Electropolymerization of a natural compound on copper as a new strategy to control the release of Cu ions with potential use in intrauterine devices (IUDs)

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Resumo:
IUDs represent the most frequently used long-acting reversible contraceptive method in the world. However, several adverse effects are caused due to the high release of Cu ions during the first few days after the insertion (burst release effect). Different inhibitory treatments have been proposed but their compatibility with the cellular environment is frequently unknown. The aim of this study was to evaluate the efficacy of electopolymerized films formed from natural phenolic compounds (carvacrol:Carv and thymol:TOH) as inhibitors of Cu ions release. The films were generated by a potentiodynamic electrochemical method on Cu disks (99.7% pure) using TOH or Carv in alkaline solution. The characterization of the polymeric layers (polyTOHCu, polyCarvCu) was made by Fourier Transform Infrared Spectroscopy (FTIR), X-ray photoelectron spectroscopy (XPS) and Atomic force microscopy (AFM). The effect of coated Cu disks on MC3T3-E1 cell line was analyzed by viability (stained with Acridine Orange) and clonogenic assays. The AFM analysis showed that polyCarvCu roughness was less than polyTOHCu (Rmax=54 nm and 161 nm, respectively). Biological tests evidenced that cell viability increased from 28.88% (bare copper) to 83.72% for polyTOHCu reaching values close to 100% of the control in case of Carv (p<0.001). Clonogenic assay (6 days) also revealed beneficial effects in the number and diameter of colonies that were more notable in case of polyCarvCu (p<0.001). Measurements of Cu ions released from coated and uncoated disks immersed in physiological solution showed that polycarvCu was able to reduce Cu ions release after 24h of immersion to ca. 20% of that of the bare disk and was more protective than polyTOHCu (40% of the bare disk). The protective effect remained after 6 days of immersion. Results demonstrated that polyCarv layer may be a new and non-cytotoxic strategy to decrease Cu ions release for medical and industrial applications.