

Dental Varnish Preparation Using Andrographis Paniculata Stem Mediated Selenium Nanoparticles and its Antimicrobial Activity against Oral Pathogens

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ABSTRACT

Introduction: The creation of a novel dental composite resin with improved antibacterial characteristics is the subject of their study. Silver is distinguished by its strong all round antibacterial properties. Cerium oxide provides possible advantages such as antioxidation and extra antibacterial activities. This work attempts to develop a material that efficiently fights germs.

Aim: The aim of this study is to introduce a novel dental composite resin that provides superior antimicrobial protection and enhanced durability addressing significant deficiencies in current dental restorative material.

Materials And Methods: This includes cerium nitrate, cerium carbonate, cerium oxide and Agn

Result: The results showed that as the concentration increases the zone of inhibition increases.

Conclusion: It can be concluded by saying that the study shows that the prepared dental varnish with high concentration shows better inhibition against oral pathogens compared to commercial dental varnishes as they have decreased zone of inhibition due to decreased concentration.

Keywords: cerium oxide, biocompatibility, nano silver, synergistic effect.

INTRODUCTION

Dental varnishes, which resemble fluoride varnishes that stop tooth decay, are typically applied to the surface of the teeth. Along with strategies in high-risk groups with limited access to dental and fluoride treatments and regulations like public water fluoridation, healthy behavioral approaches and promotion should be implemented for the prevention of dental caries in public health (1). The most common disease in the world is dental caries, which is known as early childhood caries (ECC) when it affects children younger than six. Because of the way that the occlusal architecture of deciduous second molars facilitates the accumulation of bacterial plaque, this disorder specifically affects them. Early childhood caries (ECC), the primary cause of early deciduous tooth loss that adversely affects speech, appearance, the masticatory system, and the dental arches, remains a public health concern despite the expansion of access to health care. (3) The use of fluoride, which can prevent dental caries by blocking demineralization of the crystal structures inside the tooth and boosting remineralization, is one method of the preventative treatment that is required. Many topical fluoride treatments have since been developed over time, but NaF (a 22,600 ppm F-preparation) is the most widely utilized agent. (2,3)

The plant *Andrographis paniculata* has been used for generations in traditional Asian medicine, with great success. Its alleged ability to cleanse blood leads to its usage in conditions including skin eruptions, boils, scabies, and persistent, indiscriminate fevers when blood "abnormalities" are thought to be the source of the illness. Applications in Conventional Medical Systems

There have been reports of *A. paniculata*'s choleric, antiviral, antifungal, and antibacterial properties. hypocholesterolemic, hypoglycemic, and adaptogenic properties. It is regarded as aperient, anti-inflammatory, emollient, astringent, diuretic, emmenagogue, stomach and liver tonic, carminative, antihelmintic, and antipyretic in the Unani medical system. (4)

The medicinal plant *andrographis paniculata*, often known as *A. paniculata*, has long been utilized as an anti-bacterial and anti-inflammatory herb. The main active ingredient in *A. paniculata*, andrographolide, has a variety of pharmacological properties, such as anti-inflammatory, anti-tumor, anti-obesity, and anti-diabetic properties. (5)

Selenium is a vital trace element that keeps a number of deadly or degenerative diseases at bay and is necessary for both human and animal immune systems to operate normally. According to reports,

selenium is a crucial component that protects human cells and tissues from oxidative damage and stress by functioning as a cofactor and coenzyme at the catalytic-active sites of several selenoproteins and enzymes. Additionally, the body's metabolism of iodine and peroxides is significantly influenced by selenium, which also controls the amount of iodine and free radicals and can improve disease resistance.(6)Due to selenium's potential contribution to immune system stabilization and defense response activation, selenium nanoparticles, or SeNPs, offer advantages over other nanomaterials. In addition to their pharmacological value, the usage of SeNPs and their supplements strengthens and primes the immune system to combat infections. Using a variety of plant species, this study outlines the most recent developments in the biogenesis of plant-based SeNPs and the impact of secondary metabolites on their biocompatible operation. Because of their *in vivo* activities, biocompatibility, and eco-friendliness, phyto-synthesis of SeNPs produces nanomaterials of diverse sizes, shapes, and biochemical types. This method has benefits over conventional physical and chemical procedures. (7)

