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Propolis potential activity against *Candida tropicalis* adhered cells and its biofilms

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Objectives Invasive fungal infections, such as candidiasis, represent a public health problem of major importance and *Candida tropicalis* has been highlighted among the main agents of candidiasis. Adhesion, which is the attachment of microbial cells to biological or non-biological substrates, has a critical role in the initial stages of biofilm formation. Additionally, one of the major contributions to *C. tropicalis* virulence is its versatility in adapting to a variety of different habitats and the formation of microbial communities known as biofilms. Moreover, from the clinical perspective, the most important feature of *Candida* biofilms is its intrinsic tolerance to conventional antifungal therapy. This scenario encourages the search for alternative therapies. Natural matrixes, such as propolis, compromise a multitude of bioactive properties, in particular phenolic extracts have evidenced significant antimicrobial properties against a multiple of opportunist invaders, including *Candida* species. Thus, the main objective of the present work was to evaluate the potential antifungal effect of propolis against *Candida tropicalis* adhered and biofilm cells.

Methods This study was conducted with four clinical strains of *C. tropicalis* and one reference strain, from the American Type Culture Collection (ATCC 40042). Adhesion and biofilm formation were carried out on 96-well microplates containing a cellular suspension of 1×10^5 cells ml⁻¹ and incubated for 2 h and 24 h, respectively at 37 °C. Adhered cells and pre-formed *C. tropicalis* biofilms were treated with propolis (ranging from 0.47 to 1.42 mg ml⁻¹), during 24 h at 37 °C and its effect assessed through quantification of the number of colony forming unit (CFU).

Results It was evident that all *C. tropicalis* strains tested were able to adhere and form biofilm and that propolis was able to reduce around 2.5 logs ($P < 0.05$) and 3 logs ($P < 0.05$) on adhered cells and pre-formed biofilm, respectively. Moreover, in general the propolis effect was similar among all the *C. tropicalis* clinical isolates.

Conclusions The results of this study are promising, considering that biofilms are difficult to control by conventional antibiotherapy, propolis can be considered an efficient and safe antifungal alternative strategy to combat yeast biofilm associated infections.