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INPLASY

The Efficacy of nanoparticles in reducing Candida biofilm formation: A Systematic Review and Meta-analysis

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ADMINISTRATIVE INFORMATION

Support - King Khalid University.

Review Stage at time of this submission - Completed but not published.

Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 21 April 2025 and was last updated on 21 April 2025.

INTRODUCTION

Review question / Objective To investigate the efficacy of nanoparticles in reducing Candida biofilm formation on dentures and medical devices.

Rationale Conventional antifungals are limited by biofilm resistance, matrix barriers, and rising multidrug-resistant Candida strains (e.g., C. auris). Nanoparticles offer novel mechanisms (e.g., ROS generation, matrix penetration) to overcome these challenges.

Condition being studied Candida biofilm formation on denture materials (e.g., PMMA resin) and medical devices, involving species such as C. albicans, C. glabrata, and C. auris.

METHODS

Search strategy Databases: PubMed, EBSCO, ScienceDirect, Cochrane Library, Google Scholar (first 20 pages). Keywords: Candida, biofilm, nanoparticles (e.g., Ag, ZnO, TiO_2). Search strings combined MeSH terms and free-text terms (Tables 1–2).

Participant or population In vitro studies analyzing Candida biofilms; no human/animal participants.

Intervention Nanoparticle formulations: Silver (Ag), zinc oxide (ZnO), titanium dioxide (TiO_2), chitosan, and composite nanoparticles (e.g., ZnO-Ag) applied to denture materials.

Comparator Uncoated materials (e.g., plain PMMA) or traditional antifungals (e.g., nystatin).

Study designs to be included In vitro experimental studies (SPIDER criteria: Sample = nanoparticles, Design = quasi-experimental).

Eligibility criteria Inclusion: Peer-reviewed studies on nanoparticle efficacy against Candida biofilms, using standardized biofilm assessment methods (CFU, XTT, SEM).

Exclusion: Reviews, non-English articles, bacterial-only biofilms, and studies without antimicrobial outcomes.

Information sources PubMed, EBSCO Open Research, ScienceDirect, Cochrane Library, Google Scholar.

Main outcome(s) Reduction in biofilm biomass (e.g., crystal violet staining).
Inhibition of metabolic activity (XTT assay).
Colony-forming unit (CFU/mL) reduction.

Additional outcome(s) Biocompatibility (cytotoxicity assays).
Mechanical properties (flexural strength, surface roughness).
Coating durability and adhesion.

Data management
Zotero for deduplication.
Microsoft Excel for data extraction.
Comprehensive Meta-Analysis (CMA) software for quantitative synthesis.

Quality assessment / Risk of bias analysis Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Quasi-Experimental Studies, assessed independently by two reviewers.

Strategy of data synthesis Thematic analysis of qualitative outcomes. Random-effects meta-analysis (95% CI) for quantitative data.

Subgroup analysis By nanoparticle type (Ag, ZnO, composites), concentration, and Candida species (e.g., C. albicans vs. C. dubliniensis).

Sensitivity analysis Not explicitly stated, but heterogeneity addressed via random-effects model.

Language restriction Only articles in English.

Country(ies) involved Saudi Arabia.

Other relevant information PRISMA 2020 guidelines were followed.
The SPIDER framework is used for eligibility criteria.
Focus on in vitro studies limits clinical extrapolation.

Keywords Nano-particles; Candida; Biofilm.

Dissemination plans Publication in peer-reviewed journals; no specific plans detailed in the document (standard for systematic reviews).

Contributions of each author
Author 1 - Ravinder Saini - Conceptualization, Methodology, Investigation, Funding acquisition.
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