An *in vitro* study for the antimicrobial activity of Nano ZnO and Pd loaded Nano ZnO

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Abstract: Nano-ZnO has shown to kill food-borne pathogens, including *Escherichia coli* (*E. coli*). Reactivity of pure nano-ZnO could be enhanced by loading with Pd, Pt or Au. This work aimed to compare *in vitro* activity of ZnO, nano-ZnO and nano-ZnO loaded with 5% nano-Pd against standard strains of *E. coli* in agar plates by the measurement of their MICs, which were found to be 2.5, 0.62 and 0.31mg/ml, respectively. To conclude nano-ZnO was four times more potent in killing *E. coli* than its non-nano counterpart and loading of nano-ZnO with nano-Pd increased the antimicrobial activity of nano-ZnO two times further.

Nano-ZnO has demonstrated to kill foodborne pathogens including *E.coli*, *Salmonella* sp and *Listeria monocytogenes* (1). The reactivity of the pure nano-ZnO could be enhanced by loading with noble metals like Pd, Pt and Au, which are known photo catalysts. The present work was designed to study the *in vitro* antimicrobial activity of nano-ZnO and nano-ZnO loaded with nano-Pd against *E. coli* in agar plates.

Nano-ZnO was purchased from the market (Aldrich, USA) and its size was characterized using XRD technique. The calculated values of the particle size ranged from 24–35 nm. To synthesize nano-ZnO loaded with 5% nano-Pd, appropriate amounts of $Pd(OAc)_2$ and nano-ZnO were mixed and grinded together. Anhydrous sulfur-free benzene was added to the mixture to dissolve $Pd(OAc)_2$ and stirred from time to time and the benzene evaporated by vacume rotary pump. $Pd(OAc)_2$ was then decomposed to nano-Pd by heating at 350°C, ramped at a rate of 1°C/min, for 5 hours in pure hydrogen atmosphere in a programmable oven and subsequently cooled down at the same rate.

Serial dilutions of nano-ZnO loaded with 5% nano-Pd, nano-ZnO and ZnO (as a control) were prepared in agar plates from 1% stock solution of each in Mueller Hinton agar (OXOID), inoculated with standard strains of *E. coli* (ATCC 25922) and incubated at 37°C for 24 hours. Their MICs were determined as the dilution giving no growth of the organism.

MICs of ZnO, nano-ZnO and nano-ZnO loaded with 5% nano-Pd were found to be 2.5, 0.62 and 0.31mg/ml, respectively. Thus nano-ZnO was almost four times more potent in killing *E. coli* than its non-nano counterpart and the loading of nano-ZnO with 5% nano-Pd increased the antimicrobial activity of nano-ZnO two times in our set up.

To conclude, the present study demonstrates killing of *E. coli* in culture media with nano-ZnO four times more than the respective bulk (micro-scaled) counterpart. Moreover, the loading of nano-ZnO with small amounts of nano-Pd enhances the antimicrobial activity of nano-ZnO and will reduce the cost for the potential use of nano-ZnO in the food safety for bacterial disinfection. It is hoped this work will open doors for further investigation of nano-drugs against infection.

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References

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