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I-CReST 2025: 012-074 – Harnessing Endophytic Fungi for Antifungal Potential in Sustainable Rubber Cultivation in Malaysia

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ABSTRACT

Rubber tree disease poses a major threat to Malaysia's rubber industry, causing significant reductions in latex yield and quality. If left uncontrolled, these diseases can severely impact farmer income and industry sustainability. In response to increasing concern among local rubber farmers, this study was conducted to identify endophytic fungal pathogens from infected rubber trees and evaluate the antifungal potential of selected plant extracts. Leaf samples were collected from diseased rubber trees in Lakota, Jeli, Kelantan. Endophytic fungi were isolated using the tissue transplantation method. A total of 40 fungal isolates were obtained and characterized based on morphological features such as colony shape, margin, color, and pigmentation. From these, 25 distinct isolates were selected for antifungal screening using the well diffusion method against five plant extracts: mulberry root, mulberry fruit, mulberry stem, garlic, and senna leaves. Among them, two plant extracts showed notable antifungal activity. Mulberry root extract inhibited the growth of 10 isolates (L1S4, L1S6, L2S5, L3S2, L3S5, L3S8, L4S1, L4S2, L4S4), while garlic extract was effective against isolate L1S9. The antifungal activity is likely due to bioactive secondary metabolites present in the extracts, which may suppress or eliminate fungal pathogens. These findings highlight the potential of plant-derived compounds as sustainable alternatives for managing fungal diseases in rubber trees. Further investigation is needed to isolate and characterize the active compounds and assess their efficacy for practical application in rubber plantations.

Keywords: Endophytic fungi; rubber tree disease; antifungal activity; plant extracts; sustainable agriculture

1. INTRODUCTION

Climate change is accelerating the emergence of leaf- and root-infecting pathogens that already cut Malaysian rubber yields by up to 40–60 %, threatening an industry built on rubber latex [1, 2]. Preventive strategies are therefore essential and increasingly centre on biological control, where endophytic microorganisms ubiquitous, symptom-free residents of plant tissues act as natural antagonists. Fungal and bacterial endophytes colonise plants for all or part of their life cycle, often co-existing with pathogens [3]. Endophytic fungi can occupy both inter and intracellular spaces especially in roots and may behave as mutualists, commensals, or pathogens depending on host condition [4]. Their biocontrol modes include competing for nutrients and space, releasing antibiotic metabolites, hyperparasitising pathogens, and priming host defences [5]. Complementing these microbes, certain plant extracts possess rich repertoires of secondary metabolites such as saponins, alkaloids, terpenoids that disrupt fungal membranes, impede ergosterol synthesis, or damage cell walls [6]. Mulberry root bark, for example, inhibits *Alternaria* and *Fusarium spp*. up to five-fold [7]; garlic ethanolic extracts suppress *Fusarium* and *Rhizopus* with inhibition zones up to 14 mm [8]; and Senna stem

extracts restrain dermatophytes at 5–10 mg mL^{-1} [9]. With this, the present study isolates endophytic fungi from diseased rubber leaves, characterises their morphology, and screens them against mulberry (root, stem, fruit), garlic, and Senna extracts using well diffusion assays, aiming to uncover synergistic fungal–botanical combinations for sustainable, biologically driven management of rubber-tree diseases.

2. METHODOLOGY

2.1 Sample Collection

Infected rubber trees were identified based on visible symptoms such as leaf spots, leaf drop, and bark lesions. Samples were collected from various parts of the tree, including leaves, twigs, and bark. Both healthy and diseased tissues were sampled for comparison. Sharp knives were sterilized with rubbing alcohol before and after each use to prevent contamination. Each sample was placed in a separate plastic bag, clearly labelled with the collection location and date, to avoid cross-contamination. Samples were transported to the laboratory as quickly as possible, stored in a cool, dry environment during transit, and processed within four hours of collection to maintain sample quality.

2.2 Surface Sterilization

The samples underwent a decontamination process to remove surface impurities and debris. Initially, they were immersed in 70% (v/v) ethanol for 1 minute, followed by rinsing with sterile distilled water. For the isolation of endophytic fungi, the samples were further treated with 1% (v/v) sodium hypochlorite solution for varying durations (0, 5, 10, 15, and 20 minutes). After treatment, the samples were air-dried at room temperature and then imprinted onto Potato Dextrose Agar (PDA) plates. Healthy leaf samples were used as positive controls. All experiments were performed in triplicate to ensure reliability.

