ANTIMICROBIAL ACTIVITY OF SELENIUM NANOPARTICLES AND *PTEROCARPUS SANTALINUS* BASED MOUTHWASH

RUNNING TITLE - Antimicrobial activity of Selenium nanoparticles and *Pterocarpus santalinus* based mouthwash

ABSTRACT

Introduction - Their unique size-dependent properties make these materials superior and indispensable in many areas of human activity. Selenium possesses excellent photo electrical and semiconductor properties which make it extensively used in duplicate, photography, cells and rectifiers. Selenium is also one of essential trace elements in the human body and has great importance in nourishment and medicine. In India, medicinal plants are widely used by all sections of people either directly as folk remedies or in different indigenous systems of medicine or indirectly in the pharmaceutical preparations of modern medicines. The aim of the present study is to determine antimicrobial activity of selenium nanoparticles and *Pterocarpus santalinus* based mouthwash.

Materials and methods - Antimicrobial activity of respective nanoparticles against the strain staphylococcus aureus, Bacillus and E Coli. MH Aagar was utilized for this activity to determine the zone of inhibition. Muller hinton agar was prepared and sterilized for 45 minutes at 120 lbs. Media poured into the sterilized plates and let them stabilize for solidification. The wells were cut using the well cutter and the test organisms were swabbed. The nanoparticles with different concentrations were loaded and the plates were incubated for 24 hours at 37 degree celsius. After the incubation the zones of inhibition were measured.

Result - The highest zones of inhibition were exhibited against two bacterial strains Staphylococcus aureus and Staphylococcus mutans proving that it acts as a good antibacterial against S.aureus and S.mutans infections.

KEYWORDS: *Pterocarpus santalinus*, selenium, nanoparticle, microbial activity

INTRODUCTION

In India, medicinal plants are widely used by all sections of people either directly as folk remedies or in different indigenous systems of medicine or indirectly in the pharmaceutical preparations of modern medicines (1), (2,3). A survey by UNCTAD has shown that 33% of total drugs produced by the industrialized nations are plant derived and microbes are considered, 60% of medicinal products are of natural origin. (4), (5)(6). Rig Veda mentions 67 plants having therapeutic ef- fects, Yajurveda lists 81 plants and Atharveda 290 plants (7)(7,8). The World Health Organization recently compiled a list of over 20 000 medicinal plant species. Medicinal plants and their products from India are used to treat a variety of ailments including catarrh, bronchitis, pneumonia, ulcers, and diarrhoea (9), (10), (10,11).

Researchers are increasingly turn- ing their attention to folk medicine looking for new leads to develop better drugs against cancer, as well as viral and microbial infections (12),(13),(14). Although hundreds of plant species have been tested for antimicrobial properties, the vast majority have not yet been adequately evaluated. In India alone, 2000 different plants are used for medicinal preparations for both internal and external use, according to National Health Experts (15), (16). Among them only 200 are of animal origin, and 300 of mineral origin, while 1500 drugs are extracted from various plants. The development of techniques for the controlled synthesis of metal nanoparticles of well-defined scale, shape, and composition is a major challenge in nanotechnology. Electronic, magnetic, catalytic, and optical properties of metal nanoparticles and nanocomposites vary from those of bulk metals (17),(18),(19). Nanomaterials are at the forefront of nanotechnology's rapidly evolving sector.

Their unique size-dependent properties make these materials superior and indispensable in many areas of human activity (20),(21),(22). Selenium possesses excellent photo electrical and semiconductor properties which make it extensively used in duplicate, photography, cells and rectifiers (23). Selenium is also one of essential trace elements in the human body and has great importance in nourishment and medicine (24). It has been reported that the redness of selenium nanoparticles has high biological activities and low toxicity (25–27). Medical diagnostic field also developed to use the selenium nanoparticle and also studies on the increase efficiency of glutathione peroxidase and thioredoxin reductase. Elemental selenium is one of those materials. Nowadays, selenium is well-known as an essential micronutrient of fundamental importance to human and animal health (28) .An especially interesting field of research regarding the antimicrobial activity of SeNPs, which recently gained attention, is the inhibition of biofilm formation and activity against resistant microbial strains (29), (30), (31), (32), (33,34). Previously our team has published extensive research on various aspects (35–54), this vast research experience has inspired us to research about the present study. The aim of the present study is to determine antimicrobial activity of selenium nanoparticles and *Pterocarpus santalinus* based mouthwash.

MATERIALS AND METHOD-

Plant collection -

The leaf, stem, and bark of P. santalinus Linn. f. were collected . They were thoroughly washed with tap water and dried under shade. The dried plant parts were homogenized to a fine powder and stored in airtight bottles and later used for extraction.

