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ANTI- DERMATOPHYTIC Activity of *Codiaeum variegatum* (L.) Rumph ex A. Juss and *Byrsocarpus coccineus* Schum. and Thonn. LEAF EXTRACT

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Abstract*—Dermatophytic infections remain a major public health concern, particularly in tropical and subtropical regions, due to increasing resistance, cost, and adverse effects associated with conventional antifungal agents. This study evaluated the in vitro antidermatophytic activity of ethanol leaf extracts of Codiaeum variegatum and Byrsocarpus coccineus against selected dermatophytes. The antifungal activity was assessed using the agar well diffusion method against Microsporum canis, Trichophyton rubrum, and Epidermophyton floccosum at concentrations of 50, 25, and 12.5 mg/ml. Chloramphenicol (5 mg/ml) served as the positive control. The ethanol extract of C. variegatum exhibited marked antidermatophytic activity against all test organisms, with M. canis showing the highest susceptibility. Zones of inhibition ranged from 18 to 60 mm, with notable activity observed at lower extract concentrations. The leaf extract of B. coccineus also demonstrated appreciable antifungal activity, although with comparatively lower inhibitory effects. Its highest zones of inhibition was recorded against E. floccosum at 12.5 mg/ml (40 mm). The observed antifungal activities are attributed to the presence of bioactive phytoconstituents such as flavonoids, tannins, saponins, and phenolic compounds. These findings support the ethnomedicinal use of both plants in the management of fungal skin infections and highlight their potential as sources of novel antidermatophytic agents.

Keywords*— Codiaeum Variegatum; Byrsocarpus Coccineus; Dermatophytes; Antidermatophytic Activity; Medicinal Plants; Antifungal Agents.

I. INTRODUCTION

Dermatophytosis represents a group of superficial fungal infections caused by keratinophilic fungi (dermatophytes) that colonize keratinized tissues including skin, hair, and nails, leading to conditions such as tinea pedis, tinea corporis, tinea capitis, and onychomycosis (Gupta & Singh, 2020). These infections are among the most prevalent mycotic diseases worldwide, with significant morbidity and impact on quality of life, particularly in tropical and subtropical regions where humidity favors pathogen growth and transmission (Bhatia & Kalele, 2024). Conventional antifungal therapies, while effective, are associated with limitations such as variable efficacy, cost, potential side effects, and increasing reports of treatment failure and resistance, prompting continued interest in alternative antifungal agents derived from medicinal plants (Denning & Bromley, 2015; Singh & Verma, 2025).

Medicinal plants are rich sources of bioactive phytochemicals including phenolics, flavonoids, terpenoids, and alkaloids, many of which demonstrate antimicrobial properties against dermatophytic fungi in vitro (Ahmad *et al.,* 2019). Several investigations have reported that leaf extracts of traditional medicinal plants such as *Aegle marmelos* and *Azadirachta indica* inhibit the growth of common dermatophytes including *Trichophyton* and *Microsporum* species, highlighting the potential of plant-derived compounds as alternative or complementary antifungal agents (Shambel *et al*., 2020; Verma & Singal, 2023).

Codiaeum variegatum (L.) Rumph. ex A. Juss., commonly referred to as garden croton, is a species in the family Euphorbiaceae. While primarily known as an ornamental plant, ethnobotanical surveys indicate that various cultivars of *C. variegatum* have been used in traditional medicine for the treatment of external wounds and skin infections. Its leaves contain diverse phytochemicals including alkaloids, terpenoids, and phenolic compounds with reported antimicrobial and anti-inflammatory properties (Olajide *et al*., 2021). These bioactive constituents suggest that *C. variegatum* leaf extracts may harbor antifungal activity that has not yet been systematically evaluated against dermatophytic pathogens.

Byrsocarpus coccineus Schum. and Thonn. (Connaraceae) is another medicinal plant traditionally utilized across West Africa for management of various ailments, including bacterial and fungal infections. Pharmacognostic studies documented the presence of flavonoids, tannins, and other secondary metabolites in its leaf and root extracts (Ajaiyeoba *et al*., 2020). Given the increasing need for novel antifungal agents and the rich phytochemical profiles of *C. variegatum* and *B. coccineus*, this study evaluated i*n vitro* anti-dermatophytic activity of *C. variegatum* and *B. coccineus* ethanol leaves extracts against *M. canis*, *T. rubrum*, and *E. floccosum* isolates.

II. MATERIALS AND METHODS

Collection of Plant Materials

The matured fresh leaves of *B. coccineus,* and *C. variegatum* were collected, identified and authenticated by Dr. O. A. Obembe, the taxonomist, at the Department of Plant Science and Biotechnology, Adekunle Ajasin University, Akungba-Akoko, Ondo State, Nigeria. The plants voucher specimen designated as PSBH-262 for *B. coccineus* and PSBH-243 for *C. variegatum* were deposited at the Departmental herbarium for future reference.

