

Morphological Characterization of *Penicillium* sp. on Sabouraud Dextrose Agar Media Isolated from Agricultural Worker's Feet

M. Farrel Diaz Tiffani

Briliani Kusuma Tungga Dewi

Fadilah Jauharotul Faiqoh

Rachel Aqilah Althaf

Uli Mas'uliyah Indarwati*

Kurnia Ritma Dhanti

Kurniawan

Findi Asih

Universitas Muhammadiyah Purwokerto,
Purwokerto, Indonesia

*email:

ulimasuliyahindarwati@ump.ac.id

Keywords:

Agricultural workers

Fungal Morphology

Penicillium sp.

Skin Scraping

Abstract

Fungal skin infections remain a common health problem in Indonesia, primarily due to the humid tropical climate and poor environmental hygiene. Penicillium is one fungal genus that can be found on the skin, though it is not a primary dermatophyte. This study aims to detect the presence of Penicillium sp. molds and examine their macroscopic and microscopic morphological characteristics isolated from skin scrapings of agricultural worker. The research used a qualitative descriptive method, with skin scrapings cultured on Sabouraud Dextrose Agar (SDA). Macroscopic characterization included colony color, reverse color of the colony, diameter, margins, surface texture, and growth patterns. Microscopic analysis employed the Slide Culture method with lactophenol cotton blue (LPCB) staining. Results revealed green colonies with white margins, irregular colony growth, velvety surfaces, and septate hyphae, colony diameter after one week incubation 23.5mm. Conidia appeared round and arranged in chains. Observations were compared with fungal identification keys for genus confirmation. This study is expected to provide data on the distinct morphology of Penicillium sp. and improve diagnostic accuracy for non-dermatophyte fungal skin infections in laboratory settings.

Received: 12 Aug 2025

Revised: 23 Sep 2026

Accepted: 29 Sep 2026

Published: 30 Sep 2026



Copyright © 2026 by the Authors, Published by Politeknik Kesehatan Kemenkes Jakarta III. This is an open-access article under the CC-BY-SA License (<https://creativecommons.org/licenses/by-sa/4.0/>).

INTRODUCTION

Skin diseases are among the most common causes of health disorders in humans. Globally, there are more than 1.000 types of skin-related diseases. Approximately 1.8 billion people worldwide experience skin conditions at any given time. In tropical regions and resource-limited settings, skin infections caused by bacteria, viruses, fungi, or parasites are the leading causes of health problems. In various communities, neglected skin diseases account for about 10% of all skin disease cases (1). Several factors that may cause skin diseases include climate, local community habits, and poor environmental hygiene (2,3).

Although generally not life-threatening, these conditions can impose an additional burden on annual healthcare costs in a region or country. This is supported by the findings of Patrick et al. (4), which show that the prevalence of skin lesions such as rashes, blisters, and scaling among farmers is significantly higher than among non-farming rural residents (5). reported that as many as 60.61% of farmers have experienced skin disorders, with the highest prevalence being neurodermatitis (36.5%), irritant contact dermatitis (30.2%), and fungal infections such as *tinea* (23.8%) and *pityriasis*

versicolor (23.8%). In addition, cases of *senile pruritus* (20.6%), scabies (4.7%), creeping eruption (3%), and ecthyma (1.5%).

Fungal infections of the skin are classified into three categories namely superficial mycosis, intermediate mycosis, and systemic mycosis. The main cause of fungal infections is the lack of hygiene awareness among some segments of the Indonesian population, which contributes to an increased risk of infection. In addition, transmission can occur through direct contact with individuals affected by mycosis or through indirect contact. The tropical climate in Indonesia creates an environment highly conducive to fungal growth, thereby significantly increasing the risk of fungal infections (6). Fungi are microorganisms found in agricultural soil and humid environments. Continuous exposure to such environments can increase the likelihood that fungi will adhere to or be found on the skin surfaces of agricultural workers (7,8). One genus of fungi found in the environment and on human specimens is *Penicillium*. This fungus can be identified based on the morphological characteristics of its colonies such as color, texture, and colony surface as well as microscopic characteristics, including the shape of the hyphae, conidiophores, and the arrangement of conidia (9,10).

A study conducted by Nurhidayah et al. (11) showed that 7 samples (70%) of farmers' skin were found to contain fungi of the genus *Penicillium*, followed by the genera *Aspergillus sp.* and *Trichophyton sp.* Another study by Hasan et al. (12) also reported that 5 samples (33.33%) of construction workers' fingernails tested positive for *Penicillium*. Fungi of the genus *Penicillium* belong to the class *Eurotiomycetes* and can be found in various environments, particularly in damp conditions. Their presence in skin specimens indicates that these fungi warrant attention in mycological examinations. However, identifying *Penicillium* during routine examinations can still be challenging because its morphological characteristics resemble those of several other fungal genera. Therefore, careful observation of both macroscopic and microscopic characteristics is necessary to facilitate a more accurate identification.

