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Green Synthesis and Characterisation of Zinc Oxide Nanoparticles From Annona Squamosa Leaves

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ABSTRACT

Green synthesis or phytofabrication is method of nanoparticle synthesis where plant extracts are used as reducing agents instead of harsh and toxic chemicals. Green synthesis is considered to be a relatively safe as compared to the physical and chemical method of synthesis. Here in this paper, we have reported the synthesis of *Annona squamosa* leaves extract mediated zinc oxide nanoparticles. The obtained nanoparticles were subjected to various analysis. The presence of O-H, C-H and C-N groups was observed in the FTIR. The *Annona squamosa* mediated zinc oxide nanoparticles has hexagonal shape and primitive geometry. The SEM images of revealed that these nanoparticles were spherical in shape. However, agglomeration of nanoparticles was also noted.

Keywords : Green synthesis, *Annona squamosa*, zinc oxide nanoparticles

Introduction

Nanotechnology is relatively new field of science, which deals with synthesis of nano sized particles. These nanoparticles are wieldy used in various fields, however they are extensively used in field of biomedicine due their typical physiochemical properties [1]. Metallic or metal oxide nanoparticles are especially used in bioimaging, drug and gene delivery. They are also used as an anticancer and antibacterial agent[2].

Zinc (Zn) is an essential element of body which is mainly present in organs like brain, muscles and bone. It acts as an antioxidant, helps in bone metabolism and blood clotting. Moreover, it activates several enzymes that are involved in protein synthesis. Similar to the elemental form of Zn, the zinc oxide nanoparticles (Zn NPs) have compatibility towards mammalian cells and are relatively less toxic [3]. The Zn NPs are mainly synthesised by chemical methods such as: mechanochemical process, controlled precipitation, sol-gel method, solvothermal method and etc… These methods are not feasible and uses toxic chemicals [4]. To over come this challenge, a recent shift towards green synthesis has been noted. Green synthesis is ecofriendly and economical method of nanoparticle synthesis because it uses plant extracts as capping and stabilizing agents[4].

Annona squamosa (AS), also known as custard apple or "*sitaphal*" is a tropical fruit which belongs to the Annonaceae family. The fruit is commonly eaten in India and is used as a natural flavouring agent in ice-creams. This fruit has various health benefits as well because it is rich source of vitamin B1 and potassium. Various reports have shown that apart from fruit; leaves, stems, seeds and fruit peel are also rich in phytochemicals. The leaves of

Annona squamosa (AS) has abundant essential oils such as: limonene, α- pinene, elemene, cubebene and etc. the *Annona squamosa* leaves also has polyphenolic compounds such as rutin, gallic acid, ferulic acid, quercetin, kaempferol and caffeic acid[5].[6] and group reported that these leaves have free radical scavenging activity.

In present study the *Annona squamosa* leaves are used to synthesise zinc oxide nanoparticles and its primary characterisation was done.

2. Material and methods

2.1. Collection of plant sample and extraction

The *Annona squamosa* leaves were collected from the rural areas of Nagpur and the leaves were identified with the help of a taxonomist The leaves were washed, dried and grided. The grinded powder was sieved, the fine powder was collected and was used for further extraction process. For extraction 1 g of powder was added to 100 ml of distilled water in 250 ml of beaker, the mixture was stirred for 1 hour at 85°C. The mixture was allowed to cool at room temperature and was filtered using Whatman's filter paper. The extract was collected and was used for further use.

2.2. Green synthesis of zinc oxide nanoparticles

For *Annona squamosa* leaves mediated zinc oxide nanoparticle (AS ZnNPs) synthesis 10 ml of leaves extract was added to 100ml of zinc sulphate (0.5 M), the solution was continuously stirred for 3 hours at 90°C, the colour change from orangish to light yellow ascertains the synthesis of AS ZnNPs. The colloidal solution of nanoparticles was centrifuged at 5000 rpm for 10 minutes and were washed with ethanol followed by acetone. The precipitate was transferred into crucibles and were calcinated in muffle furnace for 2 hours at 400°C. Subsequently, light white coloured nanoparticles were collected.

