IRJSE International Research Journal of Science & Engineering
Int. Res. J. of Science & Engineering, Special Issue A12, February, 2023 SJIF Impact Factor 6.70
ISSN: 2322-0015 https://doi.org/10.5281/zenodo.7838936
RESEARCH ARTICLE OPEN ACCESS

Evaluation of Antibacterial Activity of synthesized ZnO nanoparticles using *Tinospora cordifolia* Leaves

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Manuscript Details
Available online on https://www.irjse.in
ISSN: 2322-0015

Editor: Dr. Arvind Chavhan

Cite this article as:
Nayak SM, Yadav PS, Waghmode MV, Waghmode PD, Bhosale SE, Kale RD, and Rajoba SJ. Evaluation of Antibacterial Activity of synthesized ZnO nanoparticles using *Tinospora cordifolia* Leaves, *Int. Res. Journal of Science & Engineering,* 2023, Special Issue A12: 131-135. https://doi.org/10.5281/zenodo.7838936

Article published in Special issue of International Conference on "Recent Trends in Materials Science, Synthesis, Characterization and Applications (RTMS-2023)" organized by Department of Physics, Anekant Education Society's, Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati, Dist Pune, Maharashtra, India (Autonomous) date, January 3-4, 2023.

Abstract

In the current research work, zinc oxide nano particles were synthesized by simple precipitation method and studied its antibacterial activity. The antibacterial activity can be successfully enhanced for some kind of bacterium after the addition of *Tinospora cordifolia* leaves extract. The structural properties of synthesized material and the effect of *Tinospora cordifolia* leaves extract on these properties were studied by using XRD. Enhanced crystalline size was observed after the addition of *Tinospora cordifolia* leaves extract while synthesizing ZnO. Its antibacterial activity is studied against gram negative bacterium (*E. coli*). These results reveal that, without T. Cordifolia leaves extract, ZnO nano particles show antibacterial activity but with the addition of 10 % T. Cordifolia leaves extract, its antibacterial activity against gram negative bacterium (*E. coli*) is increased.

Keywords: zinc oxide nano particles, *Tinospora cordifolia* leaves extract, antibacterial activity, XRD

Introduction

In the recent years, nano materials have gained a lot of attention and importance in various fields due to their exceptional properties. Nano materials have a wide range of functions and applications which are not shown by their bulk counterpart. The properties of materials are different at the nanoscale for two main reasons – large surface area and quantum size effects. The various applications of nanomaterials differ according to their size, distribution and morphology. Nanomaterials are widely used in making various devices, in textile industry, medical science, electrochemistry, pharmaceuticals and biomedicine.

Nanoparticles of desired shape and size are synthesized by using a variety of techniques. They are also synthesized by a process called green synthesis in which plant extracts are used for the synthesis of nanoparticles. Green synthesis has a bunch of advantages as compared with other chemical methods. This technique is highly environmental friendly, decreases the use of toxic chemicals and eradicates toxic waste. Hence, green synthesis of nanomaterials leads to environmental sustainability and low energy consumption.

The Earth is a home to a vast variety of life forms which are inter-related to each other in numerous ways. These life forms include plants, animals, fungi, bacteria, etc. Bacteria are single celled microorganisms. Some bacteria are harmless but some are life-threatening as they cause serious diseases and infections in animals and humans. Antibacterial activity is an important characteristic of materials that fights against the action of bacteria by either killing the bacteria or by inhibiting the bacterial growth [1-2].

Nowadays, there has been a growing increase in the antibiotic-resistant bacteria which is a serious hazard to human health. This has led to the search of new antibacterial materials that are capable of overcoming this problem. In the recent years, nanoparticles have been increasingly used to fight against bacteria as an alternative to antibiotics.

The most suitable and promising nano materials used for this purpose are metal and metal oxide nanoparticles. This is because they naturally show antibacterial activity, are safe for human beings and are stable under harsh conditions also.