Systematically, research documenting the steps involved in identifying *Penicillium* from skin specimens of agricultural workers from the observation of colony characteristics to microscopic examination remains limited. Stepwise examination can provide a clearer picture of the growth characteristics and morphology of the fungi found in skin specimens. Therefore, this study aims to identify the macroscopic characteristics of the colonies and the microscopic morphology of *Penicillium sp.* isolated from skin scrapings of agricultural workers feet.

METHODS

This study employed a descriptive qualitative design and was conducted over a three-month period from April to June 2025 at the Microbiology Laboratory and Chemistry Laboratory of the Medical Laboratory Technology Study Program, Faculty of Health Sciences, Universitas Muhammadiyah Purwokerto. The study received ethical approval from the Health Research Ethics Committee of Universitas Muhammadiyah Purwokerto with the approval number KEPK/UMP/166/VII/2025. One skin scraping sample from an agricultural worker in village X was collected, with inclusion criteria consisting of skin showing symptoms such as scaly, cracking, noticeable pigment discoloration, characteristic patterns, and the respondent's willingness to sign an informed consent form. Exclusion criteria included respondents currently using antifungal or antibiotic therapy, those not showing clinical symptoms of fungal infection, and those unwilling to sign the informed consent form.

The instrument and materials used included sterile scalpel blades, forceps, petri dishes, a laminar air flow cabinet (ZLab), plastik wrap, a bunsen burner, inoculation needles, microscope slides, cover slips, test tubes, an autoclave (Hirayama), a microscope (Olympus), distilled water, 70% alcohol, cotton swabs, 10% potassium hydroxide (KOH), sabouraud dextrose agar (SDA) medium (Oxoid), chloramphenicol antibiotic (HIMEDIA), lactophenol cotton blue (Merck), and skin scraping samples.

Skin scraping samples were selected based on inclusion criteria. The area of the skin lesion to be sampled was sterilized using 70% alcohol to remove debris. After the alcohol evaporated, the edge of the skin lesion was excised using a scalpel and collected in a sterile petri dish. It was then covered with plastic wrap and transported to the laboratory for immediate examination using 10% KOH. A small amount of the skin scraping sample was placed on a microscope slide, a drop of 10% KOH was added, and the slide was covered with a cover slip and gently heated over a bunsen burner. The sample was observed under a microscope to detect fungal spores or hyphae. Observations were conducted using low to high magnification (13).

Macroscopic morphological identification is performed using a culture test following direct examination with a 10% KOH solution, skin scraping samples were then inoculated onto SDA medium supplemented with 0.4 g/L of the antibiotic chloramphenicol. This medium is selective for fungi and yeasts due to its pH of 5.6, which inhibits the growth of many bacterial species. The main components of SDA include peptone, agar, and dextrose (14,15). The skin samples were aseptically inoculated into the center of the SDA medium using forceps in a LAF. The medium was then covered with plastic wrap and incubated in the dark place at 25–30°C for seven days. After incubation, the isolate was gradually purified by taking a small amount of fungal hyphae with an inoculation needle and inoculating it into fresh SDA medium so that only a single fungal colony would grow. Once a single pure fungal colony is obtained, macroscopic observations are conducted, including colony color, reverse color of the colony, surface texture, colony margin, presence or absence of aerial hyphae, zonation, radial lines, exudate droplets, and colony diameter (16).

After macroscopic morphological characterization, the isolates were then inoculated using the slide culture technique to observe hyphae, conidiophores, and conidia morphology. The slide culture technique was performed by preparing a thin layer of SDA medium, which was aseptically cut into a small square block (approximately 1x1 cm) and placed centrally on a sterile glass microscope slide. The slide was then positioned on top of moistened cotton wool inside a sterile petri dish to create and maintain a humid environment throughout the incubation period. Afterward, a single fungal isolate colony is aseptically streaked into the center of the SDA block using a sterile inoculation loop, and a sterile cover slip is carefully placed over the inoculated medium so that fungal growth can occur along the space between the agar surface and the cover slip. The petri dish was then sealed with plastic wrap to prevent drying and contamination, and incubated in the dark place at a temperature of 25–30°C for 4 days. After incubation, a few drops of LPCB stain were added to the slide to stain the fungal structures, and the specimen was observed under a microscope at 40x magnification. Microscopic observations under the microscope included hyphal structure, the shape and arrangement of conidiophores, and the morphology of conidia (17,18). A descriptive analysis was conducted to identify and characterize the morphological features of *Penicillium sp.* through macroscopic and microscopic observations based on taxonomic key by Watanabe (19).

