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Evaluation of the in Vitro Antifungal Resistance of Candida Spp. Isolated from Vulvovaginal Candidiasis in Women at Tan Tao University Hospital, Vietnam

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Abstract: Objective: To evaluate the in vitro antifungal susceptibility and resistance patterns of Candida spp. isolated from women with vulvovaginal candidiasis at Tan Tao University Hospital, Vietnam in 2024. Methods: A cross-sectional study was conducted on 270 women clinically diagnosed with vaginitis. Vaginal discharge samples were examined by direct wet mount, cultured on Sabouraud Dextrose Chloramphenicol Agar, and species identification was performed using real-time PCR. Antifungal susceptibility testing was carried out by broth microdilution and disk diffusion methods according to CLSI guidelines (M27-A3, M60). Tested antifungal agents included amphotericin B, micafungin, caspofungin, ketoconazole, miconazole, itraconazole, fluconazole, posaconazole, voriconazole and nystatin. Results: Among the 43 isolates, Candida albicans was the predominant species (72.1%), followed by C. parapsilosis (25.6%), C. glabrata (16.2%) and C. tropicalis (2.3%). The isolates exhibited high susceptibility to most tested antifungal agents. Sensitivity rates were 100% for micafungin, caspofungin, posaconazole, and nystatin; 97.67% for amphotericin B and voriconazole; 95.35% for itraconazole; 93.02% for fluconazole; 88.37% for ketoconazole; and 81.49% for miconazole. Conclusion: The study indicates an increasing trend of antifungal resistance, particularly among azole agents. Routine species identification and antifungal susceptibility testing are essential for optimizing treatment regimens and reducing the risk of therapeutic failure.

Keywords: *Candida* spp., antifungal resistance, azole, *in vitro* testing, vulvovaginal candidiasis.

INTRODUCTION

Vaginitis is a common gynecological condition in women, particularly among those of reproductive age. It is estimated that approximately 75% of women experience at least one episode during their lifetime [Sobel, J. D. 2007]. Although the disease rarely causes life-threatening complications, it can significantly affect reproductive health and quality of life, leading to persistent pruritus, burning sensation, discomfort, and difficulties in daily activities and work.

Previous studies have reported that *Candida albicans* accounts for approximately 85–90% of vulvovaginal candidiasis cases [Makanjuola, O. *et al*., 2018]. However, in recent years, an increasing prevalence of non-*albicans Candida* (NAC) species, such as *Candida glabrata*, *Candida krusei*, *Candida tropicalis*, and *Candida parapsilosis*, has been documented [3]. Notably, these NAC species often exhibit higher levels of antifungal resistance compared with *C. albicans*, particularly to azole antifungal agents, which are widely used in current therapeutic regimens [Anh, N. T. *et al*., 2023]. This trend may increase the risk of treatment failure and disease recurrence.

While several studies conducted in major cities and provinces in Vietnam have investigated vulvovaginal candidiasis caused by *Candida* spp., including species distribution and antifungal susceptibility patterns, data from smaller districts remain limited. To date, we have identified only one study conducted by Nguyen Thi Kim Tuyet in Tan Thanh District, Long An Province (2018) [Tuyet, N. T. K. 2018]. Therefore, updating epidemiological data from larger healthcare facilities within the province is essential to better understand the local antifungal resistance patterns.

Based on this context, the present study aimed to evaluate the in vitro antifungal susceptibility of *Candida* spp. isolated from women with vaginitis at Tan Tao University Hospital, Vietnam in 2024. The findings of this study are expected to provide valuable evidence to support clinicians in optimizing antifungal treatment regimens, thereby improving reproductive health care outcomes for women in Long An Province**.**

MATERIALS AND METHODS

Study population

The study population consisted of women attending the Department of Obstetrics and Gynecology at Tan Tao University Hospital during the study period who were clinically diagnosed with vaginitis.

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Inclusion criteria:
Women aged 18–49 years who were married or sexually active, agreed to participate in the study, and presented with clinical manifestations suggestive of vaginitis. Participants were included if they had at least one of the following symptoms: abnormal vaginal discharge (thick, white, resembling curd-like milk), pruritus accompanied by burning sensation in the vulva/vagina, or dyspareunia.

Exclusion criteria:
Pregnant women or those suspected of being pregnant; women who were menstruating or presenting with vaginal bleeding at the time of examination; those who had used antifungal medications (oral or intravaginal) within the previous 2–6 weeks; those who had engaged in sexual intercourse or performed vaginal douching prior to the clinical visit; and individuals with severe mental disorders or communication impairments (e.g., mutism or deafness).