Long before modern medicine emerged, people have used plants and items derived from them to enhance their health. Through centuries of unremarkable use, the majority of the medicinal plants' therapeutic powers have been established over hundreds of years.(2,7)The optical and electrical properties of nanostructured materials, a technically significant object, strongly depend on the size and form of the nanoparticles present in them. The charge carriers are confined in the small area inside the nanocrystals, which is the cause of this.(8)Since they each have different qualities and activity spectrum, silver, copper, gold, titanium, and zinc have drawn special attention as metals that have been utilized as bactericidal agents for ages.(9)

MATERIALS AND METHODS

The antimicrobial activity of stem mediated selenium nanoparticles was evaluated using the agar well diffusion technique. Mueller Hinton agar plates were prepared and sterilized using an autoclave at 121°C for 15- 20 minutes. After sterilization, the medium was poured onto the surface of sterile Petri plates and allowed to cool to room temperature. The bacterial suspension (*Streptococcus mutans*, *Lactobacillus* sp, *Candida albicans*) was spread evenly onto the agar plates using sterile cotton swabs. Wells of 9 mm diameter were created in the agar plates using a sterile polystyrene tip. The wells were then filled with different concentrations (25, 50, 100 µg/mL) of SeNPs. An antibiotic was used as a standard. The plates were incubated at 37°C for 24 hours and 48 hours for fungal cultures. The antimicrobial activity was evaluated by measuring the diameter of the inhibition zone surrounding the wells. The diameter of the zone of inhibition was measured using a ruler and recorded in millimeters (mm) and the zone of inhibition was calculated.



