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Maranta arundinacea root mediated zinc oxide nanoparticles and its enhanced antibacterial activity

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ABSTRACT

The nanomaterials and nanoparticles are called as a wonder of the modern medicine. The zinc oxide nanoparticles (ZnoNPs) have also used as the antimicrobial applications (the disease causing microbes isolated from different clinical samples and plant disease samples), agriculture, and anticancer therapy. The production of ZnO NPs increased day by day and increased the applications in exposure to humans and animals. The main aim of this present study is to observe the enhanced antibacterial activity of *Maranta arundinacea* root mediated zinc oxide nanoparticles. The Zinc Oxide nanoparticles is synthesized using *Maranta arundinacea* root and the enhanced antimicrobial activity was checked with the addition of antibiotics. The root extract of *Maranta arundinacea* react with zinc sulphate solution and forms zinc oxide nanoparticles. The nanoparticles formation was preliminarily confirmed using visual observation and followed by UV-vis spectroscopic analysis. In this study, we found that the zone of inhibition is well seen in oral pathogens such as *Lactobacillus sp* and *Streptococcus mutans*, the values are found to be increased as the zone of inhibition increases. Based on our results the arrow root mediated zinc oxide nanoparticles are the better drug of choice for the control of *S. mutans* a major causative agent in the oral diseases.

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INTRODUCTION

The field of nanotechnology is one of the best researches in modern medical science. Nowadays, Nanotechnology is emerging as a rapidly growing field with its applications in science and technology for the research at nanoscale level. ZnO nanoparticles can exhibits certain antimicrobial activity. In this study, enhanced antibacterial activity of arrow root mediated zinc oxide nanoparticles was observed clearly (Malini *et al.*, 2016; Menon *et al.*, 2018; Agarwal *et al.*, 2018).

Green synthesis is important for the researchers to identify the characteristic feauture of the particular plants used for research. Hereby the green synthesis of arrow root was taken. Zinc oxide nanoparticles are well named for their antimicrobial properties. These nanoparticles can be effective against pathogenic microorganisms. The enhanced antibacterial activity of zinc oxide nanoparticles would be clearly observed in this type of study. Certain researchers identified and stated that zinc oxide nanoparticles exhibit a tremendous property and can be used to discover some of the medicines for future use.

Some research includes that zinc oxide nanopar-

Figure 1: Synthesis of zinc oxide nanoparticles using arrow root

ticles are well identified for its optical property (Karthiga *et al.*, 2019; Rajeshkumar and Naik, 2018; Menon *et al.*, 2017). Most of the industries and food processing units uses zinc oxide nanoparticles as it is less toxic when compared to other type of nanoparticles. Zinc oxide nanoparticles is safest nanoparticles and is widely used in sunscreen lotions as it is a safest barrier o human skin (Santhoshkumar *et al.*, 2017; Rajeshkumar and Bharath, 2017; Agarwal *et al.*, 2017). ZnO nanoparticles have been incorporated in certain culture media and anti microbial activity of certain bacteria is observed. In this research, zinc oxide nanoparticles are incorporated and observed enhanced antibacterial activity.

The antimicrobial activity of ZnO nanoparticles has been tested against Streptococcus mutans and lactobacillus which have presented sensitivity to these nanoparticles. Some research findings proved that zinc oxide nanoparticles are well known for its anti microbial activity against certain gram negative bacteria such as pseudomonas , E.coli etc. (Shanmugam, 2016; Malarkodi and Rajeshkumar, 2017; Rajeshkumar, 2018). Bacterial infection may also present in wounds and certain other areas. Therefore, antibacterial activity of the ZnO nanoparticles is also used in treating bone diseases and wounds.

According to the published results, ZnO nanoparticles is more effective antimicrobial agent than other nanoparticles (Sujatha *et al.*, 2018). In addition ZnO nanoparticles, it is also used in certain processing units and it is a cost-effective nanoparticles that is known for its high antibacterial activity (Rajeshkumar *et al.*, 2018a). It is important to note, that ZnO nanoparticles exhibit some advantages in comparison with other nanoparticles due to their lower cost, white appearance and UV blocking properties. Moreover, some studies indicated high specific toxicity of zinc oxide nanoparticles (ZnO NPs) against bacteria and only minimal effects were observed on human cells.