Study site and duration
The study was conducted at two institutions:
-Sample collection and initial laboratory examinations were performed at the Department of Obstetrics and Gynecology and the Clinical Laboratory Department, Tan Tao University Hospital, Duc Hoa Commune, Tay Ninh Province, Vietnam.

- Species identification of *Candida* spp. using real-time PCR and antifungal susceptibility testing were carried out at the Department of Medical Parasitology, Pham Ngoc Thach University of Medicine.
The study was conducted from June 2024 to September 2024.

Study design and sample size
This was a cross-sectional descriptive study. Clinical and demographic information was collected using a standardized questionnaire. Vaginal specimens were obtained using sterile swabs and transported to the laboratory within 48 hours for microbiological analysis.

The sample size was calculated using the following formula:

$$n = \frac{Z^2_{\left(1-\frac{\alpha}{2}\right)} p(1-p)}{d^2}$$

- n: minimum required sample size
- α: level of statistical significance (α = 0.05)
- $Z_{(1-\frac{\alpha}{2})}$: confidence coefficient (for a 95% confidence level, Z = 1.96)
- d: margin of error (d = 0.05)

The expected prevalence (p) was set at 0.227, corresponding to the prevalence of vulvovaginal candidiasis among women attending Can Tho Central General Hospital during 2022–2023 [Ni, N. T. B. *et al*., 2023].

Applying these parameters to the formula yielded a minimum sample size of 269.3 participants. In practice, 270 women who met the inclusion criteria were recruited and investigated in this study.

A convenience sampling method was applied, and participants were consecutively enrolled during the study period until the required sample size was reached.

Laboratory procedures
Direct microscopic examination: Fresh wet mount microscopy was performed using Lactophenol Cotton Blue to detect yeast cells and pseudohyphae of fungi in vaginal specimens.

Fungal culture: Specimens were cultured on Sabouraud Dextrose Chloramphenicol Agar (SDCA) (BIOKAR Diagnostics). Briefly, 2 mL of sterile 0.9% NaCl solution was added to the specimen and mixed thoroughly to obtain a suspension. A sterile cotton swab was then dipped into the suspension and streaked onto SDCA agar plates. The cultures were incubated at 35°C for 24–48 hours, after which colony growth was recorded.

- Positive culture: yeast colonies growing along the inoculation streak.
- Negative or invalid culture: filamentous fungal growth, colonies not following the inoculation streak, or no growth.

Species identification:
Identification of *Candida* species was performed using multiplex real-time PCR. A result was considered positive when amplification with specific primers was detected with a cycle threshold (Ct) value < 25.

Genomic DNA was extracted using the Top Pure Genomic DNA Extraction Kit, and amplification was carried out using the Applied Biosystems 7500 Real-Time PCR System for detection and quantification of *Candida* species.

DNA extraction
Genomic DNA of *Candida* isolates was extracted using the silica membrane-based method with the

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Top Pure Genomic DNA Extraction Kit (ABT Biological Solution Company Limited, Vietnam).

Briefly, 25 mL of absolute ethanol (96–100%) was added to the bottles containing buffer AW1 and AW2 according to the manufacturer's instructions. Five fungal colonies were transferred into a 1.5 mL microcentrifuge tube, followed by the addition of 180 µL ATL buffer and 20 µL Proteinase K. The mixture was thoroughly vortexed and incubated in a thermomixer at 56°C with shaking at 900 rpm for 5–6 hours to achieve complete cell lysis.

Subsequently, 200 µL AL buffer and 200 µL absolute ethanol were added to the tube and mixed thoroughly. The mixture was incubated at room temperature for 5 minutes, briefly centrifuged, and transferred to a Top Pure silica spin column, allowing DNA to bind to the membrane.

The column was sequentially washed with AW1 and AW2 buffers, followed by high-speed centrifugation to remove impurities and residual ethanol. Finally, DNA was eluted using AE buffer, and the eluate containing purified genomic DNA was collected for downstream PCR analysis.

Real-time PCR assay

Real-time PCR reactions were performed simultaneously with a positive control and a negative control (sterile water) in each run.

Multiplex real-time PCR reaction mixture (total volume: 25 µL):

Component	**Volume (per reaction)**
DNA template	4 µL
ABgene Master Mix	12.5 µL
Can F	0.5 µL
Can R	0.5 µL
Can dub probe (TEXAS RED)	0.5 µL
Can 1F	0.5 µL
Can 1R	0.5 µL
C. albicans probe (CY3)	0.5 µL
C. tropicalis probe (CY5)	0.5 µL
C. parapsilosis probe (ROX)	0.5 µL
Nuclease-free water	4.5 µL
Total volume	25 µL

Two multiplex reaction panels were used:
- Reaction panel 1: detection of *Candida albicans*, *Candida tropicalis*, *Candida parapsilosis*, and *Candida dubliniensis*.
- Reaction panel 2: detection of *Candida glabrata*, *Candida krusei*, *Candida orthopsilosis*, and *Candida auris*.