2.3 Leaf Imprint Test

To determine the optimal immersion period, the effectiveness of the surface sterilization method was assessed using a leaf surface imprint test. Leaf samples were imprinted onto PDA plates after undergoing different immersion durations and incubated at 25 °C for 7 days. Following incubation, the presence of epiphytic fungi was evaluated. The absence of fungal growth on the PDA plates indicated successful surface sterilization, confirming that any subsequent fungal growth during isolation originated from endophytic fungi.

2.4 Isolation of Endophytic Fungi

After surface sterilization, endophytic fungi were isolated from the infected leaf samples. The samples were given a final rinse with sterile 0.50 g/L Tween 80 solution, then cut into small fragments (5 × 5 mm). These fragments were placed on PDA medium supplemented with chloramphenicol (0.2 g/L) to suppress bacterial contamination. The plates were incubated at 25 °C and monitored daily for signs of fungal growth. Once hyphal tips emerged, they were aseptically transferred to fresh PDA plates. Subculturing was performed repeatedly to obtain pure cultures and ensure genetic uniformity of the endophytic fungal isolates.

2.5 Morphological Identification

Selected endophytic fungal isolates from the primary isolation plates were transferred onto PDA plates supplemented with chloramphenicol to promote lawn growth while preventing bacterial contamination. The plates were incubated at 28 °C for 3 days. Fungal growth was then observed, and isolates were compared based on morphological characteristics. Small fragments of the fungal mycelium were carefully extracted using sterile inoculating needles and transferred onto clean glass slides, following the method described by Maadon et al., 2018 [10]. The samples were stained with Lactophenol Cotton Blue (Hardy Diagnostics, California, USA), a standard fungal stain. Slides were examined under a compound microscope to assess morphological features. Identification was based on characteristics such as colony structure, septation, spore or conidia shape, and pigmentation.

2.6 Antifungal Assay

Plant extracts obtained from the Faculty of Agro-based Industry, Universiti Malaysia Kelantan, were used to evaluate antifungal activity against rubber tree pathogens. The extracts included mulberry (from root, stem, and fruit), garlic, and senna leaves. Endophytic fungal isolates were cultured on PDA plates and incubated at 25 °C for 7–14 days to allow sufficient spore production. Once a dense spore layer had formed, the upper mycelium was carefully scraped off. To prepare a uniform spore suspension, 1 mL of sterile distilled water was added to the plate, and 200 µL of the resulting suspension was pipetted and evenly spread onto fresh PDA plates using a sterile hockey stick. The suspension was allowed to air dry. For each fungal isolate, two PDA plates were prepared in duplicate. Two wells (6 mm diameter) were created on each plate using a sterile cork borer. For the antifungal assay, 20 µL of plant extract was dispensed into one well on both plates. The other well received 20 µL of either a positive control (fluconazole) or a negative control (methanol or absolute ethanol). All plates were incubated at 25 °C, and the formation of inhibition zones was observed and measured daily to assess antifungal activity.

3. RESULTS AND DISCUSSION

Rubber tree leaves collected from Lakota (Jeli, Kelantan) displayed classic foliar-disease symptoms: dark brown-to-black or yellow patches, circular lesions with necrotic centres, and irregular holes where tissue had abscised. In several cases these lesions coalesced into large, angular necrotic areas, symptomology typical of Corynespora leaf-fall, anthracnose, or Colletotrichum infections. One asymptomatic (healthy) leaf (LH) and four symptomatic leaves (L1–L4) representing young, mature, and old foliage were selected for endophyte isolation (Fig. 1).

Because reliable endophyte isolation hinges on removing surface-dwelling (epiphytic) fungi without harming internal (endophytic) communities, a two-step chemical sterilisation was applied. Ethanol (70%, 1 min) denatures proteins and disrupts microbial membranes, while sodium hypochlorite (NaOCl, 1%, variable immersion) oxidises cell components, providing complementary sterilising actions [11, 12]. Immersion times were optimised with a leaf-imprint assay: Younger leaves (LH, L1) required the shortest exposure because their thinner cuticles allow faster NaOCl penetration; prolonged treatment risks tissue damage and loss of viable endophytes [13, 14, 15]. Conversely, older leaves (L3, L4) needed extended immersion to eliminate more abundant surface contaminants, consistent with reports that epiphytic load increases with leaf age and disease severity [16,17]. The success of surface sterilisation confirmed by the absence of growth on imprint plates ensures that subsequent isolates originate

from true endophytes rather than surface contaminants. This step is therefore critical for downstream screening of endophytic fungi for antifungal metabolites with potential use in rubber-disease management.

