyces* sp. NP10. Front Microbiol 9:. <https://doi.org/10.3389/fmicb.2018.01302>

Schneider YK, Jørgensen SM, Andersen JH, Hansen EH (2021) Qualitative and Quantitative Comparison of Liquid–Liquid Phase Extraction Using Ethyl Acetate and Liquid–Solid Phase Extraction Using Poly-Benzyl-Resin for Natural Products. Applied Sciences 11:10241. <https://doi.org/10.3390/app112110241>

Schniete JK, Cruz-Morales P, Selem-Mojica N, *et al* (2018) Expanding Primary Metabolism Helps Generate the Metabolic Robustness To Facilitate Antibiotic Biosynthesis in *Streptomyces*. mBio. <https://doi.org/10.1128/mbio.02283-17>

Scholz T, Lopes VV, Calado CRC (2012) High-throughput analysis of the plasmid bioproduction process in *Escherichia coli* by FTIR spectroscopy. Biotechnology and Bioengineering 109:2279–2285. <https://doi.org/10.1002/bit.24502>

Schroeter T, Lapham K, Varma MVS, Obach RS (2025) Positioning Enzyme- and Transporter-Based Precipitant Drug–Drug Interaction Studies in Drug Design. J Med Chem 68:1021–1032. <https://doi.org/10.1021/acs.jmedchem.4c02629>

- Sebastian L, Paul AM, Jayanthi D (2022) Isolation and Production of Prodigiosin Pigments from *Streptomyces* spp. In: Dharumadurai D (ed) Methods in Actinobacteriology. Springer US, New York, NY, pp 683–693
- Sekurova ON, Zehl M, Predl M, *et al* (2022) Targeted Metabolomics and High-Throughput RNA Sequencing-Based Transcriptomics Reveal Massive Changes in the *Streptomyces venezuelae* NRRL B-65442 Metabolism Caused by Ethanol Shock. *Microbiol Spectr* 10:e0367222. <https://doi.org/10.1128/spectrum.03672-22>
- Selegato DM, Freitas TR, Pivatto M, *et al* (2022) Time-related multivariate strategy for the comprehensive evaluation of microbial chemical data. *Metabolomics* 18:33. <https://doi.org/10.1007/s11306-022-01896-6>
- Selim MSM, Abdelhamid SA, Mohamed SS (2021) Secondary metabolites and biodiversity of actinomycetes. *J Genet Eng Biotechnol* 19:72. <https://doi.org/10.1186/s43141-021-00156-9>
- Selvaraj JN, Ganapathi U, Vincent SGP, *et al* (2023) Statistical optimization of media components for antibiotic production in *Streptomyces* sp. CMSTAAHAL-3. *Electronic Journal of Biotechnology* 65:1–13. <https://doi.org/10.1016/j.ejbt.2023.03.005>
- Sengupta K, Saha S, Chatterjee P, *et al* (2018) Ranked Gene Ontology Based Protein Function Prediction by Analysis of Protein–Protein Interactions. In: Satapathy SC, Tavares JMRS, Bhateja V, Mohanty JR (eds) *Information and Decision Sciences*. Springer, Singapore, pp 419–427
- Serna-Cardona N, Zamora-Leiva L, Sánchez-Carvajal E, *et al* (2024) Unveiling metabolo-genomic insights of potent antitumoral and antibiotic activity in *Streptomyces* sp. VB1 from Valparaíso Bay. *Front Microbiol* 15:. <https://doi.org/10.3389/fmicb.2024.1463911>
- Sethupathy S, Sathiyamoorthi E, Kim Y-G, *et al* (2020) Antibiofilm and Antivirulence Properties of Indoles Against *Serratia marcescens*. *Front Microbiol* 11:. <https://doi.org/10.3389/fmicb.2020.584812>
- Setiawati S, Yusan RT (2022) Actinomycetes As A Source Of Potential Antimicrobial and Antibiofilm Agents. *Medical and Health Journal* 1:117–137. <https://doi.org/10.20884/1.mhj.2022.1.2.5831>
- Shafeeq S, Pannanusorn S, Elsharabasy Y, *et al* (2019) Impact of manganese on biofilm formation and cell morphology of *Candida parapsilosis* clinical isolates with different biofilm forming abilities. *FEMS Yeast Research* 19:foz057. <https://doi.org/10.1093/femsyr/foz057>