In vitro antifungal susceptibility testing

Each antifungal agent was evaluated using a single standardized method only (either minimum inhibitory concentration determination or disk diffusion), depending on the antifungal category, in order to avoid data overlap or methodological bias.

Broth microdilution method (MIC determination): The antifungal susceptibility of *Candida* spp. isolates was determined using the broth microdilution method according to the CLSI M27-A3 guidelines to determine the minimum inhibitory concentration (MIC) of antifungal agents.

Pure fungal colonies grown on Sabouraud Dextrose Agar (SDA) at 37°C for 24–48 hours were used to prepare a standardized fungal suspension equivalent to 0.5 McFarland, which was subsequently diluted to obtain a final inoculum density of 1–5 × 10^3 CFU/mL.

Testing was performed using the AST-FUNGI microdilution kit (Nam Khoa Biotek) containing predefined concentrations of antifungal agents, including: Amphotericin B: 1 µg/mL, Micafungin: 2 µg/mL, Caspofungin: 0.25 µg/mL and 1 µg/mL, Itraconazole: 0.12 µg/mL and 1 µg/mL, Ketoconazole: 0.12 µg/mL and 0.5 µg/mL, Fluconazole: 8 µg/mL and 64 µg/mL.

After incubation at 37°C for 24–48 hours, wells containing fungal growth changed color from blue to red. The MIC was defined as the lowest antifungal concentration at which the medium remained blue, indicating inhibition of fungal growth. Results were interpreted according to CLSI M60 (2020) and CLSI M59 (2022) guidelines.

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Disk diffusion method:The CLSI M44-A2 disk diffusion method was used to assess the relative susceptibility of *Candida* spp. to azole antifungal agents. A standardized 0.5 McFarland fungal suspension was evenly inoculated onto MH-GMB medium (Mueller–Hinton Agar supplemented with glucose and methylene blue).

Antifungal disks (Nam Khoa Biotek) included fluconazole, ketoconazole, itraconazole, voriconazole, posaconazole, miconazole, and nystatin. Plates were incubated at 35–37°C for 24–48 hours.

The results were interpreted by measuring the diameter of the inhibition zone (mm) and comparing them with CLSI/EUCAST breakpoints to classify isolates as susceptible (S), intermediate (I), or resistant (R). The reference strain *Candida albicans* ATCC 90028 was used as a quality control strain in each batch of testing.

Data analysis and statistical methods

All collected data were entered and analyzed using SPSS software version 26.0 (IBM Corp., USA). Descriptive statistics were applied, including frequency and percentage (%), to summarize the distribution of variables.

Ethical considerations

The study protocol was reviewed and approved by the Ethics Committee of Tay Nguyen University, Tan Tao University Hospital, and the Institute of Malariology, Parasitology and Entomology, Quy Nhon.

All participants were clearly informed about the objectives, procedures, and methods of the study before providing consent to participate. Participation was entirely voluntary, and all personal information was kept strictly confidential and used solely for research purposes.

Diagnostic tests for fungal infections were provided free of charge to the participants. Individuals who declined participation were still examined and treated according to the hospital's standard clinical procedures.

RESULTS

Species distribution of *Candida* spp.

Table 1. Identification of *Candida* species isolated using real-time PCR

Species	Number (n=43)	Percentage (%)
Candida albicans	**24**	**55.8**
Candida glabrata	**6**	**14.0**
Candida parapsilosis	**3**	**7.0**
Candida krusei	**1**	**2.3**
Candida tropicalis	**1**	**2.3**
C. albicans + C. parapsilosis	**7**	**16.3**
C. glabrata + C. parapsilosis	**1**	**2.3**
Total	**43**	**100**

Comment: Among the 43 positive samples, a total of five *Candida* species were identified. Overall, *Candida albicans* remained the predominant species, accounting for 72.1% (31/43) of isolates, while non-*albicans Candida* (NAC) species accounted for 27.9%.

Mixed infections were also observed, including 7 cases of co-infection with *C. albicans* and *C. parapsilosis* (16.3%), and 1 case of co-infection with *C. glabrata* and *C. parapsilosis* (2.3%).

Among the single-species isolates, *C. albicans* had the highest prevalence (55.8%), followed by *C. glabrata* (14.0%) and *C. parapsilosis* (7.0%). *C. krusei* and *C. tropicalis* were less frequently detected, each accounting for 2.3% of the isolates.