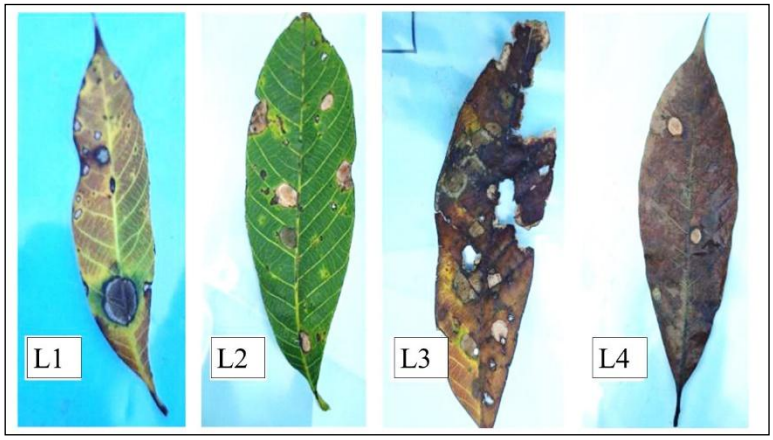

Fig. 1. Healthy and infected rubber tree leaves collected for this study. Infected leaves (L1–L4) show typical disease symptoms such as dark patches, circular lesions, and irregular holes, possibly caused by Corynespora, Colletotrichum, or anthracnose infections.

From the four symptomatic leaf samples (L1–L4), 40 endophytic fungal isolates were initially obtained. Twelve isolates were subsequently discarded because their corresponding leaf-imprint controls showed epiphytic contamination or because their colony morphology duplicated that of known epiphytes and previously recovered endophytes. Table 4.2 summarises imprint outcomes and isolate numbers: The greater isolate diversity in L1 (young leaf) suggests that younger tissues harbour a richer internal mycobiome once surface contaminants are removed, whereas older leaves (L3, L4) yielded fewer viable endophytes possibly because prolonged exposure to pathogens and environmental stressors reduces internal fungal diversity. Plant age, micro-environment, and isolation technique are well-known determinants of endophyte recovery [4, 18].

A total of 25 endophytic fungal strains were selected for morphological observation and were sub-cultured onto PDA media supplemented with chloramphenicol to inhibit bacterial contamination. While microscopic examination was performed, colony morphology remained a primary criterion for initial species recognition. However, relying solely on macroscopic features can complicate accurate identification, as colony morphology may overlap among unrelated species. The isolates exhibited diverse colony colors such as brown, pale pink, grey, orange, red, pale orange, and the most frequently observed white (Table 1).

Table 1. The isolates displayed diverse colony morphologies, characterized by arrange of colours

No.	Isolates	Colony shape	Colony Margin	Colony color	Pigmentation
1	L1S1	Irregular	Entire	White	White
2	L1S2	Stringy	Filiform	Brown, white margin	Brown, white margin
3	L1S3	Circular	Undulate	White	White
4	L1S4	Circular	Entire	White	Pale orange
5	L1S6	Irregular	Curled	White, brown	Brown
6	L1S7	Round with raised margin	Undulate	Pale pink, white margin	Pale pink

7	L1S8	Round with raised margin	Entire	Grey, white margin	White
8	L1S9	Circular	Entire	White	White
9	L1S10	Irregular	Undulate	White	White
10	L2S1	Irregular	Curled	White	White
11	L2S3	Circular	Entire	Red, white margin	Red, white margin
12	L2S4	Round with raise margin	Entire	Pale orange, white margin	Pale orange
13	L2S5	Circular	Entire	White	Black, white margin
14	L2S6	Irregular	Curled	White	White
15	L3S1	Irregular	Slightly lobed	White	Yellow
16	L3S2	Irregular	Undulate	White	Brown, white margin
17	L3S3	Circular	Curled	Grey, White	Grey, white
18	L3S4	Circular	Entire	White	White
19	L3S5	Irregular	Curled	White	White
20	L3S6	Stringy	Entire	White	White
21	L3S7	Irregular	Curled	White, orange margin	Orange
22	L3S8	Irregular	Undulate	White	Slightly brown
23	L4S2	Irregular	Undulate	White	White
24	L4S3	Circular	Entire	White	Red, white margin
25	L4S4	Irregular	Undulate	White	White