- Shang X-F, Natschke SLM, Liu Y-Q, *et al* (2022) Biology of quinoline and quinazoline alkaloids. In: The Alkaloids: Chemistry and Biology. Academic Press, pp 1–47
- Shareck J, Belhumeur P (2011) Modulation of Morphogenesis in *Candida albicans* by Various Small Molecules. Eukaryotic Cell 10:1004–1012. <https://doi.org/10.1128/ec.05030-11>
- Shariati A, Didehdar M, Razavi S, *et al* (2022) Natural Compounds: A Hopeful Promise as an Antibiofilm Agent Against *Candida* Species. Front Pharmacol 13:. <https://doi.org/10.3389/fphar.2022.917787>
- Sheir DH, Hafez M 2017 – Antibiofilm activity of *Streptomyces toxytricini* Fz94 against *Candida albicans* ATCC 10231. Microbial Biosystems 2(1), 26–39. <https://doi.org/10.21608/mb.2017.5255>
- Shirling EB, Gottlieb D (1966) Methods for characterization of *Streptomyces* species1. International Journal of Systematic and Evolutionary Microbiology 16:313–340. <https://doi.org/10.1099/00207713-16-3-313>
- Shrestha L, Marasini BP, Pradhan SP, *et al* (2021) Biotransformation of Daidzein, Genistein, and Naringenin by *Streptomyces* Species Isolated from High-Altitude Soil of Nepal. International Journal of Microbiology 2021:9948738. <https://doi.org/10.1155/2021/9948738>
- Shu H, Chen X, Jiang Q, *et al* (2024) Optimization of fungal secondary metabolites production via response surface methodology coupled with multi-parameter optimized artificial neural network model. Bioresource Technology 413:131495. <https://doi.org/10.1016/j.biortech.2024.131495>
- Siddharthan S, Rajamohamed BS, Gopal V (2020) *Streptomyces* diastaticus isolated from the marine crustacean *Portunus sanguinolentus* with potential antibiofilm activity against *Candida albicans*. Arch Microbiol 202:1977–1984. <https://doi.org/10.1007/s00203-020-01918-8>
- Siezen RJ, Khayatt BI (2008) Natural products genomics. Microbial Biotechnology 1:275–282. <https://doi.org/10.1111/j.1751-7915.2008.00044.x>
- Silva AC, Borba JVV, Alves VM, *et al* (2021a) Novel computational models offer alternatives to animal testing for assessing eye irritation and corrosion potential of chemicals. Artificial Intelligence in the Life Sciences 1:100028. <https://doi.org/10.1016/j.ailsci.2021.100028>
- Silva N b. s., Marques L a., Röder D d. b. (2021b) Diagnosis of biofilm infections: current methods used, challenges and perspectives for the future. Journal of Applied Microbiology 131:2148–2160. <https://doi.org/10.1111/jam.15049>

- Silva S, Rodrigues CF, Araújo D, *et al* (2017) *Candida* Species Biofilms' Antifungal Resistance. *Journal of Fungi* 3:8. <https://doi.org/10.3390/jof3010008>
- Silva S, Tobaldini-Valerio F, Costa-de-Oliveira S, *et al* (2016) Discrimination of clinically relevant *Candida* species by Fourier-transform infrared spectroscopy with attenuated total reflectance (FTIR-ATR). *RSC Adv* 6:92065–92072. <https://doi.org/10.1039/C6RA16769A>
- Silverman RJ, Nobbs AH, Vickerman MM, *et al* (2010) Interaction of *Candida albicans* Cell Wall Als3 Protein with *Streptococcus gordonii* SspB Adhesin Promotes Development of Mixed-Species Communities. *Infection and Immunity* 78:4644–4652. <https://doi.org/10.1128/iai.00685-10>
- Simader AM, Kluger B, Neumann NKN, *et al* (2015) QCScreen: a software tool for data quality control in LC-HRMS based metabolomics. *BMC Bioinformatics* 16:341. <https://doi.org/10.1186/s12859-015-0783-x>
- Singh A, Singh P (2023) Extraction, Separation and Characterization of Antibiotic Compound produced by *Streptomyces rimosus* (ACW9) Active against MDRs Uropathogens. *IJRASET* 11:950–962. <https://doi.org/10.22214/ijraset.2023.55278>
- Singh G, Dal Grande F, Schmitt I (2022) Genome mining as a biotechnological tool for the discovery of novel biosynthetic genes in lichens. *Front Fungal Biol* 3:993171. <https://doi.org/10.3389/ffunb.2022.993171>
- Singh KS, Devi SS, Roy M, Devi WR (2014) Synthesis, characterization and evaluation of *in vitro* antimicrobial activity of carbonyl derivatives of sulphonamide compounds. *Journal of Indian Chemical Society* Vol. 91:943–950. <https://doi.org/10.5281/zenodo.5720238>
- Singh R, Ali M, Dubey AK (2023) Anti-*Candida* attributes and *in silico* drug-likeness properties of phenyl 2'β, 6'β-trimethyl cyclohexyl ketone and phenyl nonanyl ether produced by *Streptomyces chrestomyceticus* ADP4. *J Appl Microbiol* 134:lxac024. <https://doi.org/10.1093/jambio/lxac024>
- Singh R, Dubey A (2020) Isolation and Characterization of a New Endophytic Actinobacterium *Streptomyces californicus* Strain ADR1 as a Promising Source of Anti-Bacterial, Anti-Biofilm and Antioxidant Metabolites. *Microorganisms* 8:929. <https://doi.org/10.3390/microorganisms8060929>
- Singh R, Shukla J, Ali M, Dubey AK (2024) A novel diterpenic derivative produced by *Streptomyces chrestomyceticus* ADP4 is a potent inhibitor of biofilm and virulence factors in *Candida albicans* and *C. auris*. *J Appl Microbiol* 135:lxae139. <https://doi.org/10.1093/jambio/lxae139>