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In vitro antifungal susceptibility of *Candida* spp. isolated from patients with vaginitis

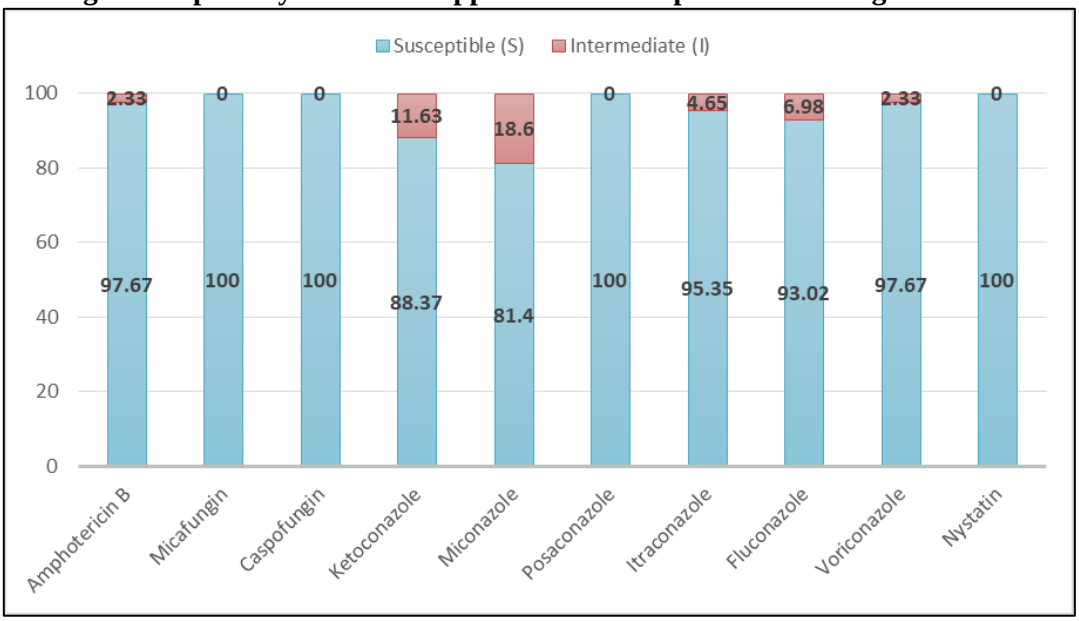
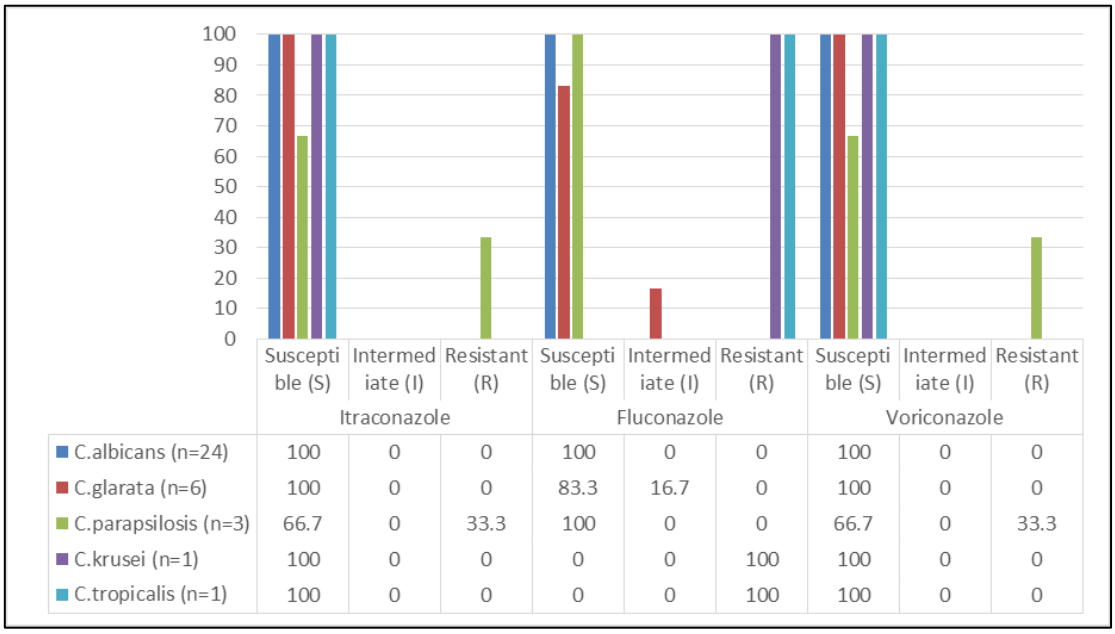