RESULTS

The morphological characteristics of the fungal isolate obtained from the skin scraping specimen are presented in Table 1. Based on Table 1, wet mount examination showed no fungal hyphae or spores, while macroscopic observation of the isolate revealed a green colony with white margins, yellowish reverse coloration, velvety surface texture, present aerial hyphae, irregular margins, a diameter of 23.5 mm after 7 days of incubation, and the absence of zonation, radial lines, and exudate droplets. Microscopic examination revealed a filamentous mycelium with septate hyaline hyphae and asexual conidia that were unicellular, round, and formed in chains, supported by brush-like conidiophores with bottle-shaped branched phialides exhibiting a biverticillate branching pattern.

Table 1. Morphological characterization of fungal isolated from skin scraping

Aspect	Observation parameters	Observation result
Wet mount with 10% KOH Macroscopic	Fungal hyphae or spores	Not present
	Colony color	Green with white margins
	Reverse color of the colony	Yellowish
	Surface texture	Velvety
	Aerial hyphae	Present
	Colony margins	Irregular
	Zonation	Not present
	Radial lines	Not present
	Exudate droplets	Not present
	Colony diameter (7 days incubation)	23.5 mm
Microscopic	Mycelium	Filamentous
	Hyphae	Septate hyaline
	Spores	Asexual (conidia)
	Conidia	Unicellular, round, formed in chains
	Conidiophores	Brush-like structure
	Phialide	Bottle shaped with branch
	Branching pattern	Biverticillate

The skin scraping specimen from agricultural worker's feet were collected and inoculated into SDA supplemented with 0.4 g/L of chloramphenicol. Prior to inoculation, the specimen was prepared as a wet mount using 10% KOH to dissolve epithelial cells and debris. Results of a wet mount examination using 10% KOH showed no fungal hyphae or spores. However, after inoculation onto SDA medium, *Penicillium* fungal colonies were observed (Figure 1).

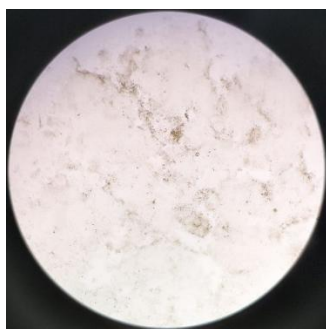
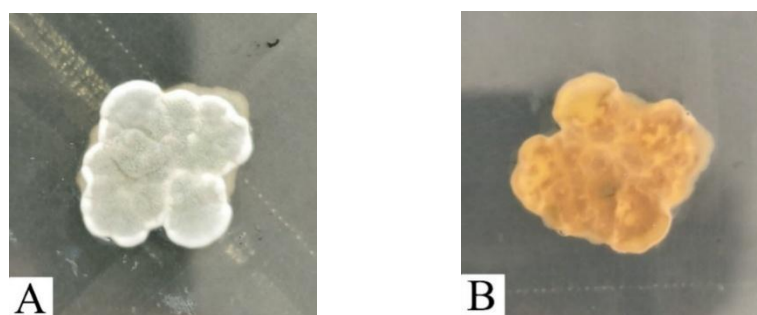


Figure 1. Wet mount of a skin scraping specimen with 10% KOH

Based on the results of inoculation and incubation in a dark place for seven days, green mold colonies were observed forming indented circular patterns with white, irregular colony edges. The underside of the colonies appeared yellowish, with a velvety surface texture and the presence of aerial hyphae. The colony shows neither zoning nor radial lines, and no exudate droplets form. The *Penicillium sp.* colony observed in this study exhibited irregular margins (Figure 2).

Figure 2. Colony morphology of *Penicillium sp.* on SDA medium. A: Observe Colony, B: Reverse Colony

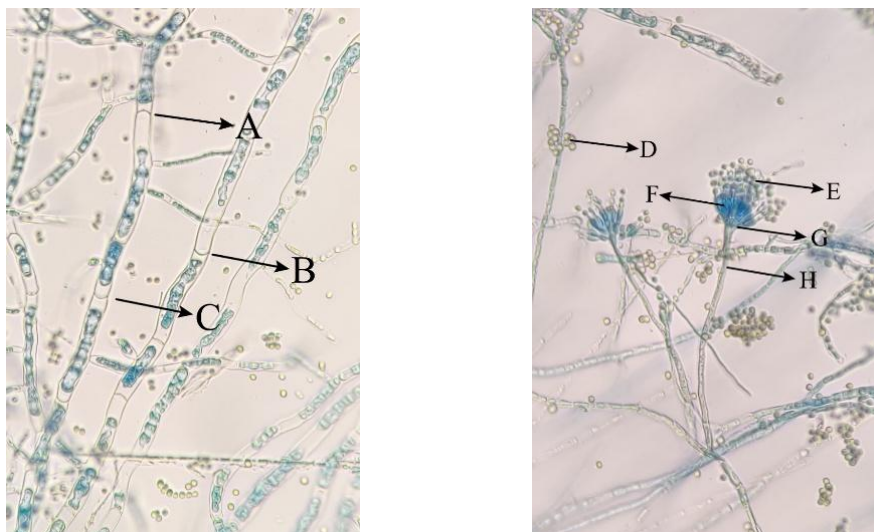


Figure 3. Microscopic structure of *Penicillium sp.* observed under compound microscope. A, B, C: Septate hyphae; D, E: Conidia; F: Phialide; G: Metula; H: Conidiophore.