Preparation of Plants' Extracts

The leaves were dried and pulverized with a mechanical blender and macerated in ethanol separately. Each mixture was shaken for seven days, filtered through muslin cloth and the filtrates were concentrated to dryness. The dried extracts were maintained in tightly closed containers until used for the experiment.

Collection and Identification of Test Organisms

Fungal isolates were obtained from the stock of Microbiology laboratory of Adekunle Ajasin University, Akungba. The test organisms used for the study were *Microsporum canis*, *Trichophyton rubrum*, and *Epidermophyton floccosum.* Potato dextrose agar slant was prepared by dissolving appropriate amount of Potato dextrose agar in sterile distilled water (39 g per 1000 litres). The medium was homogenized on an electric hot plate and was distributed (10 ml each) into cleaned McCartney bottles. The bottles containing the medium were sterilized in the autoclave for 15 minutes. The bottles were placed in a slant position on the workbench and left to solidify. Using inoculating loop, colonies were picked from the stock and streaked on the surface of the fresh slant.

Preparation and standardization of inoculum

Active cultures for antifungal assay were prepared by sub-culturing into potato dextrose broth. The broth was prepared by dissolving potato dextrose broth medium (13.65 g) in distilled water (350 ml) after which 5 ml of chloramphenicol was added to suppress the growth of bacteria. The medium was distributed into test tubes (5 ml) and sterilized in the autoclave. After cooling, colonies from the potato dextrose agar slant were picked and inoculated into the sterile broth. The inoculated tubes were incubated at 25^{o}C for 48 hours. The broth culture was diluted with sterile normal saline to 0.5 McFarland turbidity standard. The standardized inoculum was used within 15 minutes of preparation.

Antifungal assay of *B. coccineus* and *C. variegatum* ethanol extracts

The antifungal screening of *B. coccineus* and *C. variegatum* extracts against the *M. canis, T. rubrum, and E. floccosum* isolates was carried out using the modified agar well diffusion method (Balouiri *et al*., 2016). Potato dextrose agar was prepared according to the manufacturer's instructions (39 g per 1000 ml). The medium was homogeinized on a hot plate and sterilized in the autoclave. After cooling to 45^{o}C, the agar was poured into sterile petri dish and left on the workbench until it solidified. A stock concentration of 100 mg/ml was constituted by dissolving 1 g of extract in 10 ml mixture of 30% dimethylsulfoxide (DMSO) and distilled water (1:3). Two-fold serial dilution of the stock was done to obtain varying concentrations of 50, 25 and 12.5 mg/ml of the extract. Two milliliter of the 100 mg/ml concentration of the extract was diluted with equal volume of distilled water to obtain 50 mg/ml concentration of the extract. Also, 2 ml from the 50 mg/ml concentration was diluted with equal volume of sterile distilled water to obtain 25 mg/ml concentration. This was repeated to obtain 12.5 mg/ml concentration. The standardized inoculum was introduced on the potato dextrose agar by swabbing the entire surface of the plate with sterile swab moistened with the fungal suspension. Wells were carefully created on the agar plate (at least 20 mm apart) with sterile cork borer (6 mm in diameter) without distorting the media. Each concentration of the extract (50 µl) and the controls were introduced

into each well and was left on the table to settle. The potato dextrose agar plate was incubated at 25° C for 48 hours and the diameter of zone of inhibition was measured. A potent antifungal (Chloramphenicol; 5 mg/ml) and dimethylsulfoxide (DMSO) were used as positive and negative controls, respectively.

III. RESULTS

The anti-dermatophytic activity of ethanol leaves extracts of *C. variegatum* and *B. coccineus* against *M. canis*, *T. rubrum*, and *E. floccosum* is presented in Tables 1 and 2.

Anti-dermatophytic activity of *C. variegatum* ethanol extract

The ethanol extract of *C. variegatum* demonstrated strong antifungal activity against all the tested dermatophytes, with inhibition zones increasing as extract concentration decreased (Table 1). Against *M. canis*, inhibition zones of 45, 55, and 60 mm were observed at 50, 25, and 12.5 mg/mL, respectively. The inhibition at 12.5 mg/mL was comparable to that of the standard drug, chloramphenicol (60 mm), indicating high susceptibility of *M. canis* to the extract. For *T. rubrum*, the extract produced zones of inhibition of 30 mm at 50 mg/mL, 40 mm at 25 mg/mL, and 48 mm at 12.5 mg/mL, compared with 55 mm for the standard drug, chloramphenicol. Although slightly lower than the standard drug, the extract showed substantial antifungal activity. Similarly, *E. floccosum* showed inhibition zones of 18, 25, and 43 mm at 50, 25, and 12.5 mg/mL, respectively, relative to 60 mm for chloramphenicol. The extract was therefore active against *E. floccosum*, particularly at lower concentrations.

