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**Title of Thesis** : **Study of Metal oxide nanoparticles for biocatalysis, protein folding and antibacterial activity**

## Abstract

Enzymes can be excellent industrial catalyst for a sustainable development (green chemistry, production of clean fuels from renewable sources, improvement of the utilization of natural resources, food chemistry, very precise biosensors and so on). However, in general, enzymes do not fulfill the requirements for industry: they are unstable, they are soluble, they undergo inhibitions, they may be poorly selective on non-natural substrates etc. Therefore, most enzymes have to be greatly improved before industrial implementation. Immobilization of enzymes makes these biocatalysts reusable and stable and thus turns the enzyme-based process into a more economically viable approach. Nanoparticles provide an ideal remedy to the usually contradictory issues encountered in the optimization of immobilized enzymes: minimum diffusional limitation, maximum surface area per unit mass and high effective enzyme loading. $TiO_2$ nanoparticles used as a matrix for immobilization of enzyme (peroxidase, cellulase, alpha amylase) and also used for the protein folding. The Immobilized enzyme retained good activity and thermal stability as compared to free enzyme. Also $TiO_2$ nanoparticles were found to effectively assist refolding of the thermally/inactivated denatured trypsin and alpha amylase enzyme. The presence of enzyme on $TiO_2$ nanoparticles was confirmed by FTIR (Fourier transform infrared spectroscopy). Further we have synthesized $TiO_2$ nanoparticles by two approaches by using using alpha amylase enzyme and *lactobacillus sp* play an important role in the reduction of titanium hydroxide. The biosynthesized nanoparticles were characterized by X-ray diffraction (XRD) and transmission electron microscopic (TEM) methods. The nanoparticles were investigated for their antibacterial effect on *Staphylococcus aureus* and *Escherichia coli*. The minimum inhibitory concentration value of the $TiO_2$ nanoparticles was found to be 62.50 µg/ml for both the bacterial strains. The inhibition was further confirmed using disc diffusion assay. It is evident from the zone of inhibition that $TiO_2$ nanoparticles possess potent bactericidal activity. Further, growth curve study shows effect of inhibitory concentration of $TiO_2$ nanoparticles against *S. aureus* and *E. coli*. Confocal microscopy and TEM investigation confirm that nanoparticles were disrupting the bacterial cell wall. As the synthesis is eco-friendly, the antibacterial properties of these nanoparticles can be further explored in future on other bacterial strains, for their use in various industrial and medical applications.