Based on the microscopic observation of the colony isolate on SDA medium using the slide culture method, the mold colony exhibited septate hyaline hyphae. The asexual spores of the *Penicillium sp.* isolate were round, green conidia arranged in chains resembling a brush (Figure 3).

DISCUSSION

The present study isolated a filamentous fungus from a skin scraping specimen of an agricultural worker despite a negative direct KOH examination. Macroscopic and microscopic characterization demonstrated morphological features consistent with the genus *Penicillium*, including green velvety colonies, septate hyaline hyphae, round conidia arranged in chains, bottle-shaped phialides, and a biverticillate conidiophore arrangement. According to Warnisson et al. (20), the wet mount examination with KOH for detecting fungal spores or hyphae has a sensitivity of 62.5% for detecting fungal keratitis, another study by Kumari et al. (21) state that the sensitivity of KOH examination is 76.5% and its specificity is 36.9% for detecting tinea corporis. This raises the possibility that fungal spores are actually present but were not detected in the microscope's field of view, resulting in a false negative. Several factors that can contribute to false negatives include a small or limited specimen collection, hyphae or spores obscured by debris, and a very small number of fungal hyphae or spores in the specimen. Therefore, a confirmatory with culture test is necessary to ensure the accuracy of the results (22).

The characterization of fungal isolates in this study was based on the macroscopic and microscopic features of pure colony isolates. Accurate fungal identification relies heavily on macroscopic characteristics such as colony morphology, growth rate, color, texture, diffusible pigments, and hyphal structure, as well as microscopic characteristics including the arrangement and shape of spore-bearing structures. Additionally, the configuration of conidiophores and the mechanism of spore (conidia) formation play a crucial role in the precise identification of filamentous fungi (23,24).

A previous study reported that *P. lanosum* exhibited an irregular colony shape and irregular colony margins based on macroscopic observation (25). This similarity indicates that irregular colony margins can be observed in some *Penicillium* isolates. However, colony morphology may vary among species and can be influenced by growth conditions. A study by Hafsari et al. (26) also reported that the *Penicillium sp.* isolate, when incubated on pikovskaya agar (PVK) medium for

seven days, exhibited a velvety colony surface and showed no zoning, radial lines, or exudate droplets. These results indicate similarities in several macroscopic morphological characteristics of *Penicillium sp.* observed in this study. The macroscopic observations also align with the findings of Mahardhika et al. (27), green colonies with a velvety surface texture, yellow reverse coloration, and the absence of zonation are characteristic features of the *Penicillium* genus.

After seven days of incubation, the colony diameter measured 23.5 mm. There are variations in the diameter of *Penicillium* colonies, a study found that *Penicillium* inoculated from food samples on SDA medium had a diameter of 45 mm (28), whereas a study by Tarigan et al (29) showed that on Potato Dextrose Agar (PDA) medium, *Penicillium* colonies had diameters ranging from 20.5 mm to 25.4 mm after 6 days of incubation. Differences in fungal colony growth are likely due to factors such as differences in *Penicillium* strains, temperature, and nutrients in the fungal growth medium (30,31).

After macroscopic observation, part of the fungal hyphae was then inoculated using the slide culture technique. Fungal colonies grown on the slide culture were stained with LPCB to facilitate observation. LPCB contains several components including phenol, which functions to kill the organism, lactic acid, which helps preserve the fungal structure, and cotton blue, which stains the fungal cell wall. The prepared slide was then observed under a microscope, and fungal cell characterization was conducted, including the observation of mycelium, hyphae, conidiophores, sporangiophores, spores, or conidia present in the slide culture preparation (32).

The microscopic characteristics matched the identification results by Riadi et al. (18), in which *Penicillium* shows distinctive features such as hyaline, septate hyphae, and the presence of metulae and phialides. The results of this finding are consistent with studies by Simanjutak et al. (33) and Tarigan et al. (31), conidia of the genus *Penicillium sp.* are round and range in color from green to yellow (34). According to the identification key, the isolated colony was identified as a mold from the genus *Penicillium*. Molds of the genus *Penicillium* produce asexual spores known as conidia, which are unicellular, round, and arranged in chains (35).