Figure 1. In vitro antifungal susceptibility of *Candida* spp. isolates to antifungal agents in patients with vaginitis, determined by broth microdilution and disk diffusion methods (%)

Comment: Within the scope of this study, most *Candida* spp. isolates remained highly susceptible to commonly used antifungal agents. The in vitro antifungal susceptibility was evaluated in 35 single-species isolates (*Candida albicans*, *Candida glabrata*, *Candida parapsilosis*, *Candida krusei*, and *Candida tropicalis*) among the 43 *Candida*-positive samples.

Antifungal susceptibility testing was performed using broth microdilution and disk diffusion methods to determine the resistance profiles of the isolates against the tested antifungal drugs.

Results of the in vitro antifungal susceptibility of *Candida* spp. determined by the broth microdilution method



	Itraconazole			Fluconazole			Voriconazole		
	Susceptible (S)	Intermediate (I)	Resistant (R)	Susceptible (S)	Intermediate (I)	Resistant (R)	Susceptible (S)	Intermediate (I)	Resistant (R)
C.albicans (n=24)	100	0	0	100	0	0	100	0	0
C.glarata (n=6)	100	0	0	83.3	16.7	0	100	0	0
C.parapsilosis (n=3)	66.7	0	33.3	100	0	0	66.7	0	33.3
C.krusei (n=1)	100	0	0	0	0	100	100	0	0
C.tropicalis (n=1)	100	0	0	0	0	100	100	0	0

Figure 2. Resistance rates of *Candida albicans*, *Candida glabrata*, *Candida parapsilosis*, *Candida krusei*, and *Candida tropicalis* to amphotericin B, micafungin, and caspofungin.

Comment: The results indicated that *Candida albicans*, *Candida glabrata*, *Candida parapsilosis*, *Candida krusei*, and *Candida tropicalis* isolates remained susceptible to all three antifungal agents, including amphotericin B, micafungin, and caspofungin**.**

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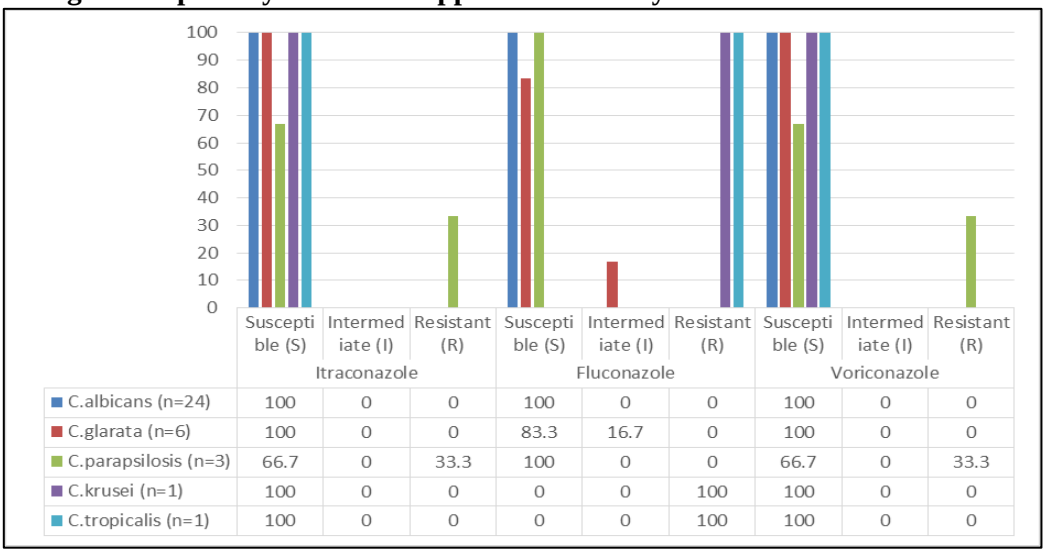
In vitro antifungal susceptibility of *Candida* spp. determined by the disk diffusion method



