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Original Research

Fabrication and characterization of curcumin loaded ZnO nanoparticles and their in vitro antibacterial activity.

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Abstract

Nanotechnology is broadly defined as the study and development of the chemical physical and natural properties of materials, devices, and structures that differ from those found on a larger scale, and Nano patents are derived from the Japanese language. Zinc oxide nanoparticles are used in a wide-ranging application, visible light, catalytic actions, ultrasonic, deodorizing, diabetes treatment, cosmetics, lasers, paints, ultraviolet light absorbing constituents, rubber industry, catalytic agent for light flattening, and specifically in the medical and pharmaceutical sciences. Curcumin is a useful plant-based material derived from "turmeric" that has the potential to be used in the green synthesis of ZnO NPs. This is due to the influence of "polyphenol," which may also result in the formation of ZnO NPs during the reduction process. Characterization reported Spherical particles with varying size from few nanometers to about 900 nm. The antibacterial activity by disk diffusion method against *E. coli* (Gram negative), *Pseudomonas aerugionsa, Bordetella bronchiseptics & Micrococcus luteus* revealed mark able zone of inhibition that declared potent antibacterial activity of Curcumin Zinc oxide nanoparticles against gram positive bacteria more than negative ones where Ciprofloxacin was used as standard.

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Introduction:

Nanotechnology is the use of nanoparticles for medical, biological, and privilege purposes, as well as the technology that contracts with tolerances and dimensions less than 100 nanometers[1]. It can be originated naturally by usage of biomolecules, slag and soil particles; they can be plotted artificially aimed at variety of industries. Researchers have been studying green synthesized metal nanoparticles due to their exceptional properties. Accordingly, nanoparticles are used as glazes, food packaging, and pharmaceutical tenders, biological cataloging has grown[2].

Nanotechnology is broadly defined as the study and development of the chemical physical and natural properties of materials, devices, and structures that differ from those found on a larger scale, and Nano patents are derived from the Japanese language[3].Solid particles with sizes reaching from 10 to 1000nm.Drug have been liquefied encapsulated, or devoted to nanoparticle matrix, dependent on the method of preparation of nanoparticles, Nano-capsule, or Nano-spheres can be attained. Nanoparticles, Nano-capsule, or Nano-spheres can attain by the method of preparation[4]. Nano-capsule is a medium in which the drug is eternally and instantaneously circulated in a cavity colonized by exclusive polymer membrane[5]. Sustainable polymeric Nano-particles are those layered with hydrophilic polymers such as poly ethylene glycol (PEG) and elevated in long-circulating particles that have been investigated as potential drug delivery systems in recent years due to their capability to circulate prolonged period of time such as protein transporters and carriers of DNA in gene analysis[6, 15].

Zinc oxide nanoparticles have semi–conductor properties, with medicinal uses. Zinc oxide nanoparticles are used in a wide-ranging application, visible light, catalytic actions, ultrasonic, deodorizing, diabetes treatment, cosmetics, lasers, paints, ultraviolet light absorbing constituents, rubber industry, catalytic agent for light flattening, and specifically in the medical and pharmaceutical sciences[7, 14]. Curcumin is a useful plant-based material derived from "turmeric" that has the potential to be used in the green synthesis of Ag NPs[8]. This is due to the influence of "polyphenol," NPs during the reduction process. Curcumin use in the consumption of NPs has been severely restricted due to its low water solubility, alkaline pH and specificity to heat light[9, 16]. Numerous methods have been described for the green synthesis of Zinc oxide nanoparticles and silver NPs from Curcumin. Among these methods ultrasonication, physical method, chemical discount, physio-chemical synthesis, and chemical mediator system[10, 13].

In this paper, we reported the green synthesis of Curcumin zinc oxide nanoparticles in an acidic media, which can be assumed as green, sustainable, and safe for the fabricating of nanoparticles as an antibacterial constituent for food processing. As a zinc originator, was use zinc chloride as a zinc oxide precursor, and Curcumin as an antibacterial activity[11, 12].