Observation of the conidiophore structure revealed a biverticillate branching pattern, with septate, cylindrical conidiophores producing conidia through phialide structures. The biverticillate branching pattern is characterized by the presence of metulae between the conidiophore and phialides. The metulae bear several phialides that produce numerous conidia. This characteristic is consistent with the study by Doilom et al. (36), which described several *Penicillium* species with biverticillate conidiophores that have metulae bearing several phialides, as well as round to oval conidia arranged in chains. The phialides were located at the tips of branched metulae, with each branch bearing phialides that produced numerous conidia. The characteristics of the conidiophores observed are consistent with the findings of Tarigan et al. (31), *Penicillium* conidiophores isolated from citrus fruit are septate and hyaline, cylindrical in shape, and consist of a single stalk bearing several phialides. The conidia were round in shape, and the phialides were bottle-shaped, typically consisting of three to six phialides. Another study showed that *Penicillium* isolated from infected rice exhibited branched conidiophores, bottle-shaped phialides, round conidia that form chains (37). Several species within the genus *Penicillium* exhibit branching patterns such as monoverticillate, divaricate, and terverticillate (38).

Pathogenic fungi thrive in agricultural environments due to favorable growth conditions. The physical environment of rice fields is characterized by high humidity, making it suitable for the spread and proliferation of *Penicillium*. The presence of this fungus is attributed to continuous contamination by fungal spores through air, water, soil, and the human body. Contamination around rice field areas may originate from fungal particles carried by infected agricultural worker who are active in the fields. Agricultural workers in rice paddies or fields are frequently affected by fungal infections, as their feet are often in prolonged contact with soil, water, and mud without adequate protective footwear. This condition

leads to moist feet, as many agricultural workers pay limited attention to personal hygiene while working (39). Prevention of fungal foot infections involves maintaining regular foot hygiene, including washing the feet with soap, drying between the toes, trimming toenails regularly, and managing foot moisture that can promote fungal growth (40).

This study has several limitations, one of which is the use of SDA medium for fungal growth. According to Sowmya (41), *Penicillium* comprises numerous species, and when cultivated on different media, *Penicillium* colonies may exhibit varying characteristics. These differences include colony color, texture, and growth rate, which can vary across different species and subspecies. In addition, the difficulty of distinguishing *Penicillium* species based solely on morphological characteristics represents a limitation in the reliability of species-level identification in the present study. Therefore, the identification of the *Penicillium* isolate in this study could not be confirmed at the species or subspecies level based solely on morphological characteristics. Molecular identification is therefore necessary to confirm its taxonomic identity. Molecular analyses can be performed by detecting sequences in genes such as tubulin (BenA), calmodulin (CaM), and RNA Polymerase II Subunit B2 (RPB2) (42).

CONCLUSION

Fungal isolates obtained from skin scrapings specimen displayed distinct morphological characteristics, with macroscopic features including green colonies with white margin, reverse color of the colony appeared yellowish, velvety surface texture, present of the aerial hyphae, irregular colony margins, no zonation, no radial lines, no exudate droplets. Microscopically, the isolates exhibited filamentous, septate hyaline hyphae, brush-like structure conidiophores with biverticillate branching pattern, and round, unicellular conidia arranged in chains. The mycelial growth rate on SDA medium showed a colony diameter of 23.5 mm on the seventh day of incubation.

DECLARATIONS

Author Contributions: MFDT, BKTD, FJF, and RAA contributed to conceptualization, methodology, data collection, research execution, analysis, and drafting of the manuscript. UMI, KR D, and K contributed to supervision and guidance throughout the research process. FA contributed to providing laboratory assistance and supporting research execution during the study.

Conflicts of Interest: The authors declare no financial, personal, professional, or institutional conflicts of interest.

Declaration of Generative AI and AI-Assisted Technologies: During the preparation of this manuscript, OpenAI's ChatGPT and Google Gemini was used purely as an editorial tool to improve linguistic fluency, correct grammar, and enhance structural coherence. AI technology was not involved in data generation, processing, or analytical interpretation. After using this tools, the authors reviewed and edited the content as needed and takes full responsibility for the content of the published article.

Source of Funding: No external funding was received to assist with the preparation of this manuscript.

Ethical Approval and Informed Consent: This study has received ethical approval from the Health Research Ethics Committee of Universitas Muhammadiyah Purwokerto with registration number KEPK/UMP/166/VII/2025. Written informed consent was obtained from the participant prior to data and specimen collection. The study was conducted in accordance with applicable ethical principles and institutional requirements.

Acknowledgements: The author would like to thank the Medical Laboratory Technology Study Program at Muhammadiyah University of Purwokerto for funding and facilitating this research. The authors also acknowledge the support provided by the Health Research Ethics Committee of Universitas Muhammadiyah Purwokerto.

