

**Effect of zinc oxide nanoparticles on *Staphylococcus aureus*   
 isolated from cowsʼ mastitic milk**

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**ABSTRACT**

The current spreading of nanomaterial applications supports the search for further possible functions of theses diminutive particles. The antibacterial potentiality of zinc oxide (ZnO) nanoparticles (NPs) against ***S. aureus*** causing mastitis was evaluated using qualitative and quantitative assays. These tests were performed in nutrient broth and nutrient agar following standard methods. In addition, the effect of different concentrations of ZnO nanoparticles on the growth of ***S. aureus*** was measured.MIC was determined using six different concentrations of ZnO nanoparticles including 16, 8, 4, 2, 1 and 0.5 mg/ml. The MIC value ***S. aureus*** was 0.5 mg/ml. The results showed that ZnO nanoparticles have antibacterial inhibition zone of 29 mm at the concentration of 10 mg/ml against ***S. aureus***., and the antibacterial activity of ZnO nanoparticles increased with increasing powder concentration in vitro.

Key word: ZnO nanoparticle, ***Staphylococcus aureus***, minimum inhibitory concentration (MIC).

**INTRODUCTION**

Recently, nanotechnology has become increasingly important in the biomedical and pharmaceutical areas as alternative antimicrobial strategy due to re-emergence infectious diseases and the appearance of antibiotic-resistant strains among a variety of disease-causing bacteria pose a serious threat to public health worldwide **(Desselberger*,* 2000 ).**

Mastitis is an important disease affecting dairy animals resulting in high economic losses to dairy producers and dairy industry as a whole estimated by 1.7 billion dollars anally in USA **(Crist *et al.,* 1997)**, so it is considered to be the most costly disease all over the world **(Sory *et al.,* 2005).**

These high losses are due to reduction in milk yield, milk becomes unfit for human consumption and treatment with costly antibiotics with cure rate 60% in field condition with a problem of milk residues **(Correa and Marine, 2002)** and culling of infected animals and in some cases may end by death of the animal. **(Santos *et al.,* 2004).** The economic impact of clinical mastitis has been estimated to be about 33–38% of the total health cost for dairy herds**( Fourichon *et al.,* 2001)**.

Resistance of mastitis pathogens to antimicrobial agents is a well-documented challenge in dairy cows. Numerous studies have determined the antibacterial susceptibility patterns of bacteria isolated from mastitis worldwide  
**( Tenhagen *et al.,* 2006).**

**S. aureus** causes different animal pathologies. In particular, it is involved in intramammary infections in cows causing economic losses and milk-safety problems **(**[**Taverna**](http://www.ncbi.nlm.nih.gov/sites/entrez?Db=pubmed&Cmd=Search&Term=%22Taverna%20F%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract) ***et al.,*2007).** Regarding the public health hazardes,***S. aureus***is a commensal organism and versatile pathogen in animals and human. It produces a broad spectrum of surface components (proteins and capsular polysaccharides) and exotoxins, they have virulence factors involved in the pathogenesis of bovine mastitis as these toxins and products are injurious to the milk producing cells of the mammary gland and impair the gland's immune defense mechanisms **(Taverna** ***et al.,* 2007).**

**Staphylococci** are facultative anaerobes that grow by aerobic respiration or by fermentation that yields principally lactic acid. They are small Gram-positive 0.5-1.5 µm spherical bacteria that occur in microscopic clusters resembling grapes and occasionally encapsulated (more virulent) **(Todar ,2005).**

Nanoparticles (NPs) are one of the promising and useful antibacterial agents that could possibly be applied in threaputics.

ZnO NPs are unique in that they are not only stable under high temperatures and pressures , but they are also generally regarded as safe (GRAS) for human beings and animals relative to organic materials (**Sawai 2003; Fu *et al.,* 2005**).

Zinc oxide NPs are inorganic antibacterial agents used in the pharmaceutical and medical industries. ZnO NPs have a significant potential for a wide range of biological applications, including as an antifungal and antibacterial agent for antibiotic resistant organisms and for preventing infections. Recent studies have demonstrated the antimicrobial activities of ZnO NPs to pathogenic microorganisms , including ***Escherichia coli*** O157:H7, ***Staphylococcus aureus***,***Streptococcus pyogenes***, ***Listeria monocytogenes***, ***Salmonella Enteritidis, Salmonella*** ***Typhimurium***, ***Bacillus cereus, Campylobacter jejuni, Botrytis cinerea*** and ***Penicillium expansum*** ( **Mirhosseini and Firouzabadi, 2013**).