- Singh TA, Passari AK, Jajoo A, *et al* (2021) Tapping Into Actinobacterial Genomes for Natural Product Discovery. *Front Microbiol* 12:. <https://doi.org/10.3389/fmicb.2021.655620>
- Singh V, Haque S, Niwas R, *et al* (2017) Strategies for Fermentation Medium Optimization: An In-Depth Review. *Front Microbiol* 7:. <https://doi.org/10.3389/fmicb.2016.02087>
- Singla RK, Dubey AK (2019) Molecules and metabolites from natural products as inhibitors of biofilm in *Candida* spp. *Pathogens. Curr Top Med Chem* 19:2567–2578. <https://doi.org/10.2174/1568026619666191025154834>
- Sionov RV, Steinberg D (2022) Targeting the Holy Triangle of Quorum Sensing, Biofilm Formation, and Antibiotic Resistance in Pathogenic Bacteria. *Microorganisms* 10:1239. <https://doi.org/10.3390/microorganisms10061239>
- Sisu C, Pei B, Leng J, *et al* (2014) Comparative analysis of pseudogenes across three phyla. *Proceedings of the National Academy of Sciences* 111:13361–13366. <https://doi.org/10.1073/pnas.1407293111>
- Siupka P, Hansen FT, Schier A, *et al* (2021) Antifungal Activity and Biosynthetic Potential of New *Streptomyces* sp. MW-W600-10 Strain Isolated from Coal Mine Water. *Int J Mol Sci* 22:7441. <https://doi.org/10.3390/ijms22147441>
- Siupka P, Piński A, Babicka D, Piotrowska-Seget Z (2020) Genome Mining Revealed a High Biosynthetic Potential for Antifungal *Streptomyces* sp. S-2 Isolated from Black Soot. *International Journal of Molecular Sciences* 21:2558. <https://doi.org/10.3390/ijms21072558>
- Smirnova N, Reynolds KA (2001) Engineered Fatty Acid Biosynthesis in *Streptomyces* by Altered Catalytic Function of β -Ketoacyl-Acyl Carrier Protein Synthase III. *Journal of Bacteriology*. <https://doi.org/10.1128/jb.183.7.2335-2342.2001>
- Solecka J, Zajko J, Postek M, Rajnisz A (2012) Biologically active secondary metabolites from Actinomycetes. *Open Life Sciences* 7:373–390. <https://doi.org/10.2478/s11535-012-0036-1>
- Solis NV, Wakade RS, Glazier VE, *et al* (2022) Systematic Genetic Interaction Analysis Identifies a Transcription Factor Circuit Required for Oropharyngeal Candidiasis. *mBio* 13:e0344721. <https://doi.org/10.1128/mbio.03447-21>
- Soll DR (2012) Signal Transduction Pathways Regulating Switching, Mating and Biofilm Formation in *Candida albicans* and Related Species. In: Witzany

G (ed) *Biocommunication of Fungi*. Springer Netherlands, Dordrecht, pp 85–102

Souza SO, Raposo BL, Sarmiento-Neto JF, *et al* (2022) Photoinactivation of Yeast and Biofilm Communities of *Candida albicans* Mediated by ZnTnHex-2-PyP4+ Porphyrin. *Journal of Fungi* 8:556. <https://doi.org/10.3390/jof8060556>

Srivastava V, Dubey AK (2016) Anti-biofilm activity of the metabolites of *Streptomyces chrestomyceticus* strain ADP4 against *Candida albicans*. *Journal of Bioscience and Bioengineering* 122:. <https://doi.org/10.1016/j.jbiosc.2016.03.013>

Steen EJ (2010) Constructing and engineering fatty acid metabolic pathways for the production of fuels and chemicals. UC Berkeley

Stevenson EM, Gaze WH, Gow NAR, *et al* (2022) Antifungal Exposure and Resistance Development: Defining Minimal Selective Antifungal Concentrations and Testing Methodologies. *Frontiers in Fungal Biology* 3:

Stüwe M, Petersen L-E, Liebeke M (2025) From microbes to molecules: unveiling host-microbe interactions with spatial metabolomics. *Mol Syst Biol* 21:947–951. <https://doi.org/10.1038/s44320-025-00129-x>