REFERENCES

1. Iskandar AC, Najihah, Yulis R, Pailungan FY, Nugroho BA, Edwin A, et al. Edukasi Pencegahan Penyakit Kulit Tropik Infeksi untuk Memperkuat Kemandirian Perilaku Hidup Bersih dan Sehat pada Remaja. *Jurnal Mandala Pengabdian Masyarakat*. 2024;5(2): 278–283. <https://doi.org/10.35311/jmpm.v5i2.426>.
2. Fatmawati A, Suardi, Diyanah D, Pada AT. Kejadian Infeksi Jamur Penyebab Tinea Pedis Terkait Higienitas Di Lingkungan Padat Penduduk Kampung Nelayan. *Jurnal Medika: Media Ilmiah Analisis Kesehatan*. 2022;7(2): 61–69. <https://doi.org/10.53861/jmed.v7i2.348>.
3. Sofyan A, Buchair NH. Penyakit Kulit dan Kelamin Akibat Infeksi Jamur Di Poliklinik RSUD Undata Palu Tahun 2013-2021. *Preventif: Jurnal Kesehatan Masyarakat*. 2022;13(2): 384–392. <https://doi.org/10.22487/preventif.v13i2.516>.
4. Patrick G, Leonard M, Flohr M, Sangha N, Torres AA, Hartenstein B, et al. Prevalence of Self-Reported Dermatologic Symptoms Among Farmers Living in Gracias a Dios, Honduras. *JAAD International*. 2022;8: 89–91. <https://doi.org/10.1016/j.jdin.2022.05.012>.
5. Hidayat MZS, Putranti IO, Susanti D. Peningkatan Kualitas Kesehatan Petani dan Gizi Masyarakat Melalui Gerakan Dokter Tani di Desa Muntang Kecamatan Kemangkon Kabupaten Purbalingga. In: *Prosiding Seminar Nasional LPPM UNSOED*. Purwokerto: LPPM UNSOED; 2024. p. 124–132.
6. Marlita S, Hartati, Taufiq N. Identifikasi Jamur (*Malassezia furfur*) pada Kulit Wanita Penderita Pityriasis Versicolor Penghuni Lembaga Perumahan Perempuan Kelas II A Sungguminasa. *Tropis: Jurnal Riset Teknologi Laboratorium Medis*. 2024;1(1): 1–5. <https://doi.org/10.37304/tropis.v1i1.13469>.
7. Arshad M, Abdullah, Tayyab Gul M, Ullah A, Khan A, Islam S, et al. Isolation and Identification of Soil Fungi from Selected Regions of Peshawar and Charsadda, Pakistan. *The Sciencetech*. 2023;4(4): 1–11.
8. Nita K, Azahra S, Makkadafi SP. Perbedaan Penggunaan Alas Kaki Terhadap Prevalensi Jamur Penyebab Onikomikosis Pada Petani Di Kelurahan Handil Bakti Palaran. *Borneo Journal Of Medical Laboratory Technology*. 2025;7(2): 826–830. <https://doi.org/10.33084/bjmlt.v7i2.8238>.
9. Fadilla AN, Kamilla L, Nuswantoro A, Tumpuk S. Potensi Tepung Kulit Pisang Raja Sebagai Media Alternatif Pertumbuhan Jamur *Penicillium* sp. *Jurnal Laboratorium Khatulistiwa*. 2024;8(1): 199–204. <https://doi.org/10.30602/jlk.v8i1.1665>.
10. Saif FA, Yaseen SA, Alameen AS, Mane SB, Undre PB. Identification of *Penicillium* Species of Fruits Using Morphology and Spectroscopic Methods. *Journal of Physics: Conference Series*. 2020;1644. <https://doi.org/10.1088/1742-6596/1644/1/012019>.
11. Nurhidayah A, Dhanti KR, Supriyadi. Identifikasi Jamur Patogen Penyebab Dermatofitosis pada Jari Kaki Petani di Desa Bojongsari, Banyumas. *Jurnal Labora Medika*. 2021;5: 8–17. <https://doi.org/10.26714/jlabmed.5.1.2021.8-17>.
12. Hasan ZA, Adawiyah R, Naim N, Armah Z. Identifikasi Jamur Penyebab Onychomycosis pada Kerokan Kuku Pekerja Bangunan. *Lontara Journal of Health Science and Technology*. 2022;3(1): 38–49. <https://doi.org/10.53861/lontarariset.v3i1.272>.
13. Priyadharshini KGS, Rajesh S, Divya B, Nirmala S. 10 % Potassium Hydroxide Mount of Skin Scraping- A Simple Tool for Diagnosing Dermatophytosis in Patients Attending a Dermatology Clinic in a Tertiary Care Hospital in Salem. *Journal of Health and Technology*. 2025;1(2): 106–114. <https://doi.org/10.65129/health.v1i2.83>.

