جامعة عبد المالك السعدي
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Université Abdelmalek Essaadi

Pole for Doctoral Studies
Center for Doctoral Studies Sciences and Techniques and Medical Sciences

ANNOUNCEMENT OF DOCTORAL THESIS DEFENSE

Ms. AHAIK Islam

Will present their research work with the aim of earning a Doctorate

Doctoral program: Biology, Chemistry, and Geology
Discipline: Biology
Specialty: Microbiology and Molecular biology

On 13/06/2026 at 10H00 at the Thesis Defense Hall of the Faculty of Sciences of Tetouan, UAE
Under the Theme

Phenotypic and molecular characterization of Candida spp. and evaluation of essential oils as alternative antifungal agents : effects on growth, virulence factors, and interactions with reference antifungal drugs

Front of the jury composed of :

First Name & Last Name	Establishment	Designation
Pr. EL LAGHDACH Anas	FS of Tetouan, UAE	President
Pr. KHAY El Ouardy	FS of Tetouan, UAE	Reviewer
Pr. MEZZOUG Nadya	FS of Tetouan, UAE	Reviewer
Pr. MISBAHI Houriya	FST of Fez, USMBA	Reviewer
Pr. ABRINI Jamal	FS of Tetouan, UAE	Examiner
Pr. ERRABII Tomader	FS of Tetouan, UAE	Examiner
Pr. GABALDÓN Toni	IRB Barcelona, Spain	Co-supervisor
Pr. BOUHDID Samira	FS of Tetouan, UAE	Supervisor

Host Research Structure: UAE/U01FS Biotechnology and Applied Microbiology Team, Laboratory of Applied Chemistry and Microbiology and Biotechnology, FS, Abdelmalek Essaadi University, Tetouan, Morocco

Abstract

Candida infections are an emerging global health problem, with five species currently recognized by the World Health Organization as critical and high-priority pathogens. Restricted antifungal options, rising resistance and limited surveillance pose major therapeutic challenges and highlight the need for new approaches. In this context, essential oils (EOs) have attracted attention due to their chemical diversity and broad antifungal activity. Our study examined ninety-three (93) clinical *Candida* isolates, combining both phenotypic and molecular methods for species identification. Susceptibility profiling of these strains was performed for fluconazole (FLZ) and anidulafungin (ANI).

C. albicans was the most common species (64.52%), followed by *C. glabrata* (15.05%), *C. parapsilosis* (6.45%), and *C. tropicalis* (4.30%), with *C. metapsilosis* detected for the first time in Morocco. FLZ MICs near resistance thresholds were observed in *C. albicans* (2) and *C. glabrata* (1), while ANI resistance occurred in *C. albicans* (1), *C. tropicalis* (1), and *C. krusei* (2). We further analyzed the chemical composition and antifungal activity of cinnamon, thyme and clove EOs against eighteen *Candida* strains representing nine species, including multidrug-resistant (MDR) strains. GC-MS analysis identified cinnamaldehyde, thymol and eugenol as the dominant constituents of cinnamon, thyme and clove EOs, respectively, each exceeding 70% in relative abundance. Antifungal susceptibility testing showed that all EOs were active, with cinnamon and thyme being the most potent. These two oils exhibited enhanced activity against MDR *C. glabrata* and *C. parapsilosis* compared to their susceptible counterparts. Cinnamon EO displayed particularly low MICs against all five clades of *C. auris* (0.002-0.008% v/v). Virulence assays revealed that cinnamon EO reduced germ tube formation in *C. albicans* from 97% to 12% at MIC/2, while thyme EO completely inhibited germ tube formation and supressed protease production in *C. auris* clades II and III. Interactions between EOs and antifungal drugs varied across non-*albicans Candida* species and depended on both the combination tested and the analytical approach.

FLZ combinations showed mainly weak to antagonistic effects by Bliss analysis, with FLZ-CEO giving the lowest score (-10.32), while FICI suggested occasional synergy, particularly for ANI-CEO and AMB-TEO in *C. auris* clade I (FICI = 0.5). The MDR *C. glabrata* derivative responded more favourably to FLZ-TEO than its parental strain (Bliss 3.71 vs -2.39), suggesting a possible link between resistance and interaction outcomes. Overall, these findings highlight EOs as potential antifungal agents against *Candida* species.

Keywords: *Candida*, essential oil, antifungal resistance, virulence, combination therapy.