Pigmentation generally reflected colony color; however, discrepancies were noted in nine isolates (L1S4, L1S6, L1S7, L1S8, L2S5, L3S1, L3S2, L3S8, and L4S3), indicating possible pigment production within the medium or altered sporulation patterns. Colony shape also varied considerably, with most isolates forming circular or irregular colonies. Some presented raised margins with rounded shapes, while a few exhibited stringy growth patterns, which were the least common. Colony margin types observed included entire, undulate, and curled margins. Less common types, such as filiform (in isolate L1S2) and slightly lobed (in isolate L3S1), suggest greater diversity in morphological structure among the isolates. These findings highlight the morphological diversity of endophytic fungi associated with infected rubber trees, reflecting a complex internal fungal community. Nonetheless, species-level identification based solely on morphology remains limited due to the overlapping features and homoplasy in hypogenous ascomycetes. Morphological identification presents challenges for phylogenetic systematics due to the scarcity of distinguishing features and the evolutionary convergence of traits [10, 19]. Therefore, molecular identification methods are recommended for accurate taxonomic classification.

The antifungal screening revealed that mulberry root extract showed the strongest activity, effectively inhibiting the growth of several endophytic fungi isolated from infected rubber tree leaves. In comparison, the other plant extracts including mulberry stem, fruit, garlic, and Senna leaves showed limited or no antifungal effects. Specifically, isolates L1S4, L1S6, L2S5, L3S2, L3S5, L3S8, L4S1, L4S2, and L2S4 exhibited susceptibility to the mulberry root extract (Table 2). The strong antifungal effect is likely due to bioactive compounds present in the root, such as flavonoids and stilbenoids, which have been shown to inhibit fungal pathogens. Supporting this, a study by Kwon et al., 2019 [7] reported that methanol and ethanol extracts from mulberry

root bark effectively suppressed the growth of *Alternaria alternata* and *Fusarium* species. These findings suggest that mulberry root extract holds promise as a natural antifungal agent.

Table 2. Antifungal activities of isolated endophytic fungi observed through the formation of inhibition zones against five different plant extracts. '–' indicates no visible inhibition zone

Isolates	Plant exract	Diameter of inhibition zone (mm)		
		Positive control	Negative control	Test
L1S4	Mulberry; root	12	-	16
	Mulberry; fruit	10	-	-
L1S6	Mulberry; root	20	-	28
	Senna; leaves	16	-	-
L1S9	Garlic	16	-	12
	Mulberry; stem	28	-	-
L1S10	Mulberry; fruit	26	-	-
L2S5	Mulberry; root	28	-	14
	Mulberry; fruit	16	-	-
	Senna; leaves	12	-	-
L3S2	Mulberry; root	20	-	28
L3S5	Mulberry; root	34	-	31
	Mulberry; stem	16	-	-
L3S8	Mulberry; root	28	-	22
	Senna; leaves	12	-	-
L4S1	Mulberry; root	24	-	12
	Garlic	14	-	-
L4S2	Mulberry; root	40	-	36
	Mulberry; fruit	20	-	-
L4S4	Mulberry; root	22	-	20
	Mulberry; fruit	31	-	-

In contrast, garlic extract showed limited antifungal activity, with only one isolate (L1S9) exhibiting an inhibition zone. The remaining isolates (L1S3, L2S1, L2S6, L3S4, L3S6, and L4S1) did not respond. Variability in garlic's antifungal effectiveness may be attributed to differences in extract concentration, fungal species tested, or the extraction solvent used [20]. Senna leaves extract and mulberry stem and fruit extracts failed to inhibit any of the tested endophytic fungi. These results align with findings by Ezemba et al., 2021 [21], who observed that ethanol and methanol extracts of *Senna alata* leaves showed no antifungal activity against *Trichophyton mentagrophytes* and *Trichophyton verrucosum* at various concentrations. The lack of inhibitory effect was attributed to the absence of critical antifungal phytochemicals such as tannins and alkaloids or potential resistance of the fungal species to the extract. Interestingly, changes in fungal colony morphology were observed after exposure to certain extracts. Changes in colony color and texture may reflect fungal stress responses caused by antifungal exposure. These compounds can disrupt the cell wall and membrane, resulting in visible morphological alterations during treatment [22, 23].