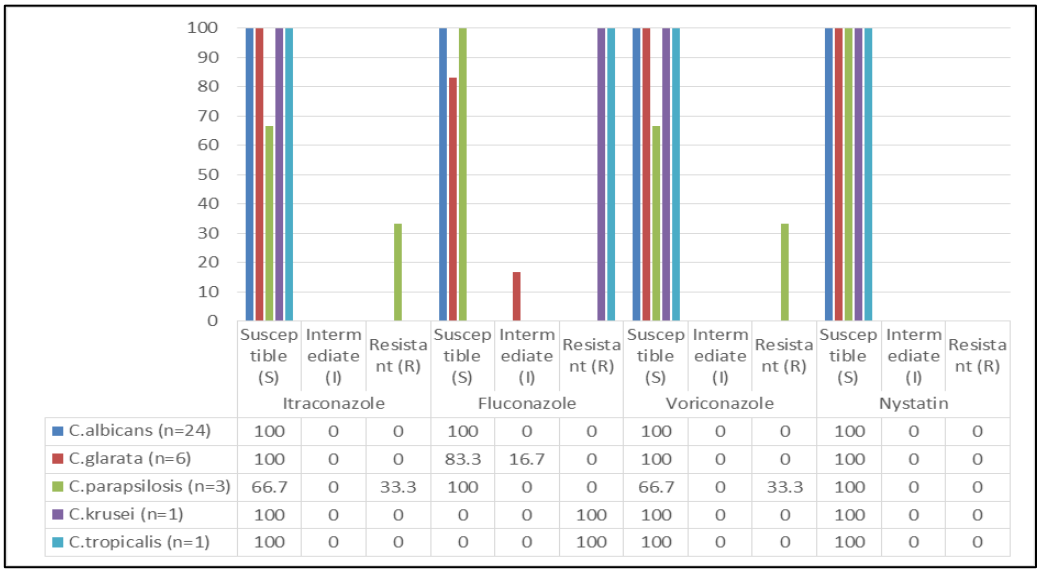
	Itraconazole			Fluconazole			Voriconazole		
	Susceptible (S)	Intermediate (I)	Resistant (R)	Susceptible (S)	Intermediate (I)	Resistant (R)	Susceptible (S)	Intermediate (I)	Resistant (R)
C.albicans (n=24)	100	0	0	100	0	0	100	0	0
C.glarata (n=6)	100	0	0	83.3	16.7	0	100	0	0
C.parapsilosis (n=3)	66.7	0	33.3	100	0	0	66.7	0	33.3
C.krusei (n=1)	100	0	0	0	0	100	100	0	0
C.tropicalis (n=1)	100	0	0	0	0	100	100	0	0

Figure 3. Resistance rates of *Candida albicans*, *Candida glabrata*, *Candida parapsilosis*, *Candida krusei*, and *Candida tropicalis* to the antifungal agents ketoconazole, miconazole, and posaconazole.

Comment: All isolates of *Candida parapsilosis*, *Candida krusei*, and *Candida tropicalis* remained fully susceptible to ketoconazole (100%). Among the six *Candida glabrata* isolates, four (66.7%) were susceptible, one (16.7%) showed dose-dependent intermediate susceptibility, and one (16.7%) was resistant. For *Candida albicans*, 22 out of 24 isolates (91.7%) were susceptible, while 2 isolates (8.3%) demonstrated dose-dependent intermediate susceptibility.

Similarly, *C. parapsilosis*, *C. krusei*, and *C. tropicalis* were completely susceptible to miconazole (100%). Among the six *C. glabrata* isolates, three (50%) were susceptible, whereas three (50%) exhibited dose-dependent intermediate susceptibility. In contrast, *C. albicans* showed 20 out of 24 isolates (83.3%) susceptible, 2 isolates (8.3%) intermediate, and 2 isolates (8.3%) resistant.

All isolates of *Candida albicans*, *Candida glabrata*, *Candida parapsilosis*, *Candida krusei*, and *Candida tropicalis* were fully susceptible to posaconazole (100%).



	Itraconazole			Fluconazole			Voriconazole			Nystatin		
	Susceptible (S)	Intermediate (I)	Resistant (R)	Susceptible (S)	Intermediate (I)	Resistant (R)	Susceptible (S)	Intermediate (I)	Resistant (R)	Susceptible (S)	Intermediate (I)	Resistant (R)
C.albicans (n=24)	100	0	0	100	0	0	100	0	0	100	0	0
C.glarata (n=6)	100	0	0	83.3	16.7	0	100	0	0	100	0	0
C.parapsilosis (n=3)	66.7	0	33.3	100	0	0	66.7	0	33.3	100	0	0
C.krusei (n=1)	100	0	0	0	0	100	100	0	0	100	0	0
C.tropicalis (n=1)	100	0	0	0	0	100	100	0	0	100	0	0

Figure 4. Resistance rates of *Candida albicans*, *Candida glabrata*, *Candida parapsilosis*, *Candida krusei*, and *Candida tropicalis* to itraconazole, fluconazole, voriconazole, and nystatin

Comment: All isolates of *Candida albicans*, *Candida glabrata*, *Candida krusei*, and *Candida tropicalis* remained fully susceptible to itraconazole (100%). In contrast, *Candida parapsilosis* showed 2 out of 3 isolates (66.7%) susceptible, while 1 isolate (33.3%) was resistant.