Subramani R, Sipkema D (2019) Marine Rare Actinomycetes: A Promising Source of Structurally Diverse and Unique Novel Natural Products. *Mar Drugs* 17:249. <https://doi.org/10.3390/md17050249>

Sung K, Park M, Chon J, Khan S (2022) Methods to Grow and Measure *In vitro* Static Biofilms. In: Rezaei N (ed) *Encyclopedia of Infection and Immunity*. Elsevier, Oxford, pp 408–429

Susilawati S, Anwar C, Saleh I, Salni S (2023) Flavonoid as Anti-Candida Agents. *IJFAC (Indonesian Journal of Fundamental and Applied Chemistry)* 8:88–97. <https://doi.org/10.24845/ijfac.v8.i2.88>

Sykes EME, White D, McLaughlin S, Kumar A (2024) Salicylic acids and pathogenic bacteria: new perspectives on an old compound. *Can J Microbiol* 70:1–14. <https://doi.org/10.1139/cjm-2023-0123>

Szklarczyk D, Franceschini A, Kuhn M, *et al* (2011) The STRING database in 2011: functional interaction networks of proteins, globally integrated and scored. *Nucleic Acids Res* 39:D561–D568. <https://doi.org/10.1093/nar/gkq973>

Szklarczyk D, Gable AL, Lyon D, *et al* (2019) STRING v11: protein–protein association networks with increased coverage, supporting functional

discovery in genome-wide experimental datasets. *Nucleic Acids Research* 47:D607–D613. <https://doi.org/10.1093/nar/gky1131>

Taechowisa T, Chuen-Im T, Phutdhawon WS (2025) Antibacterial and Anticancer Properties of Diketopiperazines from *Streptomyces* antimicrobicus BN122, an Endophyte in *Oryza sativa* var. *glutinosa*. *Pakistan J of Biological Sciences* 28:27–37. <https://doi.org/10.3923/pjbs.2025.27.37>

Taguchi Y, Hasumi Y, Abe S, Nishiyama Y (2013) The effect of cinnamaldehyde on the growth and the morphology of *Candida albicans*. *Med Mol Morphol* 46:8–13. <https://doi.org/10.1007/s00795-012-0001-0>

Takahashi Y, Nakashima T (2018) Actinomycetes, an Inexhaustible Source of Naturally Occurring Antibiotics. *Antibiotics (Basel)* 7:45. <https://doi.org/10.3390/antibiotics7020045>

Takano E, Breitling R (2014) Synthetic Biology of Antibiotic Production. In: *Reviews in Cell Biology and Molecular Medicine*. John Wiley & Sons, Ltd, pp 1–24

Tambunan T, Widada J, Damayanti E, *et al* (2021) Antiplasmodial Activity of The Low Molecular Weight Compounds from *Streptomyces* sp. GMR22. *INDONESIAN JOURNAL OF PHARMACY* 31:273–280. <https://doi.org/10.22146/ijp.634>

Tan H, Wang X, Hong H, *et al* (2020) Structures of Endocrine-Disrupting Chemicals Determine Binding to and Activation of the Estrogen Receptor α and Androgen Receptor. *Environ Sci Technol* 54:11424–11433. <https://doi.org/10.1021/acs.est.0c02639>

Tangerina MMP, Furtado LC, Leite VMB, *et al* (2020) Metabolomic study of marine *Streptomyces* sp.: Secondary metabolites and the production of potential anticancer compounds. *PLoS One* 15:e0244385. <https://doi.org/10.1371/journal.pone.0244385>

The UniProt Consortium (2023) UniProt: the Universal Protein Knowledgebase in 2023. *Nucleic Acids Research* 51:D523–D531. <https://doi.org/10.1093/nar/gkac1052>

Thenmozhi M, Kannabiran K (2013) Interaction of *Streptomyces* sp. VITSTK7 compounds with selected antifungal drug target enzymes by *in silico* molecular docking studies. *Interdiscip Sci Comput Life Sci* 5:145–149. <https://doi.org/10.1007/s12539-013-0163-z>

Thokchom S, Mukherjee S, Ningthoujam DS, Banerjee S (2024) Identification of biosynthetic gene clusters using bioinformatic tools. *FLORA AND FAUNA* 30:. <https://doi.org/10.33451/floraf fauna.v30i1pp163-166>