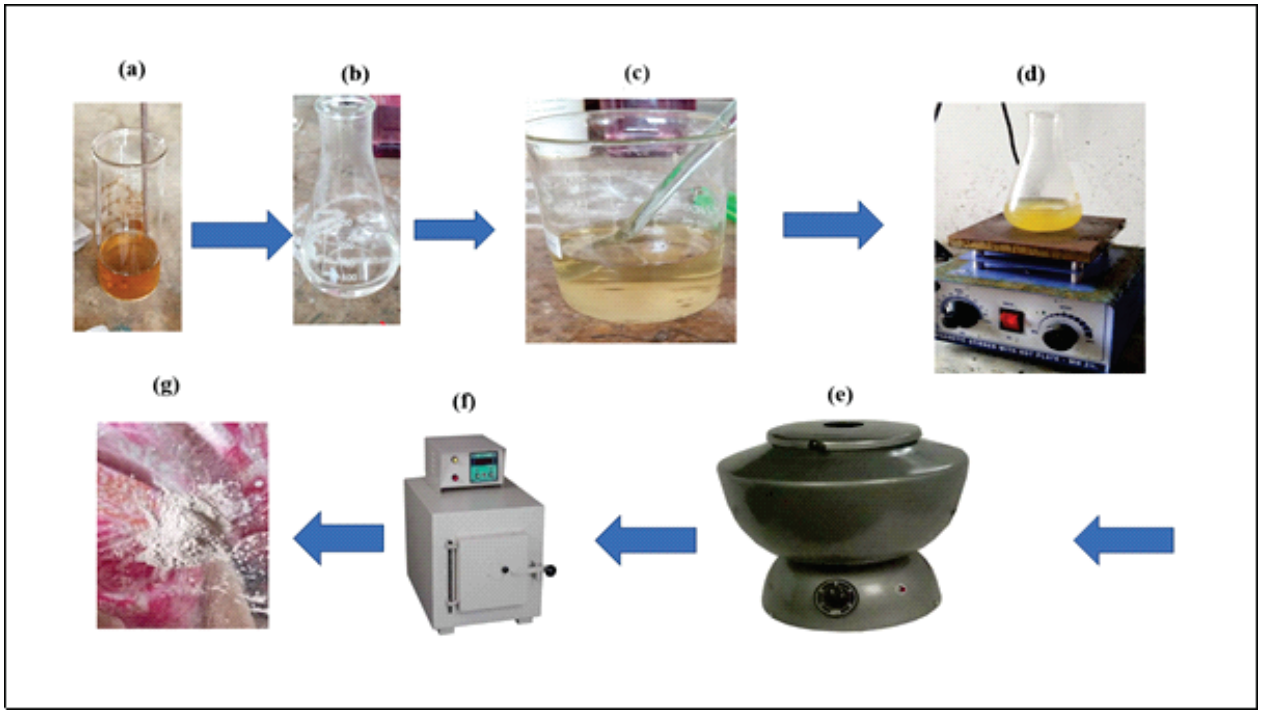

Fig1: Synthesis of *Annona squamosa* mediated zinc oxide nanoparticles (AS ZnNPs)

2.3. Preliminary characterization

The change in colour from orangish to light yellow at the end of incubation suggested the phytofabrication of *Annona squamosa* mediated zinc oxide nanoparticles (AS ZnNPs). The crystalline nature of nanoparticles was determined through XRD and for determination of functional groups FTIR technique was used. The morphology of nanoparticles was studied through SEM images.

3. Results

3.1. Fourier-transform infrared spectroscopy: The FTIR spectra of AS ZnNPs is represented in fig 2. The presence of different functional groups is determined by FTIR analysis. In present FTIR results different peaks were noted, these peaks correspond to O-H, C-N and C-H.