Green synthesized nanomaterials like silver, silver oxide, titanium dioxide, copper oxide, zinc oxide, magnesium oxide, etc. have been studied and tested for antibacterial activity. Among these, ZnO nanoparticles are quite suitable and capable against bacteria. This is because they act as good surface material, have low toxicity, inexpensive, show good UV- absorption, exhibit high catalytic efficiency, show good adsorption and absorption abilities and most importantly ZnO nanoparticles naturally exhibit strong resistance to microbes. Hence, ZnO nanoparticles are extensively used in the biomedical field and nanomedicine [3-4].

ZnO nanoparticles can be synthesized by various methods like sol-gel, coprecipitation, hydrothermal, etc. But green synthesized ZnO nanoparticles are highly preferred because of the ease of preparation, increased antibacterial activity and eco-friendly nature.

Tinospora Cordifolia is a vine of Menispermaceae family indigenous to the Indian subcontinent. *Tinospora cordifolia* leaves exhibit excellent antibacterial properties. They are naturally anti-inflammatory, anti-allergic, anti-diabetic, anti-arthritic and anti-microbial. Hence, they enhance the antibacterial activity of the material to which they are added [5-6].

The objective of current research work is to synthesize *Tinospora cordifolia* leaves extract with ZnO nano particles and to determine its antibacterial activity.

Botanical Classification:
The Plant is properly known as Guduchi. The Botanical Classification Of this medical herb is given below
Botanical Name – *Tinospora Cordifolia*
English Name– Heart leaved moonseed
Sanskrit Name – Amrita Hindi Name – Giloy
Marathi Name – Gulvel

Scientific Classification:
Kingdom- plantae
Order – Ranuculates
Family- Menispermaceae
Genus- Tinospora
Species- *Tinospora Cordifolia*

Methodology

1. Preparation of Zno Nanoparticles:
ZnO nanoparticles were synthesized by direct precipitation method. Zinc nitrate ($Zn(NO_3)_2.6H_2O$) and KOH are used as precursors. Aqueous solution of zinc

nitrate (0.2M) and KOH (0.4 M) were prepared with deionized water. Followed by this, under vigorous stirring, KOH solution was slowly added to zinc nitrate solution at room temperature. It results in the formation of white suspension. The resultant suspension was washed number of times with double distilled water and absolute alcohol. Then, obtained white suspension was subjected to centrifugation and solid product was separated. Collected pest was dehydrated at 60°C under the IR lamp for 2 hours. Then for homogenation, solid product was grinded in agate mortar [7].

2. Collection of *Tinospora Cordifolia* leaves:

The fresh leaves of *Tinospora Cordifolia* (T. Cordifolia) were collected early in the morning and were washed thoroughly 2–3 times with running tap water and sterilized with double-distilled water. The leaves sample was allowed to dry at room temperature (~32°C) and grind to obtain powder form.

3. Extraction of *Tinospora Cordifolia* leaves:

20 gm of T. Cordifolia leaves powder in dried form was added to 100 ml of double distilled water and magnetically stirred for 2 hr at 60^0C. Brown colored solution was obtained (Its schematic representation is shown in Fig. 1). After cooling to room temperature, obtained solution was filtered through Whatman No. 1 paper. For further study, pre calculated amount of T. Cordifolia leaves extract (0, and 10 ml) was mixed with already prepared 2 gm zinc oxide nanoparticles. The mixture was continuously stirred for homogeneous mixing. During the process of constant heating and stirring gel was formed after removal of excess water. This gel is kept under IR lamp for 2 hr, it was decomposed and whitish colored powder was formed.

The crystalline properties of powder were studied by using X-ray diffractometer (Philips PW-3710) with Cu (Kα) as radiation source. The morphological properties and elemental properties were analyzed using field emission scanning electron microscope (FE-SEM, Hitachi S-4200).

4. Antimicrobial studies:

A bacterial strain of interest is grown in pure culture. Using a sterile swab, a suspension of the pure culture is spread evenly over the face of a sterile agar plate. The antimicrobial agent is applied to the center of the agar plate. A hole can be bored in the center of an agar for a liquid substance. The agar plate is incubated for 18-24 hours (or longer if necessary), at a temperature suitable for the test microorganism.