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For fluconazole, all isolates of *C. albicans* and *C. parapsilosis* were fully susceptible (100%), whereas *C. krusei* and *C. tropicalis* were completely resistant (100%). Among *C. glabrata* isolates, 5 out of 6 (83.3%) were susceptible, and 1 out of 6 (16.7%) demonstrated dose-dependent intermediate susceptibility.

Regarding voriconazole, all isolates of *C. albicans*, *C. glabrata*, *C. krusei*, and *C. tropicalis* remained fully susceptible (100%), while *C. parapsilosis* showed 2 out of 3 isolates (66.7%) susceptible and 1 out of 3 (33.3%) resistant.

All isolates of *Candida albicans*, *Candida glabrata*, *Candida parapsilosis*, *Candida krusei*, and *Candida tropicalis* were fully susceptible to nystatin (100%).

DISCUSSION

Species distribution of *Candida* spp.

Among the 43 positive samples, *Candida albicans* was the predominant species, accounting for 55.8%, followed by *Candida glabrata* (14.0%), *Candida parapsilosis* (7.0%), and both *Candida krusei* and *Candida tropicalis* (2.3% each). Mixed infections were also observed, including 7 cases of co-infection with *C. albicans* and *C. parapsilosis* (16.3%), and 1 case of co-infection with *C. glabrata* and *C. parapsilosis* (2.3%).

The species composition observed in this study is comparable to that reported by Nguyen Tu Anh (2021), although differences in the proportion of individual species may be attributed to variations in sample size, geographic location, and study period [3]. The proportion of *C. albicans* in our study was lower than that reported by Nguyen Thu Hang (2022) at the National Hospital of Dermatology and Venereology, where *C. albicans* accounted for 78% of isolates, followed by *C. glabrata* (18%) and *C. parapsilosis* (4%) [Hang, N. T. *et al*., 2023]. These findings indicate that the distribution of *Candida* species may vary depending on geographic regions and population characteristics.

Our results are also consistent with the observations of Turner S.A. and Butler G. (2023), who reported that approximately 90% of human candidiasis cases are caused by five major species, including *Candida albicans*, *Candida glabrata*, *Candida tropicalis*, *Candida parapsilosis*, and *Candida krusei*, among which *C. albicans* remains the most prevalent species [Turner, S. A., & Butler, G. 2014].

Overall, these findings suggest that the species distribution of *Candida* spp. in women with vaginitis may vary considerably depending on the studied population and local epidemiological conditions.

In vitro antifungal susceptibility of *Candida* spp. causing vaginitis

Currently, antifungal agents are highly diverse in terms of drug classes and mechanisms of action. In this study, to ensure analytical accuracy and suitability with routine laboratory conditions in Vietnam, two principal antifungal susceptibility testing methods were employed: broth microdilution and disk diffusion.

The results of the broth microdilution assay showed that all five *Candida* species; *Candida albicans*, *Candida glabrata*, *Candida parapsilosis*, *Candida krusei*, and *Candida tropicalis*, were 100% susceptible to the echinocandin agents micafungin and caspofungin, whereas the susceptibility rate to amphotericin B (a polyene antifungal) was slightly reduced to 97.67% in cases of mixed infection. These findings are consistent with the study of Do Ngoc Anh (2020), which reported susceptibility rates of 95.65% for amphotericin B, 100% for micafungin, and 95.65% for caspofungin [Anh, D. N. *et al*., 2021].

Using the disk diffusion method, all isolates demonstrated complete susceptibility to posaconazole and nystatin (100%). The susceptibility rates to other azole antifungal agents were as follows: voriconazole (97.67%), itraconazole (95.35%), fluconazole (93.02%), ketoconazole (88.37%), and miconazole (81.40%). When compared with the findings of Do Ngoc Anh (2020), which reported susceptibility rates of 100% for miconazole, 91.30% for fluconazole, 86.95% for voriconazole, and 82.61% for itraconazole, slight differences were observed. These variations may be attributed to differences in the characteristics of the isolated strains and the geographical location of the study populations.

Regarding species distribution, *Candida albicans* remained the predominant etiological agent and exhibited high susceptibility to most antifungal agents tested. However, an increasing isolation rate of non-*albicans Candida* (NAC) species, particularly *Candida glabrata*, has been reported in recent years [Lamoth, F. *et al*., 2018]. Previous studies, including that of Turner S.A. (2014), have demonstrated that *C. glabrata* often exhibits reduced

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susceptibility to azole antifungal agents [Turner, S. A., & Butler, G. 2014].

