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Development, characterization, and anti-Candida evaluation of nanocomposite rings formed by hybrid polymers and nanostructured lipid carriers associated with photodynamic therapy

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Vulvovaginal candidiasis (VVC), caused mainly by Candida albicans, affects ~75% of women once in their lifetime. Antimicrobial photodynamic therapy (aPDT) is based on oxidative photochemical reactions. Phthalocyanine (PC) is an excellent agent. The incorporation of PC into nanostructured lipid carriers (NLC) and dispersion in ureasil polyether (UPEO) forms a hybrid polymeric nanocomposite since it has a dispersed phase of nanometric size, also allowing the production of vaginal rings. The aim was to evaluate the aPDT of PC-NLC-UPEO rings against C. albicans. The NLC and PC-NLC obtained by the fusion-emulsification method were homogeneous, white, and bluish, respectively, with no instability events during 90 days. The vaginal ring was produced using molds (diameter 55 mm and thickness 4 mm) by the sol-gel method, making it possible to obtain rings without high temperatures. DLS showed average hydrodynamic distribution values for NLC and PC-NLC of 143.6 nm and 133.97 nm, respectively, within the ideal range for nanocomposites for pharmacological purposes. The zeta potential was NLC -17.6 and PC-NLC -21.4, indicating steric stability in the system. The PDI of NLC was 0.196 and PC-NLC's was 0.228, expressing reliable results. The NTA technique showed a predominant size for NLC of 147.6 nm and PC-NLC of 184 nm, values close to those found in DLS. The XRD indicated the presence of PC on the surface of the PC-UPEO and PC-NLC-UPEO materials, due to the peaks close to those observed in the free PC, (2? = 6.42º; 2? = 18.15º), which were confirmed visually by digital microscopy, the intensity of the peaks is lower in PC-NLC-UPEO due to the incorporation into the NLC. The FTIR spectra showed no suppression of the characteristic groups of the materials and no new bands appeared. TG showed an improvement in the thermal stability of NLC when dispersed in UPEO, close to 100 ºC, free PC-NLC had a mass loss of 85% and when dispersed in UPEO it showed 3% at the same point. DTA revealed two endothermic events of PC-NLC near 100 ºC related to solvent loss and dehydration, the binary mixture of PC: UPEO and NLC: PC did not reveal changes in temperature or enthalpy peaks. The in vitro drug release study showed that for the PC released from PC-UPEO and PC-NLC-UPEO, around 37.8% (143.64 ?g) and 39.4% (149.72 ?g) was released within 24 hours, which is capable of promoting initial antifungal activity. By 120h, 68% of the PCs in PC-NLC-UPEO had been released, while in PC-NLC-UPEO 94% of the PCs had been released by 96h. The PC and PC-NLC antifungal activity was carried out by colony count method, showing a reduction of 1 and 4 logs for both, in the analyses with and without light, respectively. Agar diffusion was used to analyze the UPEOs, revealing halos of 7 and 15 mm in the groups with light, PC-UPEO, and PC-NLC-UPEO, respectively, demonstrating improved PC activity. In this way, the system developed proved capable of acting in the treatment of VVC caused by C. albicans.