- Thomsen T, Xu Y, Larsen L, Lorenzen J (2015) DIAGNOSIS OF CHRONIC INFECTIONS: REMEMBER THE BIOFILM. *Orthopaedic Proceedings* 97-B:84–84. https://doi.org/10.1302/1358-992X.97BSUPP_16.EBJIS2015-084
- Thomsen TR, Xu Y, Lorenzen J, *et al* (2012) Improved Diagnosis of Biofilm Infections Using Various Molecular Methods. In: Ehrlich GD, DeMeo PJ, Costerton JW, Winkler H (eds) *Culture Negative Orthopedic Biofilm Infections*. Springer, Berlin, Heidelberg, pp 29–41
- Tian H, Wang L, Aiken E, *et al* (2024) Fast Targeted Metabolomics for Analyzing Metabolic Diversity of Bacterial Indole Derivatives in ME/CFS Gut Microbiome. *bioRxiv* : 2024.07.29.605643: <https://doi.org/10.1101/2024.07.29.605643>
- Tian L-F, Liu Y-P, Chen L, *et al* (2020) Structural basis of nucleic acid recognition and 6mA demethylation by human ALKBH1. *Cell Res* 30:272–275. <https://doi.org/10.1038/s41422-019-0233-9>
- Tizabi D, Bachvaroff T, Hill RT (2022) Comparative analysis of assembly algorithms to optimize biosynthetic gene cluster identification in novel marine actinomycete genomes. *Front Mar Sci* 9:. <https://doi.org/10.3389/fmars.2022.914197>
- Tokuhara Y, Akutsu T, Schwartz J-M, Nacher JC (2024) A practically efficient algorithm for identifying critical control proteins in directed probabilistic biological networks. *npj Syst Biol Appl* 10:87. <https://doi.org/10.1038/s41540-024-00411-y>
- Toyofuku M, Inaba T, Kiyokawa T, *et al* (2016) Environmental factors that shape biofilm formation. *Bioscience, Biotechnology, and Biochemistry* 80:7–12. <https://doi.org/10.1080/09168451.2015.1058701>
- Traxler MF, Watrous JD, Alexandrov T, *et al* (2013) Interspecies Interactions Stimulate Diversification of the *Streptomyces coelicolor* Secreted Metabolome. *mBio* 4:10.1128/mbio.00459-13. <https://doi.org/10.1128/mbio.00459-13>
- Trosset J-Y, Cavé C (2019) *In silico* Drug–Target Profiling. In: Moll J, Carotta S (eds) *Target Identification and Validation in Drug Discovery: Methods and Protocols*. Springer, New York, NY, pp 89–103
- Tsugawa H, Nakabayashi R, Mori T, *et al* (2019) A cheminformatics approach to characterize metabolomes in stable-isotope-labeled organisms. *Nat Methods* 16:295–298. <https://doi.org/10.1038/s41592-019-0358-2>

- Tsui C, Kong EF, Jabra-Rizk MA (2016) Pathogenesis of *Candida albicans* biofilm. *Pathog Dis* 74:ftw018. <https://doi.org/10.1093/femspd/ftw018>
- Ugurlu SY, McDonald D, Lei H, *et al* (2024) Cobdock: an accurate and practical machine learning-based consensus blind docking method. *Journal of Cheminformatics* 16:5. <https://doi.org/10.1186/s13321-023-00793-x>
- Uikey W, Raghuwanshi KS, Uikey DW (2020) Influence of Culture Media on Growth, Colony Character and Sporulation of *Chaetomium globosum* Fungus. *IntJCurrMicrobiolAppSci* 9:2567–2572. <https://doi.org/10.20546/ijemas.2020.905.293>
- Umar AH, Syahrani R, Halim NAR, *et al* (2024) FTIR spectroscopy and multivariate analysis for differentiating *Allium* and *Eleutherine* species as spices and medicinal plants. *Vegetos*. <https://doi.org/10.1007/s42535-024-01143-4>
- Uppuluri P, Pierce ,Christopher G, and López-Ribot JL (2009) *Candida albicans* biofilm formation and its clinical consequences. *Future Microbiology* 4:1235–1237. <https://doi.org/10.2217/fmb.09.85>
- van Dissel D, Claessen D, van Wezel GP (2014) Morphogenesis of *Streptomyces* in Submerged Cultures. In: Sariaslani S, Gadd GM (eds) *Advances in Applied Microbiology*. Academic Press, pp 1–45
- van Keulen G, Dyson PJ (2014) Production of Specialized Metabolites by *Streptomyces coelicolor* A3(2). In: Sariaslani S, Gadd GM (eds) *Advances in Applied Microbiology*. Academic Press, pp 217–266
- van Wezel GP, McDowall KJ (2011) The regulation of the secondary metabolism of *Streptomyces*: new links and experimental advances. *Nat Prod Rep* 28:1311–1333. <https://doi.org/10.1039/c1np00003a>
- Vediyappan G, Dumontet V, Pelissier F, d’Enfert C (2013) Gymnemic Acids Inhibit Hyphal Growth and Virulence in *Candida albicans*. *PLOS ONE* 8:e74189. <https://doi.org/10.1371/journal.pone.0074189>
- Veilumuthu P, Godwin CJ (2022) Antimicrobial compounds produced by *Streptomyces* sp. VITGV01 against selected human pathogens. *Res J Biotech* 17:16–28. <https://doi.org/10.25303/1712rjbt16028>
- Vera-González N, Shukla A (2020) Advances in Biomaterials for the Prevention and Disruption of *Candida* Biofilms. *Frontiers in microbiology* 11:. <https://doi.org/10.3389/fmicb.2020.538602>
- Vicente CM, Thibessard A, Lorenzi J-N, *et al* (2018) Comparative Genomics among Closely Related *Streptomyces* Strains Revealed Specialized