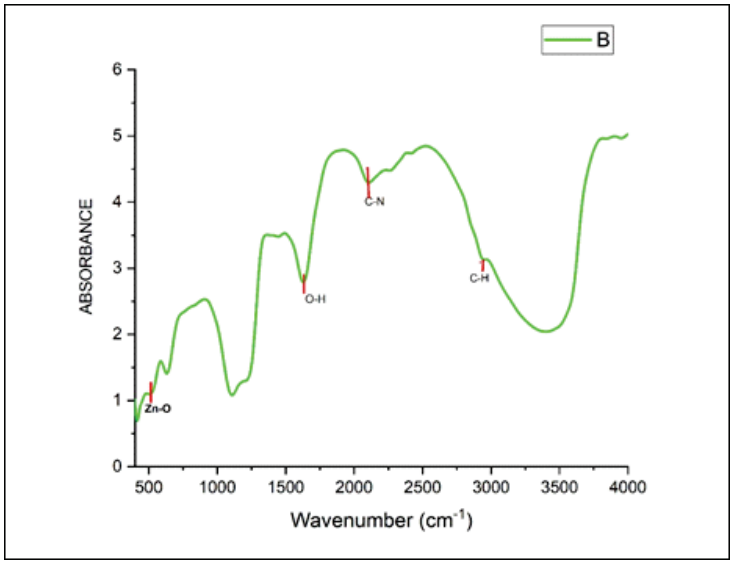

Fig 2: FTIR analysis of *Annona squamosa* mediated zinc oxide nanoparticles (AS ZnNPs)

3.2. X ray diffraction analysis

The X ray diffraction pattern of AS ZnNPs is shown in fig 3. The XRD pattern of nanoparticles reveals the crystalline or amorphous nature of nanoparticles. In present study several peaks were noted at 100, 002, 101, 102, 110, 103 and 112. According to JCPDS file no 89-0510 these peaks indicate hexagonal wurtzite crystalline nature of AS ZnNPs.

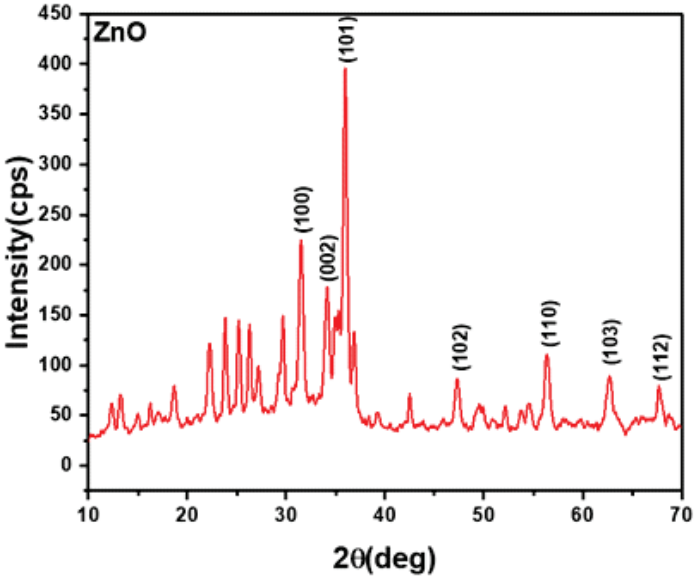

Fig 3: XRD analysis of *Annona squamosa* mediated zinc oxide nanoparticles (AS ZnNPs)

3.3. Scanning electron microscope images

The morphology of nanoparticles is studied by scanning electron microscope. In present experiment it was noted that the green synthesized AS ZnNPs were highly agglomerated. However, in few images the spherical shape of nanoparticles was visible (fig 4,5).

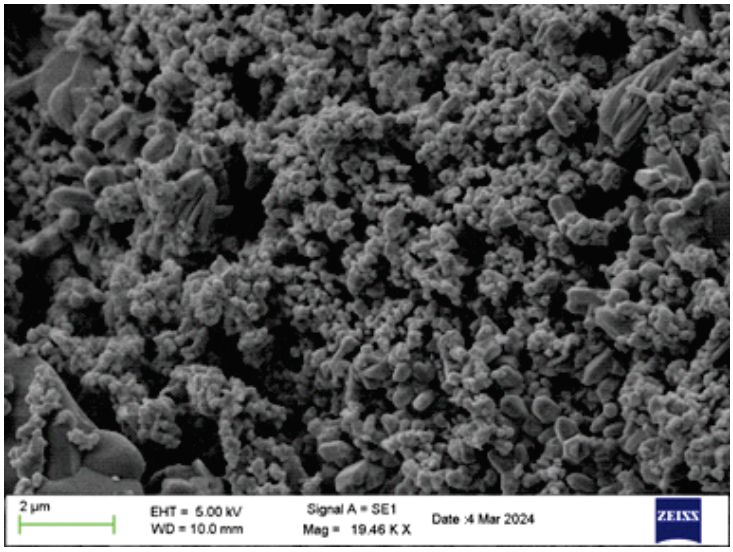

Fig4: *Annona squamosa* mediated zinc oxide nanoparticles (AS ZnNPs)