Fig 1. Dried Andrographis Paniculata leaves



Fig 2: Andrographis Paniculata mixed with distilled water

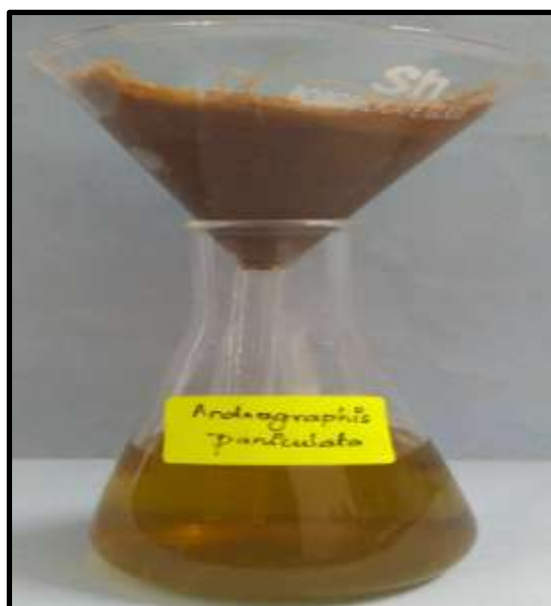


Fig 3: filtration of andrographis paniculata using whatman filter paper



Fig 3: filtration of andrographis paniculata using whatman filter paper

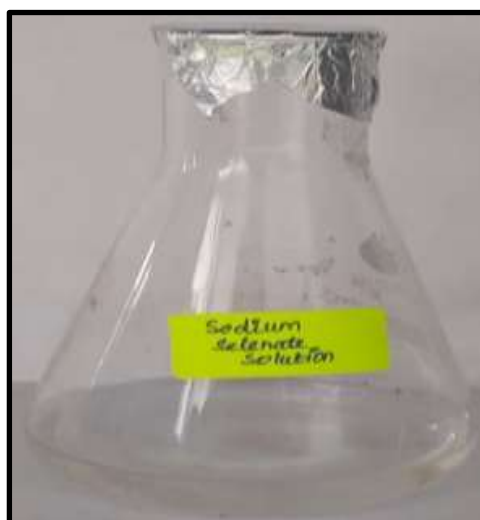


Fig 5: sodium Selenium solution



Fig 6: Andrographis paniculata with selenium nanoparticle

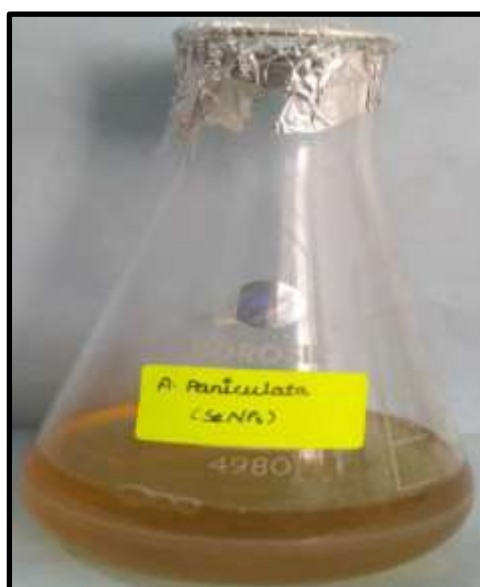


Fig 7: a.paniculata



Fig 8: A.paniculata SeNPs Dental varnish

RESULTS

Plate 1



Plate 2



Plate 3



Plate 4



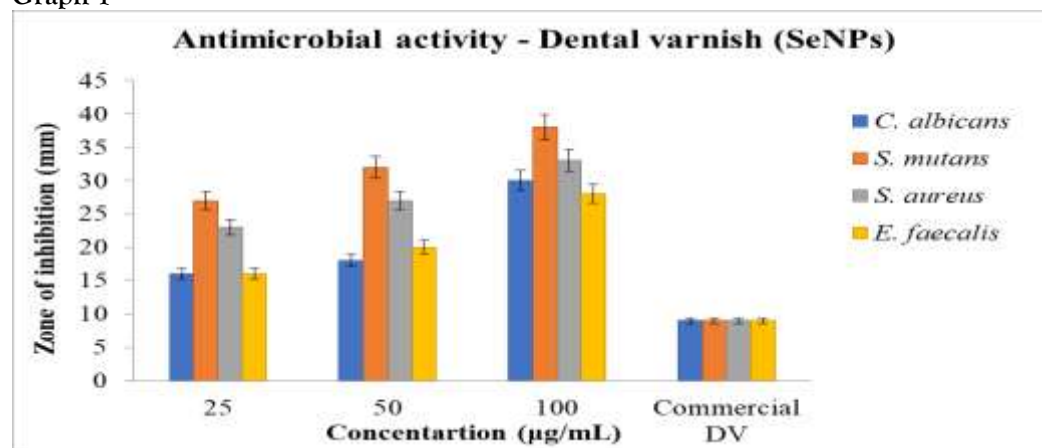
Plate 4



Table 1

	25	50	100	Commercial DV
<i>C. albicans</i>	16	18	30	9
<i>S. mutans</i>	27	32	38	9
<i>S. aureus</i>	23	27	33	9
<i>E. faecalis</i>	16	20	28	9
<i>Lactobacillus</i> sp.	28	30	35	9