It opens new prospects of their application in agriculture and biomedicine (Agarwal *et al.*, 2017). Arrowroot (Maranta arundinacea) is a tuber crop that helps in safest food processing and pharmaceutical industries. Arrow root is said to be the richest natural starch containing plant as it contains 10 to 25 % starch. Arrowroot has some medicinal properties that are identified earlier and it is known for its highest digestible activity (Kim and Fung, 2004) . Arrow root is one of the topical plant that can exhibit anti microbial activity against cough, diarrhoea etc.Arrow root is also used for the tea manufacturing nowadays (Jyothi *et al.*, 2009).

MATERIALS AND METHODS

Preparation of root extract

Fresh arrow root powder extract is collected from the market, Chennai. 1 g of these freshly prepared arrow root powder extract is mixed with 100 mL of water and boiled for 3-5 minutes in the heating mantle. Then these powder extract is filtered using filter paper into a conical flask.

Preparation of ZnO nanoparticles

0.861 gms of zinc sulphate powder is added to 50 ml of distilled water. To this 50 ml of freshly prepared arrow root extract is added.

The solution is kept in the shaker. Readings should be taken for every two hours for analysing the synthesis of nanoparticles. Then after two hours, the solution should be kept in magnetic stirrer and readings are measured.

After reaching the desired pH the mixture was allowed in the stirrer for 2 h until the formation of white precipitate was observed.

This mixture is centrifuged for 10 minutes and then the pellet was collected.

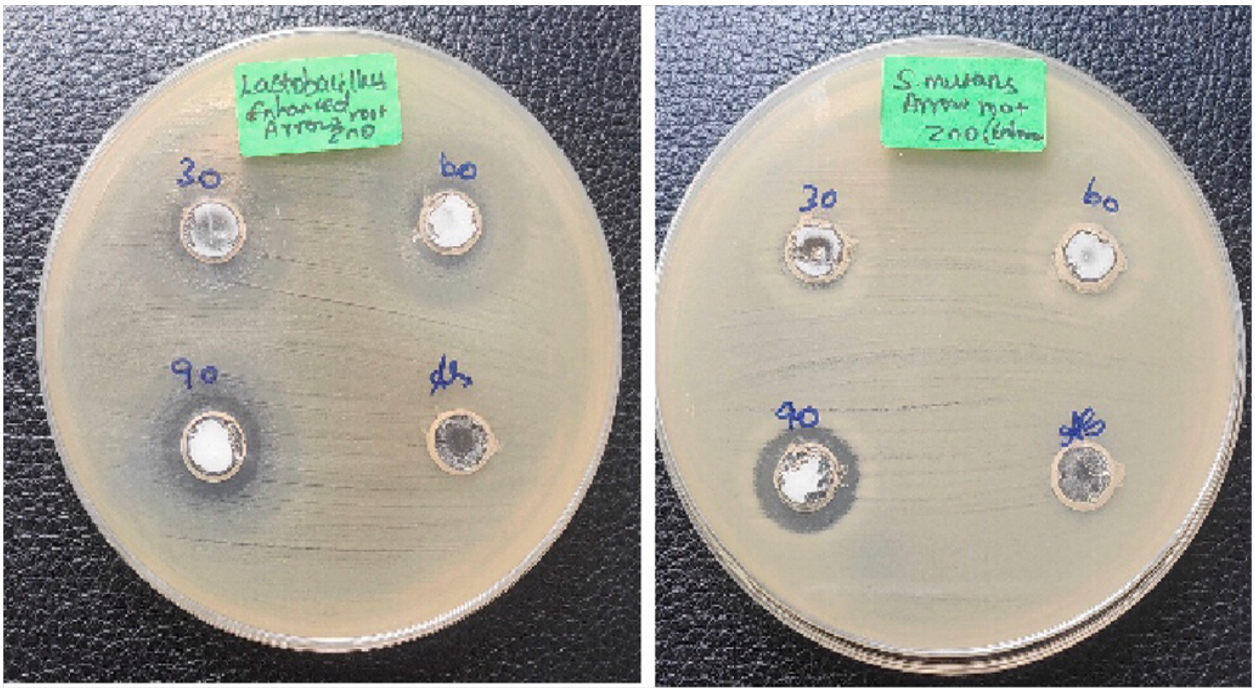

Figure 2: Enhanced antibacterial activity against Lactobacillus and S.mutans.