Metabolite Biosynthetic Gene Cluster Diversity. *Antibiotics* 7:86.
<https://doi.org/10.3390/antibiotics7040086>

Wahab A-, Nadeem F, Salar U, *et al* (2024) Coumarin derivatives as new anti-biofilm agents against *Staphylococcus aureus*. *PLOS ONE* 19:e0307439.
<https://doi.org/10.1371/journal.pone.0307439>

Wall G, Montelongo-Jauregui D, Vidal Bonifacio B, *et al* (2019) *Candida albicans* biofilm growth and dispersal: contributions to pathogenesis. *Curr Opin Microbiol* 52:1–6. <https://doi.org/10.1016/j.mib.2019.04.001>

Wang A, Weldrick PJ, Madden LA, Paunov VN (2021a) Enhanced clearing of *Candida* biofilms on a 3D urothelial cell *in vitro* model using lysozyme-functionalized fluconazole-loaded shellac nanoparticles. *Biomater Sci* 9:6927–6939. <https://doi.org/10.1039/D1BM01035B>

Wang C, Xu N, Cui S (2021b) Comparative transcriptome analysis of roots, stems, and leaves of *Pueraria lobata* (Willd.) Ohwi: identification of genes involved in isoflavonoid biosynthesis. *PeerJ* 9:e10885.
<https://doi.org/10.7717/peerj.10885>

Wang M, Zhang L, Jiang X, *et al* (2024) Multiomics analysis revealed that the metabolite profile of raw milk is associated with the lactation stage of dairy cows and could be affected by variations in the ruminal microbiota. *Journal of Dairy Science* 107:8709–8721. <https://doi.org/10.3168/jds.2024-24753>

Wang R, Zhao Z, Zhang H, *et al* (2020) Formation of the exceptional [M – H]⁺ cation in atmospheric pressure ionization mass spectrometry analysis of 2-(diphenylsilyl) cyclopropanecarboxylate esters. *Rapid Commun Mass Spectrom* 34:e8866. <https://doi.org/10.1002/rcm.8866>

Wang R-Y, Yan Y-Y, Li B, *et al* (2023) Pattern Recognition Analysis of Metabolites in *Escherichia coli* Based on ESI-Orbitrap Mass Spectrometry. *Chemistry & Biodiversity* 20:e202201153.
<https://doi.org/10.1002/cbdv.202201153>

Wang Y, Long W, Zhang F, *et al* (2022) Hexyl-Aminolevulinate Ethosomes: a Novel Antibiofilm Agent Targeting Zinc Homeostasis in *Candida albicans*. *Microbiology Spectrum* 10:e02438-22.
<https://doi.org/10.1128/spectrum.02438-22>

Watchaputi K, Jayasekara LACB, Ratanakhanokchai K, Soontorngun N (2023) Inhibition of cell cycle-dependent hyphal and biofilm formation by a novel cytochalasin 19,20-epoxycytochalasin Q in *Candida albicans*. *Sci Rep* 13:9724. <https://doi.org/10.1038/s41598-023-36191-4>

- Waterbeemd H v (2009) Improving Compound Quality through *in vitro* and *in silico* Physicochemical Profiling. *Chemistry & Biodiversity* 6:1760–1766. <https://doi.org/10.1002/cbdv.200900056>
- Wei B, Du A-Q, Zhou Z-Y, *et al* (2021) An atlas of bacterial secondary metabolite biosynthesis gene clusters. *Environmental Microbiology* 23:6981–6992. <https://doi.org/10.1111/1462-2920.15761>
- West KHJ, Ma SV, Pensinger DA, *et al* (2023) Characterization of an Autoinducing Peptide Signal Reveals Highly Efficacious Synthetic Inhibitors and Activators of Quorum Sensing and Biofilm Formation in *Listeria monocytogenes*. *Biochemistry* 62:2878–2892. <https://doi.org/10.1021/acs.biochem.3c00373>
- Westerhuis JA, van Velzen EJJ, Hoefsloot HCJ, Smilde AK (2008) Discriminant Q2 (DQ2) for improved discrimination in PLSDA models. *Metabolomics* 4:293–296. <https://doi.org/10.1007/s11306-008-0126-2>
- Wongsariya K, Duangupama T, Pansomsuay R, *et al* (2025) Genome Characterization for the Antimicrobial Potential of *Streptomyces samsunensis* SA31, a Rhizospheric Actinomycete of *Cymbopogon citratus* (DC) Stapf. *CURRENT APPLIED SCIENCE AND TECHNOLOGY* e0260305–e0260305. <https://doi.org/10.55003/cast.2024.260305>
- World Health Organization (2022) WHO Fungal Priority Pathogens List to Guide Research, Development and Public Health Action. 2022. <https://www.who.int/publications-detail-redirect/9789240060241>. Accessed 5 Feb 2024
- Worley B, Powers R (2013) Multivariate Analysis in Metabolomics. <http://www.eurekaselect.com> 1:92–107
- Wu Y, Sun A, Chen F, *et al* (2024) Synthesis, structure–activity relationship and biological evaluation of indole derivatives as anti-*Candida albicans* agents. *Bioorganic Chemistry* 146:107293. <https://doi.org/10.1016/j.bioorg.2024.107293>
- Xia H, Li X, Li Z, *et al* (2020) The Application of Regulatory Cascades in *Streptomyces*: Yield Enhancement and Metabolite Mining. *Front Microbiol* 11:406. <https://doi.org/10.3389/fmicb.2020.00406>
- Xiao Q, Gao M, Sun J, *et al* (2024) Discovery of Acylated Glycine and Alanine by Integrating Chemical Derivatization-Based LC-MS/MS and Knowledge-Driven Prediction. *Anal Chem* 96:18957–18966. <https://doi.org/10.1021/acs.analchem.4c03145>