4. CONCLUSION

This study highlights the potential of mulberry root extract as a natural antifungal agent for managing rubber tree diseases. Among the five tested plant extracts, only mulberry root and, to a lesser extent, garlic extract exhibited antifungal activity, forming clear inhibition zones against several endophytic fungal isolates. Mulberry root extract inhibited 9 isolates, likely due to bioactive root-derived secondary metabolites such as flavonoids and stilbenoids known to affect fungal pathogens like *Alternaria* and *Fusarium*. Garlic extract demonstrated limited, isolate-specific inhibition, while mulberry stem, fruit, and Senna leaves showed no antifungal effects at the tested concentrations. Overall, these findings emphasize the importance of selecting effective plant parts in antifungal screening and suggest that mulberry root extract holds promise as part of an integrated approach to rubber tree disease management.

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REFERENCES

[1] S. A. S. Sagaff, N. S. Ali, M. M. Mahyudin, M. Y. Wong, and M. R. Yusop, "Emerging and Existing Major Leaf Diseases of *Hevea brasiliensis* in Malaysia," Journal of Current Opinion in Crop Science, vol. 3, no. 1, pp. 34–47, Mar. 2022, Available: https://www.jcocs.com/index.php/ej/article/view/129

[2] M. M. Mahyudin, A. S. Noran, M. Z. H. Ismail, and K. Ahmad, "Chapter 18 - Diseases of rubber trees: Malaysia as a case study," ScienceDirect, Jan. 01, 2023. https://www.sciencedirect.com/science/article/abs/pii/B9780443186943000171

[3] B. Alam et al., "Endophytic Fungi: From Symbiosis to Secondary Metabolite Communications or Vice Versa?" Frontiers in Plant Science, vol. 12, Dec. 2021, doi:https://doi.org/10.3389/fpls.2021.791033

[4] Akram et al., "Uniting the Role of Endophytic Fungi against Plant Pathogens and Their Interaction," Journal of Fungi, vol. 9, no. 1, p. 72, Jan. 2023, doi:https://doi.org/10.3390/jof9010072

[5] D. B. Collinge, D. F. Jensen, M. Rabiey, S. Sarrocco, M. W. Shaw, and R. Shaw, "Biological Control of Plant Diseases – What Has Been Achieved and What Is The Direction?" Plant Pathology, vol. 71, no. 5, Mar. 2022, doi:https://doi.org/10.1111/ppa.13555

[6] L. F. Tan et al., "Plant as an Alternative Source of Antifungals against *Aspergillus* Infections: A Review," Plants, vol. 11, no. 22, p. 3009, Nov. 2022, doi: https://doi.org/10.3390/plants11223009

[7] O-Chul. Kwon, W.-T. Ju, H.-B. Kim, and K. Y. Soon, "Antifungal activities of extracts from different parts of mulberry plant against *Alternaria alternata* and *Fusarium sp*.," International Journal of Industrial Entomology and Biomaterials, vol. 38, no. 1, pp. 6–13, 2019, Accessed: Jun. 29, 2025. [Online]. Available https://www.kci.go.kr/kciportal/ci/sereArticleSearch/ciSereArtiView.kci?sereArticleSearchBean.artiId=ART002449590

[8] A. B. K. Daniel Danladi, Aisha Haruna Musa, "Antifungal Activity of Garlic (*Allium sativum*) Extract on Some Selected Fungi," Journal of Medicinal Herbs and Ethnomedicine, pp. 12–14, Jan. 1970, doi: https://doi.org/10.25081/jmhe.2018.v4.3383

[9] F. Guerra, A. Adil Ansari, R. Kurup , and G. Subramanian, "Antifungal Activity of *Senna alata, Senna bicapsularis* and *Pityrogramma calomelanos*," Sep. 04, 2020. 10.9734/jocamr/2020/v10i330164

[10] S. N. Maadon et al., "Isolation and Identification of Endophytic Fungi from UiTM Reserve Forest, Negeri Sembilan," Sains Malaysiana, vol. 47, no. 12, pp. 3025–3030, Dec. 2018, doi: https://doi.org/10.17576/jsm-2018-4712-12

