

Chapter 59

Antimycotic Activity of Nanoparticles of MgO, FeO and ZnO on some Pathogenic Fungi

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ABSTRACT

*Fungi are important pathogens of vegetables, fruits, cereals, pulses, and other crops. Several management strategies have been used for the control of pathogenenic fungi. Each of these methods has one or other limitations. Due to hazardous effects caused by excessive use of pesticides, scientists in the agricultural field are searching for alternative measures against pesticides. As an alternative to chemically manufactured pesticides, use of nanoparticles as antimicrobial agents has become more common as technological advances. Until now, limited research provided some evidence of the application of nanoparticles for the control of plant diseases caused by fungi. In the present study antimycotic activity of nanoparticles of magnesium, Iron and zinc have been investigated under in-vitro conditions and was observed from the study that all the nanoparticles at different concentrations brought about significant inhibition in the germination of spores of *Penicillium notatum*, *Aspergillus niger*, and *Nigrospora oryzae* Berk. However, the highest inhibition in the germination of all the test fungi was observed at higher concentrations followed by lower concentrations of nanoparticles. The nano MgO at highest concentration was found most effective in reducing the spore germination followed by nano-FeO and nano-ZnO at the same concentration respectively.*

1. INTRODUCTION

Plants are often attacked by various pathogens such as fungi, bacteria, viruses, etc. which results in great losses to farmers (Kodam, 1983; Snow-

don, 1990; Rajam, 1992; Lolpuri, 2002; Esfahani, 2006). Several conventional methods have been used for the control of these pathogens and each of these methods have one or other limitations. Some of these methods such as use of pesticides cause hazardous effect on the environment and human health. Therefore, uses of nanoparticles of have

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been considered alternate, ecofriendly and cost effective management strategy for the control of pathogenic microbes (Patolsky *et al.*, 2006; Kim *et al.*, 2009; Kumar & Yadev, 2009; Aruoja *et al.*, 2009; Kim *et al.*, 2012). These nanoparticles have a great potential in the management of plant diseases as compared to synthetic fungicides (Park *et al.*, 2006). Silver for instance displays multiple modes of inhibitory action against microorganisms (Clement *et al.*, 1994), therefore, it may be used with relative safety for control of various plant pathogens, compared to synthetic fungicides (Park *et al.*, 2006).

Changes in agricultural technology have been a major factor shaping modern agriculture. Among the latest line of technological innovations, nanotechnology occupies a prominent position in transforming agriculture and food production. The development of nanodevices and nanomaterials could open up novel applications in plant biotechnology and agriculture (Scrinis & Lyons, 2007). Currently, the main thrust of research in nanotechnology focuses on applications in the field of electronics (Feiner, 2006), energy (Chen, 2007), medicine and life sciences (Caruthers *et al.*, 2007). Experiences gained from these fields facilitate the development of genetically modified crops, plant protecting chemicals and precision farming techniques. Besides these, plants and/or their extracts provide a biological synthesis route of several metallic nanoparticles which is more ecofriendly and allows a controlled synthesis with well defined size and shape (Sharma *et al.*, 2009; Goodsell, 2004). The utilization of microorganisms such as bacteria, fungi, herbal extracts, sand yeasts and now fungi in the syntheses of nanoparticles is a relatively recent activity. Many fungi have been used to biosynthesize and grow nanoparticles or to reduce the activity of toxic metallic ions to non-toxic metallic ions (Mehra & Wing, 1991; Kowshik *et al.*, 2000; Watson *et al.*, 2000; Klittich & Leslie, 1988; Mukherjee *et al.*, 2002; Bhainsa & D'Souza, 2006). Agriculture and food system security, novel delivery systems for

disease treatment such as use of nanoparticles are effective and safe control measures as compared to other control measures such as use of pesticides and agrochemical which has hazardous effect on environment (Jo & Kim, 2009; Park *et al.*, 2006; Min *et al.*, 2009).

Nanotechnology also offers an important role in improving the existing crop management techniques. Agrochemicals are conventionally applied to crops by spraying and/or broadcasting. Usually only a very low concentration of chemicals, which is much below the minimum effective concentration required, has reached the target site of crops due to problems such as leaching of chemicals, degradation by photolysis, hydrolysis and by microbial degradation. Hence repeated application is necessary to have an effective control which might cause some unfavorable effects such as soil and water pollution. Nano-encapsulated agrochemicals enhanced targeted activity and less ecotoxicity with safe and easy mode of delivery thus avoiding repeated application (Green & Beestman, 2007; Boehm *et al.*, 2003; Tsuji, 2001). The control of parasitic weeds with nanocapsulated herbicides thereby reducing the phytotoxicity of herbicides on crops is a best example (Perez-de-Luque & Diego, 2009). Properly functionalized nanocapsules provide better penetration through cuticle and allow slow and controlled release of active ingredients on reaching the target weed. The use of such nanobiopesticide is more acceptable since they are safe for plants and cause less environmental pollution in comparison to conventional chemical pesticides. Plants are also considered as nanofactories, The use of biological systems for the synthesis of nanoparticles is gaining increased attention since it is more ecofriendly compared to various physical and chemical methods (Sharma *et al.*, 2009; Mohanpuria *et al.*, 2008; Garnea Torresdey *et al.*, 2002). Therefore, this study presents the antimycotic effects of different type of nanoparticles on some pathogenic fungi, *Penicillium notatum*, *Aspergillus niger* and *Nigrospora oryzae* Berk.

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