Plant extract preparation -

Commercially available dry powder of *Pterocarpus santalinus* was used for this experiment. This experiment was conducted in Saveetha Dental College,Chennai,Tamilnadu. This experiment was carried out by dissolving 1g of *Pterocarpus santalinus* in 100ml of water. This moisture was then boiled in a heating mantle st 70 degrees celsius for up to 10 minutes. The boiled mixture was then filtered using Whattman number 1 filter paper to obtain the plant extract. Then 40ml of plant extract was measured using a measuring cylinder and the mixture was added to 60ml of 1mM selenium dissolved in 60 ml distilled water.

Preparation of mouthwash -

To an eppendorf tube, 10 ml of distilled water was taken then 0.3g of sucrose was measured using an electrical weighing scale and was added to the tube containing the water. The mixture was mixed well and then 0.01g of sodium lauryl sulphate and 0.001g of sodium benzoate were added and mixed well. Then 12 drops of the plant pellets were added to the above mixture followed by adding 2 drops of peppermint oil.

Antimicrobial activity -

Antimicrobial activity of respective nanoparticles against the strain staphylococcus aureus, Bacillus and E Coli. MHAagar was utilized for this activity to determine the zone of inhibition. Muller hinton agar was prepared and sterilized for 45 minutes at 120 lbs. Media poured into the sterilized plates and let them stabilize for solidification. The wells were cut using the well cutter and the test organisms were swabbed. The nanoparticles with different concentrations were loaded and the plates were incubated for 24 hours at 37 degree celsius. After the incubation the zones of inhibition were measured.

RESULT -

FIGURE 1 - GREEN SYNTHESIS OF SELENIUM NANOPARTICLES AND *PTEROCARPUS SANTALINUS* BASED MOUTHWASH

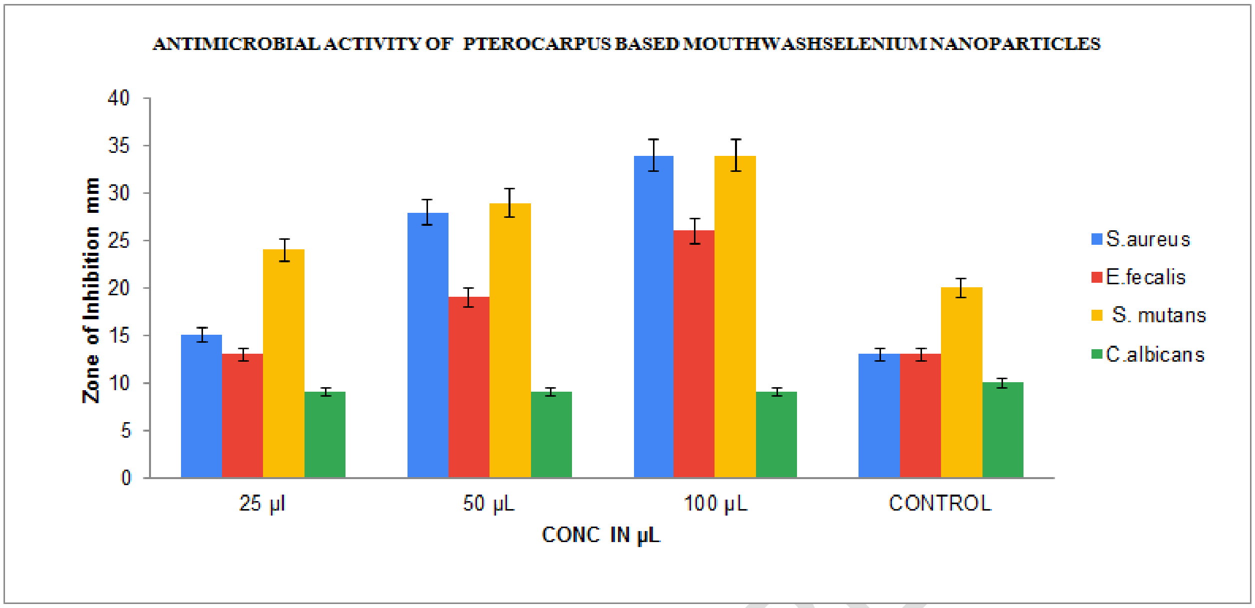

FIGURE 2 - Antimicrobial activity of P.santa based mouthwash selenium nanoparticles, data implies as mean±SEM .