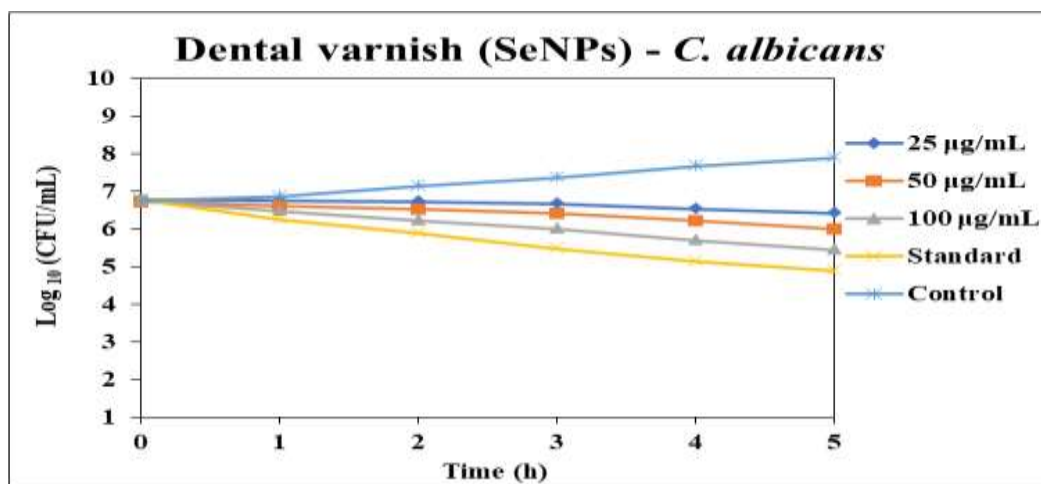
Graph 1



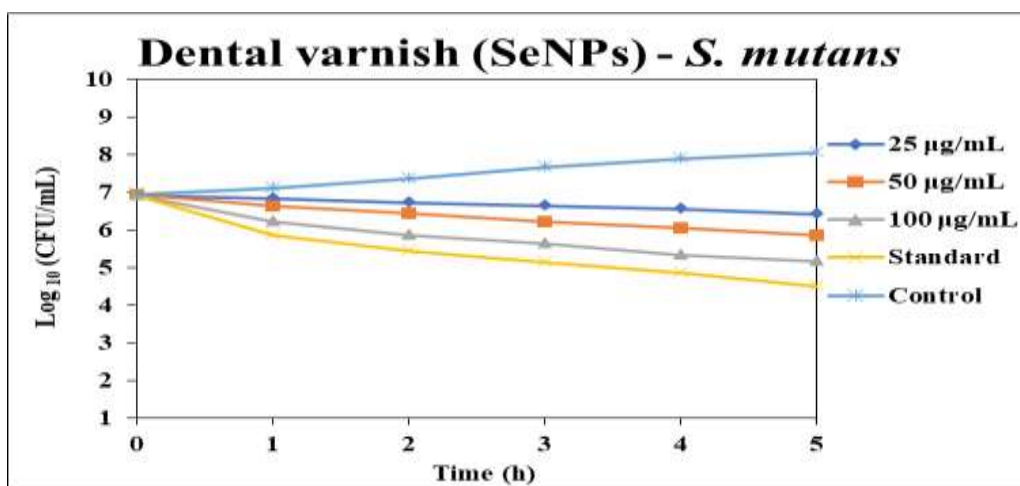
Graph 1:Antimicrobial activity of dental varnish

X axis represents concentration in µg/ml and y axis represents cone of inhibition in mm.

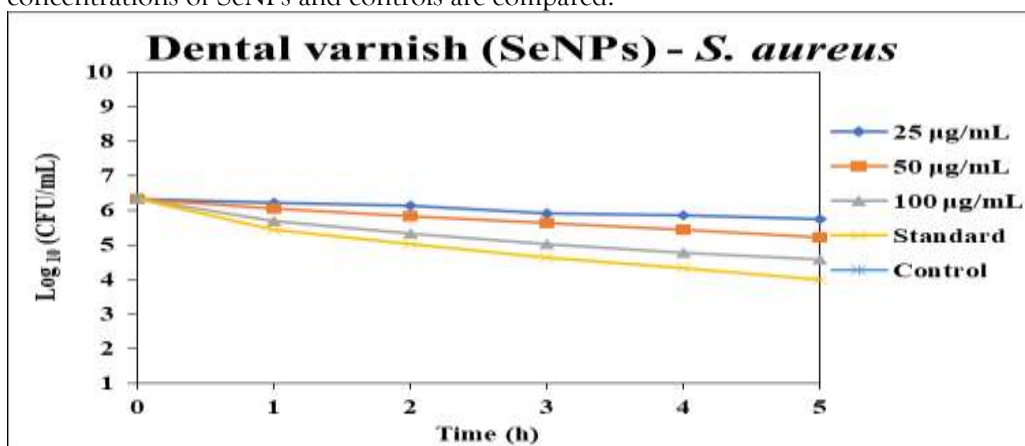
i The results showed that as the concentration increases the zone of inhibition increases



