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PROCEEDINGS ABSTRACT

Antifungal efficacy of selected oral antidiabetic drugs against *Candida albicans* and *Candida glabrata*: an *in vitro* pharmacodynamic analysis

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Type 2 diabetes mellitus (T2DM) is a chronic, progressive metabolic disorder that can trigger profound systemic immune dysfunction, thereby markedly increasing patient susceptibility to severe opportunistic infections. Chronic hyperglycaemia can impair critical host defence mechanisms; as a result, diabetics face a substantially elevated risk of both mucosal and invasive fungal infections, most notably infections caused by a *Candida* species. Although *Candida albicans* remains the predominant isolated pathogen, other species such as *Candida glabrata* are rapidly emerging due to their innate resilience in glucose-rich environments and their baseline resistance to standard antifungal therapies [1]. Concurrently, increasing amount of evidence suggests that common oral antidiabetic drugs (OADs) that are traditionally utilized solely for glycaemic control, may also possess secondary, off-target, antimicrobial properties. This study aimed at quantifying and comparing the intrinsic *in vitro* antifungal efficacies of five widely prescribed OADs (metformin, pioglitazone, gliclazide, vildagliptin, and dapagliflozin) against standard clinical isolates of *Candida albicans* (ATCC-90028) and *Candida glabrata* (ATCC-90300). The drugs' antifungal activity was initially assessed by employing a highly controlled 96-well static microdilution assay. Serial concentrations of each OAD (0.125–8.0 mg/L) were inoculated with a standardized fungal suspension (2×10^4 CFU/mL) in an RPMI-1640 growth medium. After a 24-h incubation at 37°C, the relative optical density was quantified spectrophotometrically at 600 nm in order to measure dynamic fungal growth inhibition. In an attempt to overcome the inherent limitations of static concentration models and to accurately simulate the *in vivo* physiological drug clearance, a dynamic *in vitro* pharmacokinetics / pharmacodynamics (PK/PD) model was employed using a precision peristaltic pump and a cellulose dialysis membrane (<50-kDa). The system replicated continuous human plasma clearance and measured the cumulative drug exposure–response relationship. Comprehensive PD parameters, specifically the half-maximal inhibitory concentration (IC_{50}), maximum inhibitory effect (E_{max}), and area under the curve (AUC), were calculated using a nonlinear variable-slope sigmoidal regression model. The mathematical modelling demonstrated exceptional robustness, with goodness-of-fit (R^2) values exceeding 0.973 across all evaluated dose–response curves. Metformin exhibited the most potent intrinsic antifungal profile, achieving an E_{max} of 72% (IC_{50}: 1.0 mg/L; AUC: 82.85%) against *C. albicans* as well as of 68% (IC_{50}: 2.0 mg/L; AUC: 76.40%) against *C. glabrata*. Pioglitazone exhibited robust secondary efficacy, yielding an E_{max} of 65% (IC_{50}: 2.0 mg/L) against *C. albicans* and of 56% (IC_{50}: 4.0 mg/L) against *C. glabrata*. Gliclazide showed moderate but consistent fungistatic

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properties across the two strains (achieving an E_{max} of 50% and 45%, respectively). On the other hand, vildagliptin and dapagliflozin exhibited the weakest antifungal activities, both requiring the maximum tested concentration (IC_{50}: 8.0 mg/L) in order to achieve minimal inhibition thresholds (peak E_{max} of 42% and 40%, respectively, against *C. albicans*). The employed dynamic PK/PD model has confirmed that a sustained drug exposure is directly correlated with compounding antifungal responses, particularly in the case of metformin. Our study provides quantitative confirmation that specific OADs possess highly variable but biologically significant, intrinsic antifungal properties. In fact, metformin and pioglitazone demonstrate substantial fungistatic efficacy at concentrations approaching clinically relevant plasma levels. Conversely, the remarkably poor intrinsic antifungal activity of dapagliflozin supports the current clinical consensus that the sodium-glucose co-transporter-2 (SGLT2) inhibition-associated candidiasis is primarily an environmental consequence of induced glycosuria that creates a nutrient-rich environment for fungal growth rather than a direct immune or structural failure induced by the SGLT2 inhibitors themselves [2,3]. The antifungal effects of these specific agents may offer a secondary clinical advantage against opportunistic *Candida* infections in vulnerable T2DM populations. Further *in vivo* studies are critically warranted in order to translate these dynamic PD findings into proactive clinical practice.

Keywords

antifungal; *in vitro*; metformin; oral antidiabetic drugs; pharmacodynamics

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Conflicts of interest statement

None to declare.

References

[1] Valaiyapathi B., Gower B., Ashraf A. P.: Pathophysiology of type 2 diabetes in children and adolescents. *Curr. Diabetes Rev.* 16(3): 220–229 (2020). https://doi.org/10.2174/1573399814666180608074510

[2] Zhao X., Wang Y., Zhang Q., Huang Y., Wei X., Wu D.: Antifungal effects of metformin against *Candida albicans* by autophagy regulation. *J. Microbiol.* 63(4): e2411008 (2025). https://doi.org/10.71150/jm.2411008

[3] Hegazy W. A. H., Rajab A. A. H., Abu Lila A. S., Abbas H. A.: Anti-diabetics and antimicrobials: Harmony of mutual interplay. *World J. Diabetes* 12(11): 1832–1855 (2021). https://doi.org/10.4239/wjd.v12.i11.1832

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