- Xu C, Liu D, Zhang L, *et al* (2021) AutoOmics: New multimodal approach for multi-omics research. *Artificial Intelligence in the Life Sciences* 1:100012. <https://doi.org/10.1016/j.ailsci.2021.100012>
- Xu H, Dickschat JS (2023) A Detailed View on Geosmin Biosynthesis. *Chembiochem* 24:e202300101. <https://doi.org/10.1002/cbic.202300101>
- Xu L, Ye K-X, Dai W-H, *et al* (2019) Comparative Genomic Insights into Secondary Metabolism Biosynthetic Gene Cluster Distributions of Marine *Streptomyces*. *Marine Drugs* 17:498. <https://doi.org/10.3390/md17090498>
- Xu M, Wang Y, Zhao Z, *et al* (2016) Functional Genome Mining for Metabolites Encoded by Large Gene Clusters through Heterologous Expression of a Whole-Genome Bacterial Artificial Chromosome Library in *Streptomyces* spp. *Applied and Environmental Microbiology* 82:5795–5805. <https://doi.org/10.1128/AEM.01383-16>
- Xu S, Bai C, Chen Y, *et al* (2024a) Comparing univariate filtration preceding and succeeding PLS-DA analysis on the differential variables/metabolites identified from untargeted LC-MS metabolomics data. *Analytica Chimica Acta* 1287:342103. <https://doi.org/10.1016/j.aca.2023.342103>
- Xu S, Kang A, Tian Y, *et al* (2024b) Plant Flavonoids with Antimicrobial Activity against Methicillin-Resistant *Staphylococcus aureus* (MRSA). *ACS Infect Dis* 10:3086–3097. <https://doi.org/10.1021/acsinfecdis.4c00292>
- Xu Z, Huang T, Min D, *et al* (2022) Regulatory network controls microbial biofilm development, with *Candida albicans* as a representative: from adhesion to dispersal. *Bioengineered* 13:253–267. <https://doi.org/10.1080/21655979.2021.1996747>
- Xue J, Wu M (2015) Cyclic Dipeptides from *Streptomyces michiganensis*. *Chem Nat Compd* 51:395–396. <https://doi.org/10.1007/s10600-015-1296-6>
- Yadav AN, Kour D, Rana KL, *et al* (2019) Chapter 20 - Metabolic Engineering to Synthetic Biology of Secondary Metabolites Production. In: Gupta VK, Pandey A (eds) *New and Future Developments in Microbial Biotechnology and Bioengineering*. Elsevier, Amsterdam, pp 279–320
- Yamamoto FY, Pérez-López C, Lopez-Antia A, *et al* (2023) Linking MS1 and MS2 signals in positive and negative modes of LC-HRMS in untargeted metabolomics using the ROIMCR approach. *Anal Bioanal Chem* 415:6213–6225. <https://doi.org/10.1007/s00216-023-04893-3>
- Yang L, Zhang Y-H, Huang F, *et al* (2022a) Identification of protein–protein interaction associated functions based on gene ontology and KEGG pathway. *Front Genet* 13:. <https://doi.org/10.3389/fgene.2022.1011659>