14. Fitria N, Setiawati F. Modifikasi Media Jagung (*Zea mays*) dan Kacang Tanah (*Arachis hypogea*) sebagai Media Pertumbuhan *Aspergillus flavus*. *Jurnal Online Institut Teknologi Nasional*. 2020;8(1): 57–66. <https://doi.org/10.26760/rekalingkungan.v8i1.57-66>.
15. Hasan ZA, Adawiyah R, Naim N, Armah Z. Identifikasi Jamur Penyebab Onychomycosis pada Kerokan Kuku Pekerja Bangunan. *Lontara Journal of Health Science and Technology*. 2022;3(1): 38–49. <https://doi.org/10.53861/lontarariset.v3i1.272>.
16. Riadi I, Octavia B, Habibi M. Deteksi dan Identifikasi Kapang pada Proses Biodeteriorasi Arsip Foto Memory of The World (MOW) Restorasi Candi Borobudur. *Jurnal Konservasi Cagar Budaya*. 2021;15(1): 3–14. <https://doi.org/10.33374/jurnalkonservasicagarbudaya.v15i1.255>.
17. Tjampakasari CR, Agustini R, Baihaki I, Noor S, Bustami A. Kultur Slide Sebagai Metode Mikroskopik Tidak Langsung Untuk Identifikasi Jamur Kapang. *Jurnal Sehat Indonesia (JUSINDO)*. 2024;6(1): 201–210. <https://doi.org/10.59141/jsi.v6i01.75>.
18. Riadi I, Octavia B, Habibi M. Deteksi dan Identifikasi Kapang pada Proses Biodeteriorasi Arsip Foto Memory of The World (MOW) Restorasi Candi Borobudur. *Jurnal Konservasi Cagar Budaya*. 2021;15(1): 3–14. <https://doi.org/10.33374/jurnalkonservasicagarbudaya.v15i1.255>.
19. Watanabe T. *Pictorial Atlas of Soil and Seed Fungi*. New York: CRC Press; 2010. <https://doi.org/10.1201/ebk1439804193>.
20. Warnnissorn P, Sawatdiwithayayong J, Surit P. Efficacy and Rapidity of Potassium Hydroxide Mount and Modified Chicago Sky Blue 6B Stain with Potassium Hydroxide in Fungal Keratitis Detection. *Korean J Ophthalmol*. 2024;38(2): 98–104. <https://doi.org/10.3341/kjo.2023.0106>.
21. Kumari V, Kumar S, Ejaz M, Kumar K, Aziz HR, Azam H. Diagnostic Accuracy of Potassium Hydroxide Mount Versus Fungal Culture in Tinea corporis. *Archives of Microbiology Research*. 2025;1(1): 8–13.
22. Nurfadillah, Hartati, Sulfiani. Identifikasi Jamur Dermatofita Penyebab Tinea unguium pada Kuku Kaki Petani di Dusun Ballakale Desa Aska Kecamatan Sinjai Selatan Kabupaten Sinjai. *Kampurui Jurnal Kesehatan Masyarakat*. 2021;3(2): 84–92. <https://doi.org/10.55340/kjkm.v3i2.498>.
23. Millatia Z, Sabdaningsih A, Muskananfolia MR. Isolasi dan Karakterisasi Jamur dari Sedimen Mangrove Tapak, Semarang. *Jurnal Pasir Laut*. 2022;6(2): 67–74. <https://doi.org/10.14710/jpl.2022.48286>.
24. Tjampakasari CR, Agustini R, Baihaki I, Noor S, Bustami A. Kultur Slide Sebagai Metode Mikroskopik Tidak Langsung Untuk Identifikasi Jamur Kapang. *Jurnal Sehat Indonesia (JUSINDO)*. 2024;6(1): 201–210. <https://doi.org/10.59141/jsi.v6i01.75>.
25. Simamora A V, Henuk JBD, Nenotek PS, Hahuly M V, Serangmo DYL, Kapitan W. Identifikasi Jamur Pascapanen pada Buah Tomat yang Dijual di Beberapa Pasar Tradisional di Kupang. *Agrisa*. 2022;11(2): 54–65.
26. Hafsari AR, Pertiwi VD. Isolasi dan Identifikasi Kapang Pelarut Fosfat dari Fosfat Guano Gua Pawon. *Biologi dan Pendidikan biologi*. 2017;10(2): 165–180. <https://doi.org/10.20414/jb.v10i2.13>.
27. Mahardhika WA, Dion R, Naufal MFQ, Ramadhany W, Lunggani AT. Isolation and Characterization of Mold on Furniture in Biological Laboratory Environment Using Contact Plate Method. *Jurnal Biologi Tropis*. 2022;22(3): 765–772. <https://doi.org/10.29303/jbt.v22i3.3416>.
28. Arini LDD, Pramonodjati F, Weka MAN. Identifikasi Karakteristik Mikroskopik dan Makroskopik pada Jamur *Rhizopus* sp., *Aspergillus* sp., dan *Penicillium* sp., pada Beberapa Sampel Makanan. *USADA NUSANTARA: Jurnal Kesehatan Tradisional*. 2026;4(1): 23–40. <https://doi.org/10.47861/usd.v4i1.2150>.