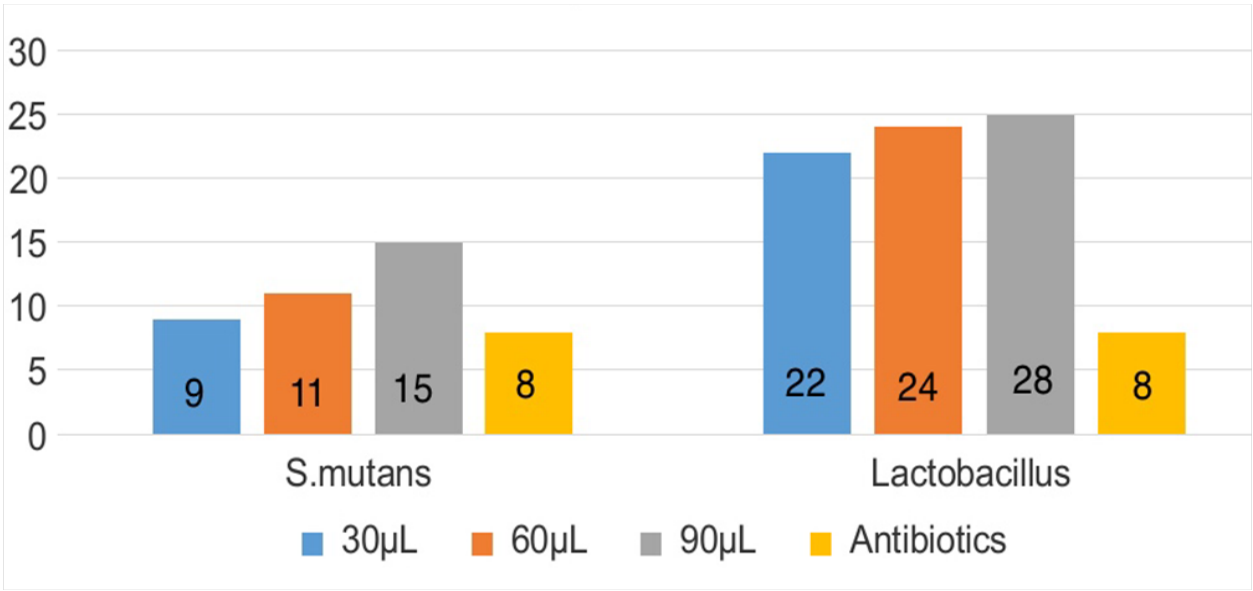

Figure 3: Graphical representation of enhanced antibacterial activity using arrow root zinc oxide nanoparticles

Enhanced antibacterial activity

For enhanced antibacterial activity, antibiotic powder is mixed with distilled water. Then the antibiotic solution is added to prepared zinc oxide nanoparticles and then inoculated in the agar culture medium. Then it will allowed be to culture. The result was then observed.

RESULT

The Figure 1 shows the green synthesis of zinc oxide nanoparticles synthesized using arrow root. The cloudiness confirms the nanoparticles formation.

Figure 2 and Figure 3 explains that ,In the present study, test for antimicrobial activity was carried out using the Agar well diffusion method. Two agar plates for Identifying the inhibitory effect over Lactobacillus and S. mutans respectively, were used. Each plate had four wells each with different nanoparticle concentrations being 30 μL, 60 μL and 90 μL and antibiotics, while the fourth was a standard. Against Lactobacillus, the diameter of zone of inhibition of the nanoparticles at 30 μL, 60 μL , 90

μL and antibiotics is observed to be 22 mm, 24 mm, 28 mm and 8 mm respectively.

With S. mutans, the diameter of zone of inhibition of the nanoparticles at 30 μL, 60 μL , 90μL and antibiotics was obtained as 9 mm, 11 mm, 15 mm and 8 mm respectively. The zinc oxide nanoparticles were actively involved in the antimicrobial and anticancer activity (Rajeshkumar *et al.*, 2018b,c).

DISCUSSION

Arrow root is a tropical tuber native from Indonesia. It has high level of enhanced antibacterial activity when added with antibiotic Amoxicillin. Thus it has very effective zone of inhibition against bacterial disease. Zone of inhibition is well observed in this nanoparticles. Hence it is used as better drug of choice.

CONCLUSIONS

From the present study it can be concluded that zinc oxide arrow root nanoparticles have a considerable enhanced antibacterial activity at high concentrations. This can be used for further investigation in employing them as less bio-toxic alternatives to already existing chemically synthesised drugs.

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Conflict of Interest

The authors declare that they have no conflict of interest for this study.

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