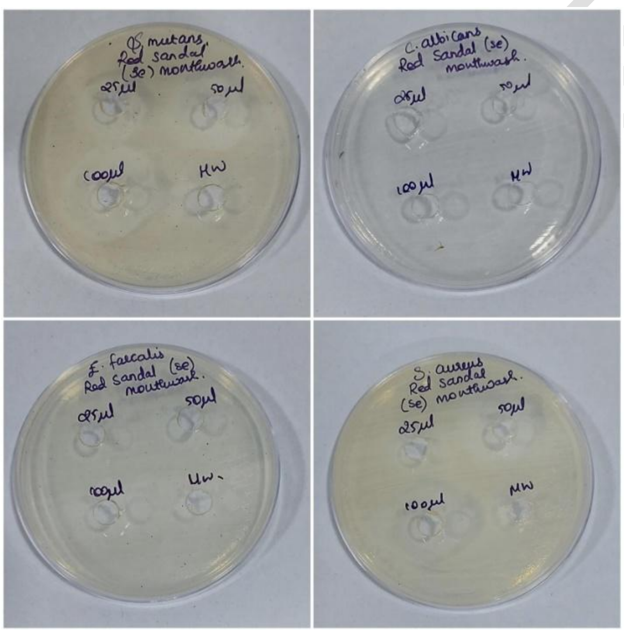

FIGURE3- Zone Of Inhibition Against *S.Mutans, C.Albicans,E.Faecalis,S.Aureus*

In the present study, the MIC of bacterial and fungal growth at varying concentrations of biosynthesized selenium nanoparticles are analyzed. The antibacterial activity of selenium nanoparticles was evaluated based on their zone of inhibitions and the results were compared with the standard antibacterial agent The antimicrobial activity of selenium nanoparticles against *S. aureus* showed a zone of inhibition of 15 mm at the concentration of 25µl, 28mm at the concentration of 50 and 35mm at 100µl concentration which is comparatively more than the used standard antibiotic which showed zone of inhibition of 13mm.

The antimicrobial activity of selenium nanoparticles against *E.faecalis* showed a zone of inhibition of 13 mm at the concentration of 25µl, which is comparatively less than the used standard antibiotic which showed zone of inhibition of 15mm, 19mm at the concentration of 50 and 26mm at 100µl concentration which is comparatively more than the used standard antibiotic. The antimicrobial activity of selenium nanoparticles against S.mutans showed a zone of inhibition of 24 mm at the concentration of 25µl, 29mm at the concentration of 50 and 34mm at 100µl concentration which is comparatively more than the used standard antibiotic which showed zone of inhibition of 20mm. The antifungal activity of selenium nanoparticles against C.albicans showed a zone of inhibition of 9 mm at the concentration of 25µl, 9mm at the concentration of 50 and 9mm at 100µl concentration which is comparatively more than the used standard antibiotic which showed zone of inhibition of 10mm.

DISCUSSION

Analyzing the results of the present study, it can be found that the highest zones of inhibition were exhibited against two bacterial strains Staphylococcus aureus and Staphylococcus mutans proving that it acts as a good antibacterial against S.aureus and S.mutans infections. Selenium has been described as a potential cancer treatment and prevention candidate, as well as an anti-inflammatory agent, in the treatment of cardiovascular diseases and thyroid disorders, and as a key component of bone and muscle metabolism (65), (66), (67), (68). SeNPs have been shown in many studies to have a lower risk of selenium toxicity while having the same bioavailability and efficacy in increasing the activities of selenoenzymes as Se-Met and selenite (69–71) .

Many researchers are now focusing on the anticancer activity of SeNPs, either alone or in combination with other anticancer agents, as a result of these findings (72–74). One of the pioneering work that reported the antimicrobial activity of SeNPs was done by (75) The authors show that SeNPs with a diameter of about 100 nm inhibit the growth of Staphylococcus aureus at concentrations as low as 7.8 g/mL in this paper.Inhibition of biofilm formation and activity against resistant microbial strains is a particularly important area of research on SeNPs' antimicrobial activity that has recently gained attention (29),(30),(31),(32),(33,34).Bacterial biofilm is thought to be the highest degree of bacterial defence against the immune system and antibiotics.

Due to microbial synergy, polymicrobial biofilms strengthened this tolerance, raising the risk of serious health complications (76). Polymicrobial infections are often caused by a combination of bacteria and fungi. Many of these infections, such as those caused by Candida albicans and Staphylococcus species, are associated with high mortality rates (77) (78) (79) (80) (81) (82) (83) (84) (85) (86) (87) (88) (89) (90) (91). The morphology of nanoparticles also has an effect on their ability to destroy microbial organisms (92,93). The ability of nanoparticles to operate simultaneously through these multiple mechanisms is their key advantage as antimicrobial agents. As a result, unlike commercial antibiotics, microbes are unable to establish resistance to these articulated mechanisms of action. Positively charged NPs, according to some authors, have a greater capacity for inhibiting bacterial growth due to their stronger attachment to bacteria (67,94).

CONCLUSION

The present study is a preliminary evaluation of antimicrobial activity of plants. It indicates that several plants have the potential to generate novel metabolites(55-64). The crude extract demonstrating anticandidal activity could result in the discovery of novel anticandidal agents, The plants demonstrating broad spectra of activities may help to discover new chemical classes of antibiotics that could serve as as selective agents for the maintenance of animal or human health and provide biochemical tools for the study of infectious disease.

NOTE:

The study highlights the efficacy of "FOLK MEDICINE" which is an ancient tradition, used in some parts of India. This ancient concept should be carefully evaluated in the light of modern medical science and can be utilized partially if found suitable.

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