29. Tarigan ESB, Rahmiati, Lubis R. Karakteristik Makroskopis dan Mikroskopis Jamur Kontaminan Pascapanen pada Buah Jeruk Madu Berastagi di Desa Seribu Jandi Sumatera Utara. *Jurnal Ilmiah Biologi UMA (JIBIOMA)*. 2025;7(1): 14–23. <https://doi.org/10.31289/jibioma.v7i1.6110>.
30. Muggia L, Kopun T, Grube M. Effects of Growth Media on The Diversity of Culturable Fungi From Lichens. *Molecules*. 2017;22(5): 824. <https://doi.org/10.3390/molecules22050824>.
31. Tarigan ESB, Rahmiati, Lubis R. Karakteristik Makroskopis dan Mikroskopis Jamur Kontaminan Pascapanen pada Buah Jeruk Madu Berastagi di Desa Seribu Jandi Sumatera Utara. *Jurnal Ilmiah Biologi UMA (JIBIOMA)*. 2025;7(1): 14–23. <https://doi.org/10.31289/jibioma.v7i1.6110>.
32. Marlita S, Hartati, Taufiq N. Identifikasi Jamur (*Malassezia furfur*) pada Kulit Wanita Penderita Pityriasis Versicolor Penghuni Lembaga Permayarakatan Perempuan Kelas II A Sungguminasa. *Tropis: Jurnal Riset Teknologi Laboratorium Medis*. 2024;1(1): 1–5. <https://doi.org/10.37304/tropis.v1i2.13469>.
33. Simanjuntak N, Khotimah S, Linda R. Keanekaragaman Kapang Udara di Ruang Perkuliahan Fakultas Matematika dan Ilmu Pengetahuan Alam Universitas Tanjungpura Pontianak. *Protobiont*. 2015;4(2): 55–62. <https://doi.org/10.26418/protobiont.v4i2.10874>.
34. Arini LDD, Pramonodjati F, Weka MAN. Identifikasi Karakteristik Mikroskopik dan Makroskopik pada Jamur *Rhizopus* sp., *Aspergillus* sp., dan *Penicillium* sp., pada Beberapa Sampel Makanan. *USADA NUSANTARA: Jurnal Kesehatan Tradisional*. 2026;4(1): 23–40. <https://doi.org/10.47861/usd.v4i1.2150>.
35. Watanabe T. *Pictorial Atlas of Soil and Seed Fungi*. New York: CRC Press; 2010. <https://doi.org/10.1201/ebk1439804193>.
36. Doilom M, Guo J wei, Phookamsak R, Mortimer PE, Karunarathna SC, Dong W, et al. Screening of Phosphate-Solubilizing Fungi From Air and Soil in Yunnan, China : Four Novel Species in *Aspergillus*, *Gongronella*, *Penicillium*, and *Talaromyces*. *Frontiers in microbiology*. 2020;11: 1–24. <https://doi.org/10.3389/fmicb.2020.585215>.
37. Amalia AR, Purnawati A, Prasetyawati ET. Secondary Metabolites of *Trichoderma* sp . as Antifungal Against Rice Seed-borne Pathogen Fungi. *Jurnal Pembelajaran dan Biologi Nukleus*. 2023;9(November): 483–495. <https://doi.org/10.36987/jpbn.v9i3.4822>.
38. Visagie CM, Houbraken J, Frisvad JC, Hong SB, Klaassen CHW, Perrone G, et al. Identification and Nomenclature of the Genus *Penicillium*. *Studies in Mycology*. 2014;78: 343–371. <https://doi.org/10.1016/j.simyco.2014.09.001>.
39. Nurhidayah A, Dhanti KR, Supriyadi. Identifikasi Jamur Patogen Penyebab Dermatofitosis pada Jari Kaki Petani di Desa Bojongsari, Banyumas. *Jurnal Labora Medika*. 2021;5: 8–17. <https://doi.org/10.26714/jlabmed.5.1.2021.8-17>.
40. Arizandy R, Rahmawati YT, Sandhi TAN. Analisis Faktor Risiko Tinea Pedis Pada Pengguna Sepatu Boots. *CoMPHI Journal: Community Medicine and Public Health of Indonesia Journal*. 2023;4(1). <https://doi.org/10.37148/comphijournal.v4i1.138>.
41. Sowmya KL, Ramalingappa B. Microscopic Characteristics as Preliminary Identification of Some Toxin Producing Fungi from Bakery Food Samples. *Food Science and Nutrition*. 2024;10: 1–6. <https://doi.org/10.24966/fsn-1076/100178>.
42. Houbraken J, Kocsubé S, Visagie CM, Yilmaz N, Wang XC, Meijer M, et al. Classification of *Aspergillus*, *Penicillium*, *Talaromyces* and Related Genera (Eurotiales): An Overview of Families, Genera, Subgenera,

Sections, Series and Species. *Studies in Mycology*. 2020;95: 5–169.
<https://doi.org/10.1016/j.simyco.2020.05.002>.