[11] OB Oyebanji et al., "Simple, Effective and Economical Explant-Surface Sterilization Protocol for Cowpea, Rice and Sorghum Seeds," African Journal of Biotechnology, vol. 8, no. 20, 2019, Accessed: Jun. 29, 2025. [Online]. Available: https://www.ajol.info/index.php/ajb/article/view/65980/0

[12] M. Tao et al., "Sterilization and Disinfection Methods for Decellularized Matrix Materials: Review, consideration and proposal," Bioactive Materials, vol. 6, no. 9, pp. 2927–2945, Sep. 2021, doi: https://doi.org/10.1016/j.bioactmat.2021.02.010

[13] G. Strobel and B. Daisy, "Bioprospecting for Microbial Endophytes and Their Natural Products," Microbiology and Molecular Biology Reviews, vol. 67, no. 4, pp. 491–502, Dec. 2003, doi: https://doi.org/10.1128/mmbr.67.4.491-502.2003

[14] Y. Yu, Z. Chen, H. Xie, X. Feng, Y. Wang, and P. Xu, "Overhauling the Effect of Surface Sterilization on Analysis of Endophytes in Tea Plants," Frontiers in Plant Science, vol. 13, May 2022, doi: https://doi.org/10.3389/fpls.2022.849658

[15] P. K. Sahu et al., "Surface Sterilization for Isolation of Endophytes: Ensuring What (not) to Grow," Journal of Basic Microbiology, vol. 62, no. 6, Jan. 2022, doi: https://doi.org/10.1002/jobm.202100462

[16] L. Shujiang, P. Yan, Zhu Tianhui, Zhu Hanmingyue, M. Cui, and Qiao Tianmin, "Diversity of Epiphytic Fungi on the Diseased and Healthy Leaves of Bambusa," African Journal of Microbiology Research, vol. 6, no. 49, pp. 7556–7563, Dec. 2012, doi: https://doi.org/10.5897/ajmr12.1543

[17] S. Park, B. Szonyi, R. Gautam, K. Nightingale, J. Anciso, And R. Ivanek, "Risk Factors for Microbial Contamination in Fruits and Vegetables at the Preharvest Level: A Systematic Review," Journal of Food Protection, vol. 75, no. 11, pp. 2055–2081, Nov. 2012, doi: https://doi.org/10.4315/0362-028x.jfp-12-160

[18] D. Fitriarni and R. S. Kasiamdari, "Isolation and Identification of Endophytic Fungi from Leave and Stem of *Calopogonium mucunoides*," Journal of Tropical Biodiversity and Biotechnology, vol. 3, no. 1, p. 30, Apr. 2018, doi: https://doi.org/10.22146/jtbb.32477

[19] R. Lücking et al., "Unambiguous Identification of Fungi: Where Do We Stand and How Accurate and Precise Is Fungal DNA Barcoding?," IMA Fungus, vol. 11, no. 1, Jul. 2020, doi: https://doi.org/10.1186/s43008-020-00033-z

[20] David Fernando Carreón-Delgado, Itzel Yoali Hernández-Montesinos, Karla Nallely Rivera-Hernández, D. Sugeyrol, Carlos Enrique Ochoa-Velasco, and C. Ramírez-López, "Evaluation of Pretreatments and Extraction Conditions on the Antifungal and Antioxidant Effects of Garlic (*Allium sativum*) Peel Extracts," Plants, vol. 12, no. 1, pp. 217–217, Jan. 2023, doi: https://doi.org/10.3390/plants12010217

[21] C. C. Ezemba, "The Antifungal Activity of *Senna alata* Leaf Extract on Dermatophytes," Ssrn.com, 2021. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4085591 (accessed Jun. 29, 2025)

[22] M. Sanguinetti and B. Posteraro, "Susceptibility Testing of Fungi to Antifungal Drugs," Journal of Fungi, vol. 4, no. 3, p. 110, Sep. 2018, doi: https://doi.org/10.3390/jof4030110

[23] "Pharmacological Research - Modern Chinese Medicine, Vol 7, June 2023, ScienceDirect.com by Elsevier," Sciencedirect.com, 2023. https://www.sciencedirect.com/journal/pharmacological-research-modern-chinese-medicine/vol/7/suppl/C (accessed Jun. 29, 2025).