Materials & Methods:

Preparation of Zinc oxide Nano-particles:

Aqueous solution of Zinc chloride and sodium hydroxide was used to create nanoparticles (NaOH). Separate solution of two was made in distilled water in a molar ratio of 1:2. The zinc chloride solution is combined with ethanol and stirred until it is homogeneous. NaOH solution was then dropped into the zinc chloride solution.

Preparation of Zinc oxide Nano-particles by using Curcumin:

2 mg/ mL Curcumin stock solution was prepared in ethanol fig 1. After that, Curcumin solution was added to the ZnOsolution. To complete the grafting/surface absorption of Curcumin to ZnO the mixture was stirred for 24 hours. Resulting suspension was centrifuged at 6000 rpm and washed three times with distilled water. At the end vacuum was dried and white color zinc oxide nanoparticles were collected.

Characterization of Zinc oxide Nano-particles:

The physical evidence for the formation of ZnO NPs is the color change of zinc oxide solution by adding Curcumin solution from light yellow brown to white in ZnO. The color shift was caused by the excitation of the External Plasmon Resonance.

Anti-bacterial activity:

ZnO Nano-particles were tested for antibacterial activity against four bacterial strains. *E.coli* (Gram negative), *Pseudomonas aerugionsa*, *Bordetella bronchiseptics* & *Micrococcusluteus*(Gram positive) mention in Table 1. Disk diffusion test was used to analyze the susceptibility of bacterial isolates against ZnO NPs. Freshly prepared preincubated agar plates were spread over by bacterial suspensions using sterile swabs. 6 mm disks of filter paper soaked with 50 µl of stock solutions of distilled water were placed over agar plates and incubated at 37ºC for three to seven days. The antimicrobial activity was estimated by measuring inhibitory zone diameters (mm) around the disks using digital patchy meter.

Bacterial strains (5 105 CFU/ml concentration) were exposed to various dilutions (concentrations) of zinc oxide nanoparticles. Petri dishes were incubated at 37°Cin an aerobic condition for 24 hours.

Result and Discussion:

UV-visible spectrometry:

Zinc Oxide Nanoparticles:

The scanning electron microscope confirmed the successful synthesis of variety of different morphologies of ZnO nanoparticles (SEM) in fig 2. Spherical particles with slight ovoid features were observed with diameter 40–100 nm range. Hydrothermal, micro-emulsion, solvo thermal, sol–gel and thermal decomposition of precursors have been used to prepare zinc oxide nanoparticles. The shape and size of ZnPs are affected by kinetic factors such as reactant concentration base type, pH, temperature, stir speed and surfactant. Nano-rods, Nano-plates, and Nano-spherical particles may be formed. Varying in size from few nanometers to about 900

Anti-bacterial activity:

ZnO Nano-particles were tested for antibacterial activity against four bacterial strains. *E. coli* (Gram negative), *Pseudomonas aerugionsa*, *Bordetella bronchiseptics* & *Micrococcus luteus* (Gram positive). Disk diffusion method was used. Bacterial strains (5 105 CFU/ml concentration) were exposed to zinc oxide nanoparticles. Petri dishes were incubated at 37°Cin for 24 hours.

Conclusion:

Zinc oxide Nano-particles have been synthesized, they have spherical, rod, crystal, round, short petal and long petal shapes. We examined the effect of Curcumin-loaded Zinc oxide Nano-particles as anti-bacterial agents. They have strong antibacterial activity against foodborne pathogenic bacteria *E. coli*. The spherical Nano-particles show good anti-bacterial activity as compared to others. According to SEM results, Curcumin and ZnO were uniformly dispersed in the biopolymer matrix resulting in compatible composite films. At the end of this research the current study was directed to evaluate the relative study between Zinc oxide Nano-particles by using Curcumin. The results from the experiment showed that both Nano-particles have their own biological activities.

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Table 1: Zinc Oxide nano particles implemented against various bacteria, indicating that Gram positive bacteria have a higher inhibition value than E.coli (Gram –ve bacteria). As a result, our findings indicate that it has a significant antibacterial effect.