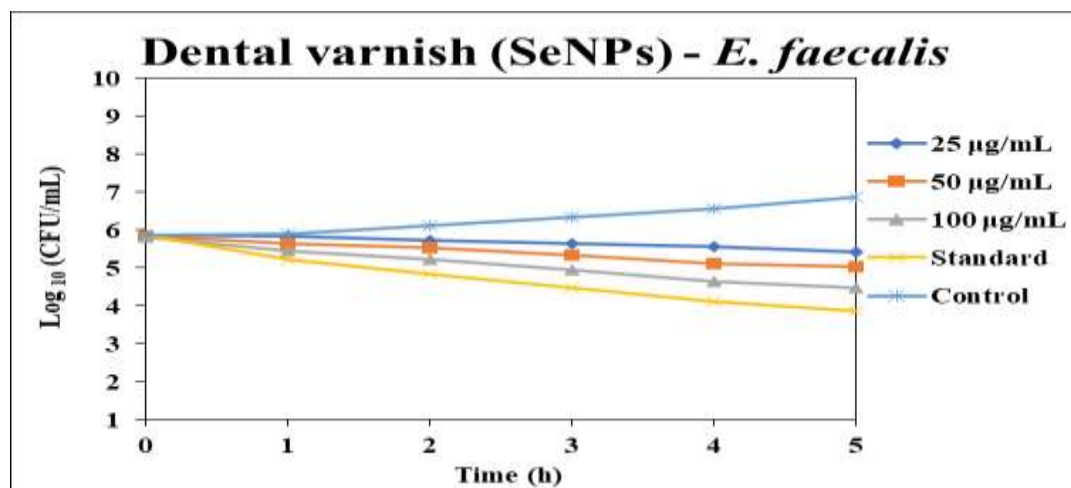
Graph 2: shows the effect of dental varnish containing selenium nanoparticles (SeNPs) on the growth of *Candida albicans* over a period of time. Y-axis represents the logarithm base 10 of colony-forming units per milliliter ($\text{Log}_{10}\{10\}$ CFU/mL), indicating the concentration of *C. albicans*. X-axis Represents time in hours (h), ranging from 0 to 5 hours.



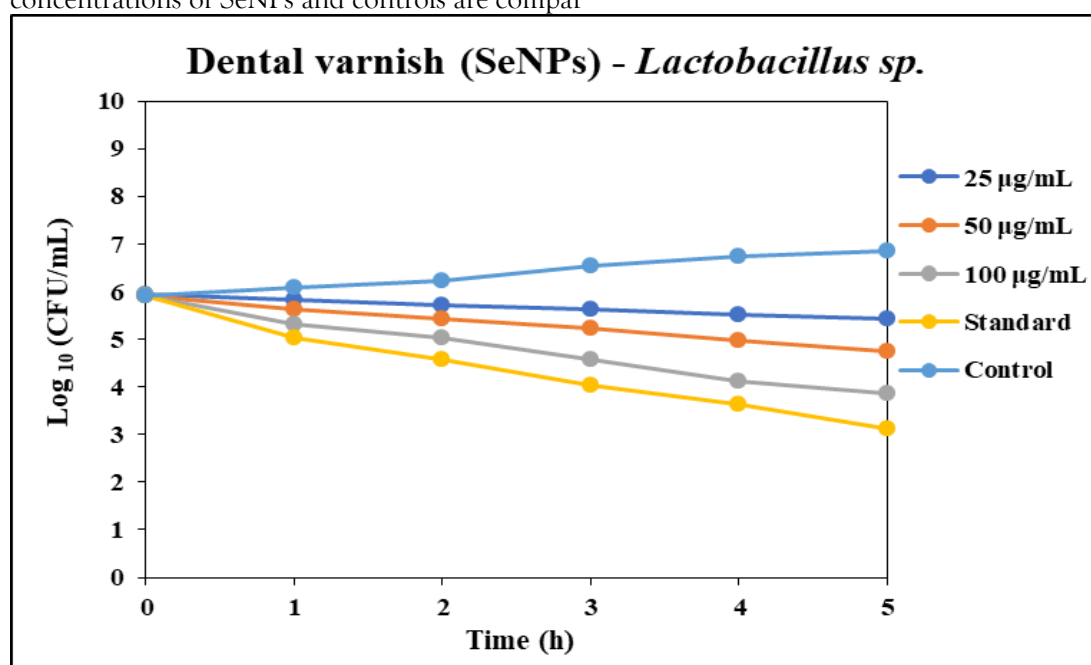
Graph 3: The graph shows the effect of dental varnish containing selenium nanoparticles (SeNPs) on the growth of *Streptococcus mutans* over a period of 5 hours. The data is represented as the log of colony-forming units per milliliter (CFU/mL) on the y-axis and time in hours on the x-axis. Different concentrations of SeNPs and controls are compared:



Graph 4 : The graph shows the effect of dental varnish containing selenium nanoparticles (SeNPs) on the growth of *Staphylococcus aureus* over a period of 5 hours. The data is represented as the log of colony-forming units per milliliter (CFU/mL) on the y-axis and time in hours on the x-axis. Different concentrations of SeNPs and controls are compared.



Graph5: The graph shows the effect of dental varnish containing selenium nanoparticles (SeNPs) on the growth of *Enterococcus faecalis* over a period of 5 hours. The data is represented as the log of colony-forming units per milliliter (CFU/mL) on the y-axis and time in hours on the x-axis. Different concentrations of SeNPs and controls are compared.



Graph 6: This graph depicts the effect of different concentrations of selenium nanoparticles (SeNPs) in dental varnish on *Lactobacillus* species over time. The concentrations used are 25 µg/mL, 50 µg/mL, and 100 µg/mL, along with a standard treatment and a control.

DISCUSSION

The result of *Andrographis paniculata* stem mediated selenium nanoparticles in preparation of dental varnish showed that as the concentration of the μg increased in the 5 given bacteria the zone of inhibition increased hence showing that as the concentration increases the more efficient the dental varnish is in inhibiting the growth of dental caries.

A similar study showed that According to this study, *Azadirachta indica* was successfully used to produce AgNPs using biological techniques. These findings suggest that multidrug-resistant bacterial infections can be managed by biosynthesized aggregates. Additional research is necessary to identify unnecessary activities, theorize ways to alter the drug's effects, and identify innovative treatments for this medical issue.(10)

Another similar study showed that The efficacy of chemically manufactured AgNPs in treating dental caries, preventing tooth demineralization, and reducing dental biofilms is being tested in clinical trials. AgNP-based goods are already present in many consumer goods and are predicted to increase dramatically in the years to come. Therefore, it is pivotal that their biodistribution and toxicity is evaluated before their use in human products. Despite these concerns, plant-based AgNPs can be used for development of

multifunctional dental care products that can aid in the prevention and treatment of dental infections and diseases.(11)

Another study showed that Using the Agar diffusion method, the dental varnish's physicochemical characteristics and antibacterial activity against *Lactobacillus acidophilus* and *Streptococcus mutans* were assessed. The outcome shows that the varnish formulation has adequate physicochemical qualities, making it appropriate for use in dental varnish formulation. With a notable zone of inhibition, the antibacterial activity demonstrated the effectiveness of cocoa polyphenol varnish in preventing the development of *Lactobacillus acidophilus* and *Streptococcus mutans*. Sustained release cocoa polyphenol varnish had good physicochemical characteristics and acceptable antibacterial efficacy against *Lactobacillus acidophilus* and *Streptococcus mutans* in conclusion.(12)

CONCLUSION

In this study, the preparation of dental varnish using *Andrographis paniculata* stem-mediated selenium nanoparticles (SeNPs) demonstrated significant antimicrobial activity against oral pathogens. The biosynthesis of SeNPs was successfully achieved using the natural extract from *Andrographis paniculata* stems, which acted as both a reducing and stabilizing agent. The synthesized SeNPs were characterized by various analytical techniques, confirming their stability and efficacy. The antimicrobial activity of the SeNPs incorporated into the dental varnish was tested against common oral pathogens, including *Streptococcus mutans* and *Candida albicans*. The results showed that the SeNPs exhibited potent antibacterial and antifungal properties, making them an effective component for dental varnish formulations. The incorporation of these nanoparticles into dental varnish not only enhances its antimicrobial properties but also offers a natural and biocompatible alternative to traditional chemical agents..It can be concluded by saying that the study shows that the prepared dental varnish with high concentration shows better inhibition against oral pathogens compared to commercial dental varnishes as they have decreased zone of inhibition due to decreased concentration.

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