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Antifungal, antibacterial, antibiofilm and colorimetric sensing of toxic metals activities of eco friendly, economical synthesized Ag/AgCl nanoparticles using Malva Sylvestris leaf extracts

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Abstract

Silver nanoparticles, one of the most popular nanomaterials, are used extensively in medicine and industries. The present study biosynthesized spherical Ag/AgCl nanoparticles with a size range of 10–50 nm in less than 5 min. The synthesis was performed in a single step, in a low-cost and eco-friendly manner, from the aqueous extract of Malva Sylvestris leaves. The aqueous extract had a large number of phenolic compounds and carbohydrates as reducing and capping agents. The nanoparticles also showed significant antibacterial and anti-biofilm activities against some multi drug resistant bacteria. They additionally showed antifungal activities on several Candida species. The highest concentration of Ag/AgCl-NPs (62.5 μg/ml) was required in order to inhibit P. aeruginosa B 52, C. glabrata and C. parapsilosis growth. The lowest concentration of Ag/AgCl-NPs (7.8125 μg/ml) inhibited the growth of C. orthopsilosis, P. aeruginosa ATCC 27853 and B. subtilis ATCC 6633. A total of 125 μg/ml of Ag/AgCl-NPs was used to prevent P. aeruginosa B 52 biofilm growth. The concentration of 62.5 μg/ml Ag/AgCl-NPs also eradicated both P. aeruginosa 48 and P. aeruginosa B 52 biofilms. The results showed that Hg2+ and Pb2+ contaminants in water could be colorimetrically detected by these nanoparticles.