S. No.	Micro-organism	Standard Antibiotic (ciprofloxacin)	ZnONPs
1	*E.coli*	20mm	14mm
2	*Pseudomonas aeruginosa*	30mm	15mm
3	*Micrococcus luteus*	33mm	25mm
4	*Bordetellabronchiseptics*	25mm	-ve

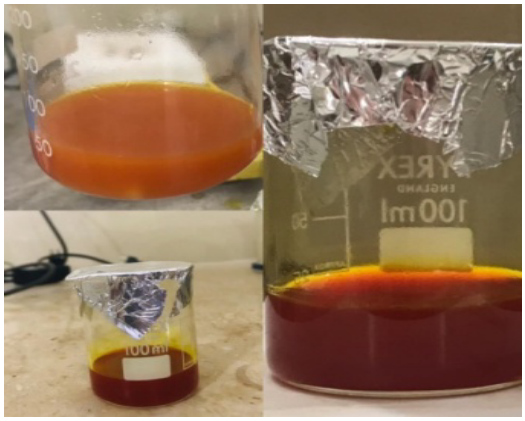

Fig 1: Curcumin stock solution

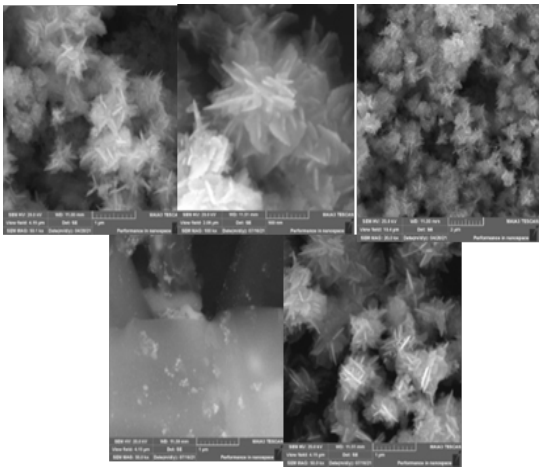

Fig 2 SEM analysis

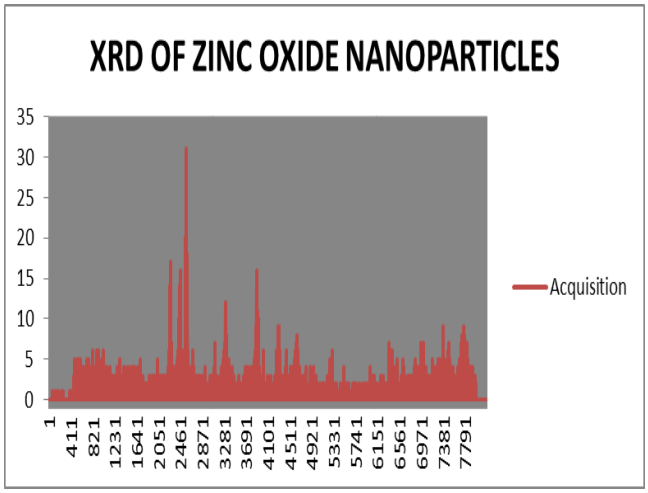

Fig 3: XRD ANALYSIS

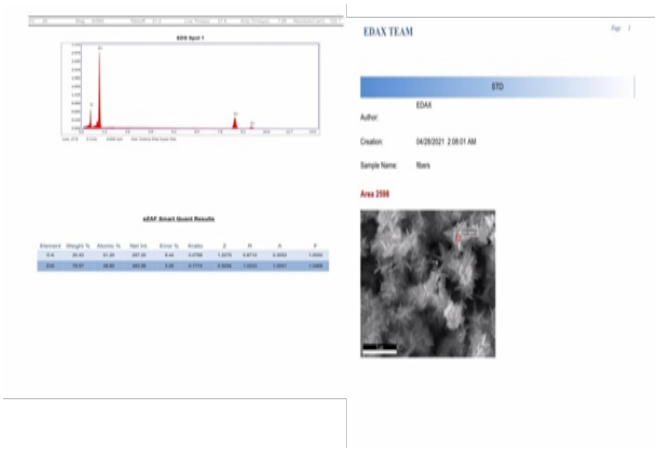

Fig 4: EDAX of ZnONPs