Fig. 1: Extract preparation

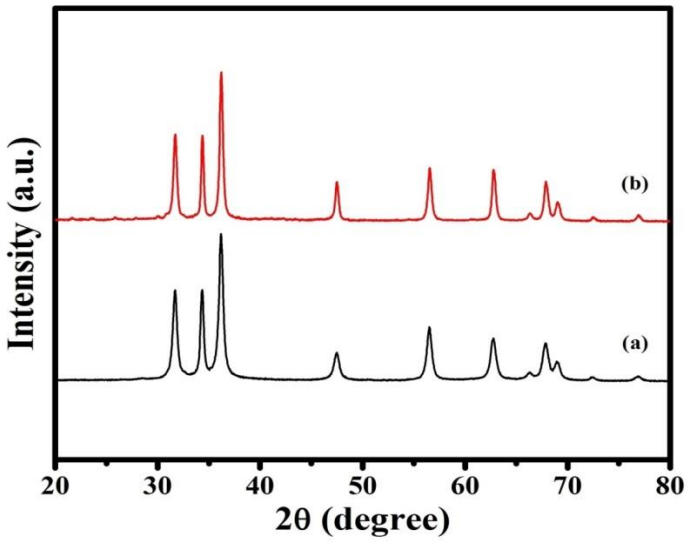

Fig. 2: XRD Pattern of (a) ZnO Nanoparticles and (b) ZnO + 10 % T. Cordifolia Leaves Extract

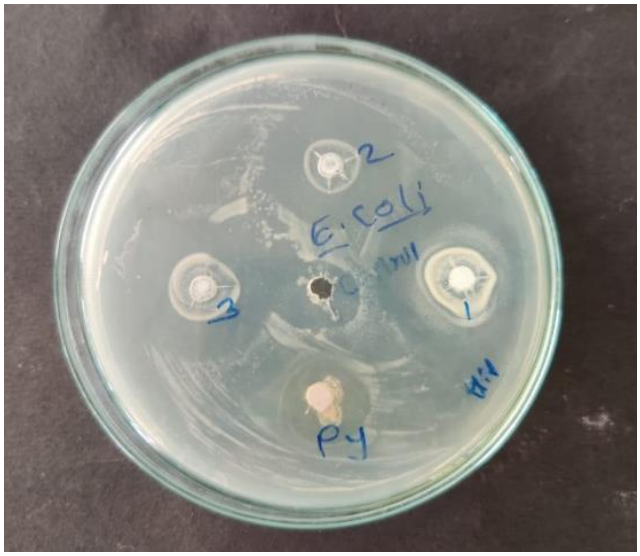

Fig. 3: Antibacterial activity was performed against gram negative bacteria (E coli)

Result and Discussion

The crystal phase composition of synthesized pure ZnO and ZnO+ 10% T. Cordifolia Leaves extract nano particles is investigated by using X-ray diffraction (XRD) pattern as shown in Figure 2(a–b). All patterns match well with JCPDS card no. 36-1451 of ZnO. The reflection (100), (002), (101), (102), (110), and (103) corresponding to ZnO are present in XRD patterns. The average crystallite size (D) was calculated using Scherrer formula. The observed average crystallite size is 34 and 37 nm for ZnO and ZnO + 10% mLT. Cordifolia Leaves extract respectively. It clearly indicates T. Cordifolia leaves extract promotes to enhance crystalline size of material.

A study of antibacterial activity was performed against gram-negative bacterium (*E. coli*) and it is shown in Figure 3. This results shows that, without T. Cordifolia

leaves extract, ZnO nano particles show antibacterial activity against gram-negative bacteria (*E. coli*). However, with addition of 10% T. Cordifolia Leaves extract, increased antibacterial activity against gram-negative bacteria (*E. coli*).

Conclusions

The present study for antibacterial activity of ZnO nano particles using 10 % T. Cordifolia leaves extract provides environmentally friendly, cost effective, and simple technique to synthesis metal oxides. The crystalline size increases with the addition of extract. Its antibacterial activity is studied against gram negative bacterium (*E. coli*). These results reveal that, without T. Cordifolia leaves extract, ZnO nano particles show antibacterial activity but with the addition of 10 % T. Cordifolia leaves extract, its antibacterial activity against gram negative bacterium (*E. coli*) is increased.

Conflicts of interest: The authors stated that no conflicts of interest.

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