- Yang S-Q, Zhou H-J, Teng L-P, Zeng H (2022b) *Streptomyces*: Derived Active Extract Inhibits *Candida albicans* Biofilm Formation. *Curr Microbiol* 79:332. <https://doi.org/10.1007/s00284-022-03013-1>
- Yu H, Chen Y, Huan T (2021) Computational Variation: An Underinvestigated Quantitative Variability Caused by Automated Data Processing in Untargeted Metabolomics. *Anal Chem* 93:8719–8728. <https://doi.org/10.1021/acs.analchem.0c03381>
- Yu J, Wang Y, Ragueneau-Majlessi I (2024) Risk of Enzyme- and Transporter-mediated Drug Interactions With Drugs Approved by the US Food and Drug Administration in 2022: A Detailed Analysis of *In vitro* and Clinical Data Available in New Drug Application Reviews. *Clinical Therapeutics* 46:499–508. <https://doi.org/10.1016/j.clinthera.2024.04.008>
- Yu L-H, Lu K-Q, Shi G-X, *et al* (2014) Study on inhibitory effect of different extract fractions from longdan xiegan decoction on biofilms of *Candida albicans*. *Zhongguo Zhong Yao Za Zhi* 39:1280–1284
- Yuan C, Wang Y, Zhang L, Wang D (2024) Procatechuic acid and procatechuic aldehyde increase survival of *Caenorhabditis elegans* after fungal infection and inhibit fungal virulence. *Front Pharmacol* 15:. <https://doi.org/10.3389/fphar.2024.1396733>
- Yuan Y, Huang C, Singh N, *et al* (2023) Automated, self-resistance gene-guided, and high-throughput genome mining of bioactive natural products from *Streptomyces*. *bioRxiv* 2023.10.26.564101. <https://doi.org/10.1101/2023.10.26.564101>
- Zabala D, Braña AF, Salas JA, Méndez C (2016) Increasing antibiotic production yields by favoring the biosynthesis of precursor metabolites glucose-1-phosphate and/or malonyl-CoA in *Streptomyces* producer strains. *J Antibiot* 69:179–182. <https://doi.org/10.1038/ja.2015.104>
- Zamith-Miranda D, Heyman HM, Cleare LG, *et al* (2019) *Candida auris*: multi-omics signature of an emerging and multidrug-resistant pathogen. 528232
- Zaongo SD, Ouyang J, Isnard S, *et al* (2023) *Candida albicans* can foster gut dysbiosis and systemic inflammation during HIV infection. *Gut Microbes* 15:2167171. <https://doi.org/10.1080/19490976.2023.2167171>
- Zarnowski R, Sanchez H, Jaromin A, *et al* (2022) A common vesicle proteome drives fungal biofilm development. *Proc Natl Acad Sci U S A* 119:e2211424119. <https://doi.org/10.1073/pnas.2211424119>

- Zawrotniak M, Wojtalik K, Rapala-Kozik M (2019) Farnesol, a Quorum-Sensing Molecule of *Candida albicans* Triggers the Release of Neutrophil Extracellular Traps. *Cells* 8:1611. <https://doi.org/10.3390/cells8121611>
- Zhang H, Machutta CA, Tonge PJ (2010) 8.07 - Fatty Acid Biosynthesis and Oxidation. In: Liu H-W (Ben), Mander L (eds) *Comprehensive Natural Products II*. Elsevier, Oxford, pp 231–275
- Zhang K, Ding W, Han C, *et al* (2024) Investigation on taxonomy, secondary metabolites and antibacterial activity of *Streptomyces sediminicola* sp. nov., a novel marine sediment-derived Actinobacteria. *Microb Cell Fact* 23:285. <https://doi.org/10.1186/s12934-024-02558-z>
- Zhao J, Li Q, Zeeshan M, *et al* (2024) Integrative Genomics and Bioactivity-Guided Isolation of Novel Antimicrobial Compounds from *Streptomyces* sp. KN37 in Agricultural Applications. *Molecules* 29:2040. <https://doi.org/10.3390/molecules29092040>
- Zheng Y, Saitou A, Wang C-M, *et al* (2019) Genome Features and Secondary Metabolites Biosynthetic Potential of the Class Ktedonobacteria. *Front Microbiol* 10:. <https://doi.org/10.3389/fmicb.2019.00893>
- Zhou P, Li Q, Chen C, *et al* (2022) Macrocyclic polyketides from microorganisms: structural diversities and bioactivities. *Journal of Holistic Integrative Pharmacy* 3:268–299. [https://doi.org/10.1016/S2707-3688\(23\)00049-3](https://doi.org/10.1016/S2707-3688(23)00049-3)
- Zhu H, Hu ,Linfeng, Rozhkova ,Tetiana, *et al* (2023a) Spectrophotometric analysis of bioactive metabolites and fermentation optimisation of *Streptomyces* sp. HU2014 with antifungal potential against *Rhizoctonia solani*. *Biotechnology & Biotechnological Equipment* 37:231–242. <https://doi.org/10.1080/13102818.2023.2178822>
- Zhu X, Wang A, Zheng Y, *et al* (2023b) Anti-Biofilm Activity of Cocultimycin A against *Candida albicans*. *International Journal of Molecular Sciences* 24:17026. <https://doi.org/10.3390/ijms242317026>