

Activity of ketoconazole coated gold nanoparticles against dandruff causing fungi

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We investigated the antifungal property of gold Nanoparticles coated with ketoconazole against the dandruff causing organism - *Malassezia pachydermatis* in comparison with pure ketoconazole by disc diffusion method. The diameter of the inhibition zone is greater for gold Nanoparticles coated with ketoconazole than for pure ketoconazole. This shows that gold Nanoparticles enhances the bioactivity of ketoconazole. Zone of inhibition increased with increase in concentration of gold Nanoparticles (0.1 mM<0.2 mM<0.3 mM). We conclude that ketoconazole coated gold Nanoparticles prevent the growth of the dandruff causing organism. The inhibitory power is greater than the pure drug. Thus, gold Nanoparticles can be incorporated along with ketoconazole and formulated into an effective antidandruff shampoo.

Key words : Nanoparticles, Gold, Dandruff, Ketoconazole, *Malassezia*

INTRODUCTION

Nanotechnology offers unique approaches to probe and control a wide variety of biological process that occur at nanometer length (Kulkarni, 2007; West and Halas, 2000). Controlling the structure of a drug precisely at nanoscale dimension can enhance its solubility, biocompatibility and bioconjugation. Drug-nanoparticle hybrid systems have widely been found useful in the enhancement of bioavailability, bioactivity and stability of drugs used in various infections. Gold Nanoparticles have well developed surface chemistry (Prime and Whitesides, 1991), controllable geometry (Sun and Xia, 2002), rigidity and stability (Boyen *et al.*, 2002). Thus, gold Nanoparticles could function as versatile drug carriers and hence be used in the treatment of several medical and biological problems.

Dandruff is one of the serious problem in the society. *Malassezia* species is well recognized as a causative organism for dandruff. It is characterized by scaling of scalp and skin in humans (Gupta *et al.*, 2000). *Malassezia furfur*, *Malassezia sympodialis*, *Malassezia sloofia*, *Malassezia pachydermatis*, *Malassezia globosa*, *Malassezia obtusa* and *Malassezia restricta* are some examples for dandruff causing fungi (Hammer *et al.*, 2000). Most of antidandruff shampoos are formulated using ketoconazole (a triazole). In spite of several commercially available antidandruff shampoos, dandruff recurrence is more frequent. Hence, a novel therapy is needed to eradicate and prevent recurrence of dandruff.

Antimicrobial agents in the form of Nanoparticles

act with higher efficacy against bacteria (Grace and Pandian, 2006). *In vitro* antibacterial activity of streptomycin, gentamycin and neomycin have been increased by coating the drugs to Nanoparticles (Grace and Pandian, 2006). Assuming that the action of ketoconazole (commercial antidandruff agent) could also be enhanced by coating onto gold Nanoparticles, the antifungal property of gold Nanoparticles coated with ketoconazole against the dandruff causing organism - *Malassezia pachydermatis* in comparison with pure ketoconazole was investigated. Previous studies too have used pure ketoconazole as a reference drug for investigating the antifungal property of various test drugs (Hammer *et al.*, 2000; Jonson *et al.*, 2004; Pierard *et al.*, 1991).

MATERIALS AND METHODS

Chemicals:

Gold chloride and trisodium citrate were purchased from Sigma Chemicals. Ketoconazole was purchased from Hi media. All other chemicals and reagents were of analytical grade. Double distilled deionized water was used for the experiments.

Citrate capped gold Nanoparticles:

Citrate capped gold Nanoparticles were prepared as described by Grace and Pandian (2006). Gold Nanoparticles of 12-15 nm with the concentration of 0.5 mM was initially prepared. 50 ml of each 0.1mM, 0.3mM and 0.5mM gold Nanoparticles was mixed separately with