Anti-dermatophytic activity of *B. coccineus* ethanol extract

The ethanol leaf extract of *B. coccineus* also exhibited antifungal activity against all tested dermatophytes (Table 2). For *M. canis*, inhibition zones of 12, 30, and 35 mm were recorded at 50, 25, and 12.5 mg/mL, respectively, compared with 60 mm for the standard drug, chloramphenicol. Against *T. rubrum*, the extract produced inhibition zones of 15 mm at 50 mg/mL, 25 mm at 25 mg/mL, and 33 mm at 12.5 mg/mL, while the control, chloramphenicol produced 55 mm. The extract showed moderate activity, with improved inhibition at lower concentrations. For *E. floccosum*, inhibition zones of 10, 22, and 40 mm were recorded at 50, 25, and 12.5 mg/mL, respectively, compared with 65 mm for chloramphenicol. This indicates that *E. floccosum* was the most susceptible dermatophyte to *B. coccineus* extract.

Table 1: Anti-Dermatophytic Activity of *Codiaeum variegatum* Ethanol Extract

Micro Organism	Zone of inhibition(mm)			Control
	(50 mg/ml)	(25 mg/ml)	(12.5 mg/ml)	
M. canis	45	55	60	60
T. rubrum	30	40	48	55
E. floccosum	18	25	43	60

NOTE: Control (chloramphenicol, 5 mg/ml)

Table 2: Anti-fungal activity of *Brysocarpus coccineus* Schumach and Thonn. extract

Micro organisms	Zone of inhibition			Control
	(50 mg/ml)	(25 mg/ml)	(12.5 mg/ml)	
M. canis	12	30	35	60
T. rubrum	15	25	33	55
E. floccosum	10	22	40	65

Note: Control (Chloramphenicol, 5 mg/ml)

IV. DISCUSSIONS

The present study demonstrates that the ethanol leaf extract of *C. variegatum* exhibits pronounced antidermatophytic activity against *M. canis*, *T. rubrum*, and *E. floccosum*, while *B. coccineus* also showed appreciable antifungal activity against the tested dermatophytes. Dermatophytes are the primary etiological agents of superficial mycoses, and the increasing incidence of resistance and adverse effects associated with conventional antifungal drugs has renewed interest in plant-derived alternatives. Results from Table 1 indicate that *C. variegatum* extract produced substantial zones of inhibition against all tested organisms, with *M. canis* showing the highest susceptibility. Notably, inhibition zones increased as extract concentration decreased, with the highest activity observed at 12.5 mg/ml. This inverse dose–response pattern, though atypical, may reflect improved diffusion of active low-molecular-weight compounds at lower concentrations or reduced antagonistic interactions among phytoconstituents at higher doses. Comparable observations have been documented in plant-based antifungal assays where concentration-dependent diffusion dynamics influenced inhibition zones (Balouiri *et al*., 2016). Among the dermatophytes, *T. rubrum* and *E. floccosum* exhibited moderate to strong sensitivity to *C. variegatum*, although their inhibition zones were consistently lower than those of the standard antifungal agent, chloramphenicol. This finding suggests that while the extract may not surpass conventional drugs in potency, it demonstrates significant intrinsic antifungal activity worthy of further investigation. The antifungal potential of *C. variegatum* has been attributed to its rich phytochemical profile, including flavonoids, tannins, saponins, terpenoids, and phenolic compounds, many of which are known to disrupt fungal cell walls, interfere with ergosterol synthesis, and impair membrane integrity (Sofowora *et al*., 2013; Cowan, 1999).

The antifungal activity observed for *B. coccineus* leaf extract (Table 2) further supports its ethnomedicinal relevance. *B. coccineus* is widely used in African traditional medicine for the treatment of skin infections, wounds, and inflammatory conditions. Previous studies have reported antimicrobial and antifungal activities of *B. coccineus*, which have been linked to the presence of bioactive compounds such as alkaloids, glycosides, tannins, and phenolics (Adebayo & Ishola, 2009; Ajibesin *et al*., 2008). Although, the zones of inhibition varied among test organisms and concentrations, the extract demonstrated measurable inhibitory effects, indicating broad-spectrum antifungal potential.

Comparatively, *C. variegatum* showed stronger and more consistent activity against the dermatophytes tested than *B. coccineus*, particularly against *M. canis*. This variation in efficacy may be attributed to differences in phytochemical composition, extract solubility, and the specific susceptibility of fungal species. Dermatophytes are known to differ in cell wall composition and enzymatic machinery, which can influence their response to antifungal agents (Weitzman & Summerbell, 1995).

V. CONCLUSION

Overall, the findings of this study corroborate earlier reports on the antifungal efficacy of medicinal plants and reinforce the potential of *C. variegatum* and *B. coccineus* as sources of novel antidermatophytic agents. The results demonstrated that both plant extracts possess measurable antifungal properties, with activity varying according to concentration and fungal species. Importantly, *C. variegatum* extract showed consistently higher inhibitory effects compared to *B. coccineus* extract achieving near-complete suppression of *M. canis* even at lower concentrations, while maintaining strong activity against *T. rubrum and E. floccosum*.

Further studies are recommended to isolate and characterize the active compounds, determine minimum inhibitory and fungicidal concentrations, assess toxicity and safety profiles, and evaluate in vivo efficacy. Such investigations will be critical in advancing these plants from preliminary laboratory evaluation to potential clinical application.

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