In our study, all *Candida* species remained susceptible to micafungin, caspofungin, and nystatin, suggesting that these antifungal agents may represent potential therapeutic alternatives for azole-resistant vulvovaginal candidiasis (with the exception of caspofungin in certain clinical contexts). When considering only *C. albicans* isolates from vulvovaginal candidiasis, our results also indicated high in vitro susceptibility to amphotericin B.

Regarding azole antifungal agents, including ketoconazole and miconazole (imidazole subgroup) as well as itraconazole, voriconazole, fluconazole, and posaconazole (triazole subgroup), triazoles may be preferred over imidazoles in clinical practice. Although both subgroups share similar antifungal spectra and mechanisms of action, triazoles generally exhibit slower metabolism and lower interference with human sterol synthesis compared with imidazoles. Due to these pharmacological advantages, most newly developed antifungal agents belong to the triazole class [Tsega, A., & Mekonnen, F. 2019].

Antifungal resistance is currently a major challenge in clinical medicine, making treatment increasingly difficult and leading to higher rates of therapeutic failure. Therefore, continuous surveillance and periodic evaluation of antifungal susceptibility patterns in *Candida* spp. are essential in order to detect early changes in resistance trends and to support the development of more effective and evidence-based antifungal treatment strategies.

Study limitations

This study has several limitations. First, certain variables related to sexual behavior, genital hygiene practices, and previous history of vaginitis were difficult to obtain accurately because these topics are sensitive and personal, which may have affected the completeness and reliability of the collected information.

Second, due to the relatively short study period, the number of patients recruited was limited. Consequently, the prevalence of *Candida* infection observed in the study population was not high, and species identification as well as in vitro antifungal susceptibility testing could only be performed on 43 out of the 270 participants who tested positive for *Candida* spp.. These limitations may affect the generalizability of the findings to the broader population.

CONCLUSION

This study included 270 women diagnosed with vaginitis who attended the Department of Obstetrics and Gynecology at Tan Tao University Hospital from June to September 2024. Among them, 43 cases were positive for *Candida* spp. infection. Of these, 7 samples showed co-infection with *Candida albicans* and *Candida parapsilosis* (16.3%), while 1 sample showed co-infection with *Candida glabrata* and *Candida parapsilosis* (2.3%).

Candida albicans remained the predominant species, accounting for 55.8% (24 isolates), followed by *Candida glabrata* (6 isolates; 14.0%) and *Candida parapsilosis* (3 isolates; 7.0%). *Candida krusei* (1 isolate) and *Candida tropicalis* (1 isolate) were less frequently detected, each representing 2.3% of the total isolates.

Analysis of 35 single-species isolates showed that *C. albicans*, *C. glabrata*, *C. parapsilosis*, *C. krusei*, and *C. tropicalis* were fully susceptible (100%) to amphotericin B, micafungin, caspofungin, posaconazole, and nystatin. However, notable differences in susceptibility were observed among azole antifungal agents, particularly ketoconazole, miconazole, fluconazole, itraconazole, and voriconazole.

Among the non-*albicans* *Candida* species, *C. glabrata* demonstrated a trend toward reduced susceptibility, with increased resistance and intermediate susceptibility to ketoconazole (33.34%) and miconazole (50.0%). *C. tropicalis* and *C. krusei* exhibited complete resistance to fluconazole (100%), whereas *C. parapsilosis* showed partial resistance to itraconazole and voriconazole (33.33%). In contrast, *C. albicans* maintained the highest susceptibility to most azole antifungal agents tested in this study.

RECOMMENDATIONS

The results of this study indicate that the antifungal resistance rate of vaginal *Candida* spp. remains relatively low. Commonly used antifungal agents such as fluconazole and nystatin still demonstrate high therapeutic efficacy and may continue to be used as first-line treatment options for vulvovaginal candidiasis.

Additionally, other azole antifungal agents may be selected based on antifungal susceptibility profiles. In clinical practice, triazole antifungals (such as itraconazole, voriconazole, and posaconazole) may be preferentially considered over imidazole agents (such as ketoconazole and miconazole), since

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triazoles generally exhibit slower metabolism and lower interference with human sterol synthesis, while maintaining a similar antifungal spectrum and mechanism of action.

Regular surveillance of antifungal resistance patterns and monitoring of changes in the species distribution of *Candida* should be maintained. Such monitoring is essential to promptly update treatment strategies and optimize the management of vulvovaginal candidiasis.

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