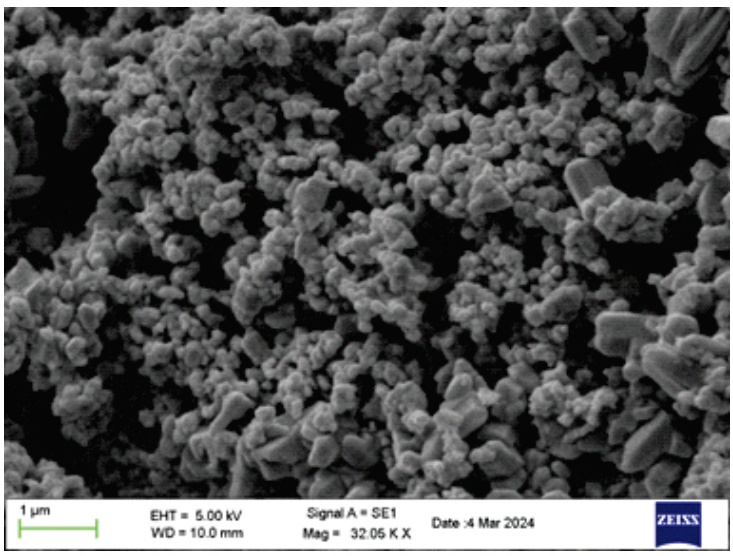

Fig5: *Annona squamosa* mediated zinc oxide nanoparticles (AS ZnNPs)

4. Discussion

Metallic nanoparticles are promising candidates in field of nanotechnology because of its small size and large surface area [7]. The metal oxide nanoparticles are extensively used in drug delivery, tissue or tumour imaging, photothermal therapy and water purification. The commonly used metals or metal oxides nanoparticles are: sliver, gold, iron oxide, titanium oxide and etc. Out of all these metals or metal oxides nanoparticles, zinc oxide nanoparticles attract lots of attention due to its physical and chemical properties. These properties depend upon the size of zinc oxide nanoparticles. The size of these nanoparticles can be altered by its route of synthesis [8]. Researchers have shown lots of interest in green synthesis method as it is cost effective and ecofriendly. This method involves use of plant extracts as

reducing and capping agents [9]. In present study, *Annona squamosa* mediated zinc oxide nanoparticles were synthesised. These nanoparticles were characterised by using various methods and techniques such as: XRD, FTIR and SEM.

The FTIR results of these AS ZnNPs showed presence of O-H, C-N and C-H, these groups correspond to hydroxyl groups, aromatic amine and alkanes. The presence of O-H indicates the presence of polyphenolic compounds. Various reports have shown that the polyphenolic compounds acts as reducing and capping agents, thereby facilitating the synthesis of nanoparticles[10]. Our results are similar to the findings of[10].

The crystalline nature of AS ZnNPs was determined by XRD analysis. The results of XRD analysis showed various peaks at 100, 002, 101, 102, 110, 103 and 112. These peaks align with JCPDS file no 89-0510 and the results suggests that the phytofabricated AS ZnNPs had hexagonal wurtzite crystalline nature. Our findings are similar to the findings of[11], who synthesised ZnNPs using *Bridelia ferruginea* extract.

The morphology of these nanoparticles was determined scanning electron microscope (SEM) images. The green synthesised AS ZnNPs were highly agglomerated, however, a few spherical ZnNPs were noted. The agglomeration of ZnNPs was also reported by[12], the agglomeration of nanoparticles could be due to the presence of phytochemicals on the surface.

5. Conclusion

The zinc oxide nanoparticles were green synthesised using *Annona squamosa* leaves extract. The *Annona squamosa* leaves extract was found to be rich in polyphenolic compounds, these compounds are responsible for formation of zinc oxide nanoparticles. These nanoparticles were crystalline, agglomerated and were irregular in shape. Further characterisations of these nanoparticles are needed before antimicrobial studies.

6. References

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