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A minireview on antifungal activity of silver nanoparticles

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Abstract

Silver nanoparticles are well known as they possess antiseptic activities against number of microbes i.e. bacteria, fungi and virus. Usage of silver nanoparticles in various fields such as biomedical engineering, cosmetology, food packaging industry, textile industry, crops, animal husbandry etc increase interest of researchers towards silver nanoparticles. Synthesis of silver nanoparticles is cheap and handy. Fungus is the microbe which destroy food and make it unfit for human health. Food can be easily contaminant by fungus, as it requires just a moist and warm place. Silver nanoparticle has antifungal activity against many fungi. Efficiency of silver nanoparticles is increased by combination with commercially available drugs. Here in this review we tried to enlist the antifungal activity of silver nanoparticles against many fungi.

Keywords: Silver nanoparticles, fungus, human health, fungal diseases.

INTRODUCTION

Silver nanoparticles (AgNPs) are the most thoroughly investigated nanomaterials and popular due to its biocidal properties [1]. Applications of AgNPs, as a biological agent are commonly increasing [2] [3] [4]. AgNPs most commonly used in biomedical engineering, cosmetology, food packaging industry, textile industry, crops, animal

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husbandry, etc [5]. For several eras, silver (Ag+) has been known as disinfectant agent against various harmful microorganisms [6], [7]. Properties of bulk materials are different from those of metal nanoparticles made from the similar atoms [8].

Silver nanoparticles (AgNPS) are mostly used nanoparticles because of their potential applications in various fields of science, such as optics, pharmaceutical and medical sciences for the development of drug delivery systems, biosensors, therapeutic agent, gene therapy, optoelectronics [9]. It is the most studied Nanoparticle [10]. Antimicrobial property is the fact which increasing interest towards AgNPs [11]. The nanoparticles have bactericidal behaviour to their credit because of the presence of electronic effects, which become changed due to the smaller size of particles. Silver NPs have the ability to act against microorganisms that can cause 650 different types of diseases [12]. AgNPs is prepared by cheap and efficient chemical reduction method, various reductants are used i.e sodium borohydride, citrate, ascorbate and elemental hydrogen for synthesis of AgNPs [13].

Food is spoiled by some species of fungi include: Rhizopus, Alternaria, Penicillium, Aspergillus and Botrytis. Fungi spoils Breads and fruits are more likely than bacteria as fungi need acidic and low moisture environments to grow [14]. Fungus produce mycotoxins, they destroy foodstuffs and grains during storage, and compromise their nutritive value which become unfit for human consumption [15]. Foods contaminant from fungus are injurious for human health [16]. Decayed food become undesirable for consumer because of change in taste, smell or appearance [14]. Fungal infections are prevalent all over the world. These diseases affect hair, nails and skin. According to the global estimates, billions of people have seriously been affected from fungal infection so far and the number of affectees, according to an estimate, is about 1.5 million. Theses fungal diseases, if not diagnosed on time and treated properly may also cause death [17].

Antifungal activities of Silver nanoparticles (AgNPs)

Sang Woo Kim et al, reported antifungal activity of AgNPs. They used three types of AgNPs with three types of agar plates (potato dextrose agar (PDA), malt extract agar, and corn meal agar plates) on which 18 types of different fungal pathogenic plants (Alternaria alternate, Alternaria brassicicola, Alternaria solani, Botrytis cinerea,

Cladosporium cucumerinum, Corynespora cassiicola, Cylindrocarpon destructans, Didymella bryoniae, Fusarium oxysporum f. sp. Cucumerinum, F. oxysporum f. sp. Lycopersici, F. oxysporum, Fusarium solani, Fusarium sp, Glomerella cingulate, Monosporascus cannonballus, Pythium aphanidermatum, Pythium spinosum, Stemphylium lycopersici) were treated. Result of their experiment showed that WA-CV-WB13R AgNPs has more inhibitory effects then other two types of AgNPs and according to them PDA has more ability to inhibit plant pathogenic fungi as compare to other two types of agar plates [7].

Pulit, Banach et al showed a research on antifungal properties of nanosilver, synthesized by green method used raspberry extract. Silver Nano particles obstruct the fungal growth of Cladosporium cladosporoides and Aspergillus niger. Due to the more resistant of Aspergillus niger, 70% of its growth was blocked in contrast with that of Cladosporium cladosporoide which was less resistant and growth was inhibited about 90% [18].

Matei, CORNEA et al reported the antifungal properties of lactic acid bacteria against Aspergillus ochraceus. They used different strain of LAB to ensure its antifungal effect and he certified the antifungal effect of LAB from his research work [16].

Gajbhiye et al. demonstrated the antifungal test against Phoma glomerata, P. herbarum, Fusarium semitectum, Trichoderma sp., and C. albicans by using biosynthesized Ag-NPs. They were found AgNPs to be effective against all these test fungi [19].

An antifungal activity of AgNPs against plant pathogenic fungi i.e. Aspergillus niger, A. foetidus, A. flavus, A. oryzae, A. parasiticus, and F. oxysporum has been reported [20].

Candida species which are highly pathogenic and involved in several infections i.e. urinary tract infection, have been found to be resistant to many commonly used antifungal agents. Rajarathinam and Kalaichelvan, found AgNPs applicable agents for the control of three Candida species, namely, C. albicans, C. tropicalis, and C. krusei. Additionally, they also show its application as additive in commercially available dish and hand wash [21]. In another study, AgNPs was showed effective against C. albicans and C. glabrata [22].Antifungal activity of AgNPs against seed-borne pathogens such as Aspergillus, Alternaria, Rhizoctonia, A. niger, A. flavus, Rhizoctonia bataticola, Sclerotium rolfsii, Alternaria macrospora, C.

albicans, C. parapsilosis, C. krusei, Cryptococcus neoformans, A. fumigatus, A. flavus, C. tropicalis, F. solani, Sporothrix schenckii, C. albicans and C. glabrata, C. albicans, C. kefyr, A. niger, C. tropicalis, C. krusei, A. flavus, A. fumigates, A. flavus, and C. albicans, also have been reported [23], [24], [25], [26], [27]. AgNPs has been treated against Candida albicans (ATCC 5027), Saccharomyces cerevisiae (ATCC 5027) and found effective [28].

AgNPs, are being considered as powerful and fast acting fungicides against many opportunistic human fungal pathogens [29].

AgNPs combination with commercially available drugs for antifungal activity

Several reports are available that showed synergistic effect of AgNPs when used in combination of commercially available drugs. The synergistic effect of AgNPs against some plant pathogenic fungi was reported when used with fluconazole [19]. In another study, Kandile et al. demonstrated the synergism between AgNPs and commercially available drugs [30]

Antifungal activity of AgNPs was significantly increased against Aspergillus flavus and C. albicans in combination with different heterocyclic compounds such as thiazolidine, phthalazine, pyrazolo, tetrazolo, hydrazide, and pyridazine derivatives [31].

Conclusion

Nanoparticles are most common in use because of their applications in variety of fields. One of the nanoparticle is silver nanoparticle which is used in almost all fields. It poses not only antibacterial activity but also have antifungal. Antifungal activity of silver nanoparticles has been reported against several types of fungus.

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