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'GREEN METAL NANO TECHNOLOGY IN DENTISTRY'-A NARRATIVE REVIEW

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ABSTRACT:

Over time, there has been a lot of interest in the synthesis of green AgNPs utilising plant extracts due to the remarkable antibacterial capabilities of these nanoparticles. These particles' nanosized makes it easier for them to pass through cell membranes, interacts with internal organelles, and eventually damages cells when they proliferate. With the exceptional benefits, including practicality, simplicity of usage, and the utilisation of specialised processes like bacteria, plants are currently the preferred method for synthesising metal nanoparticles. Based on the idea of converting silver ions (Ag+) to silver nanoparticles (Ag0), green synthesis techniques for the synthesis of silver nanoparticles are provided. The literature reveals that the modified metal nano particles modifying with green methods are already practicing by dental clinicians, whereas still less percentage of practitioners are using this green nano technology. Hence this narrative review includes different metal nano particles using in dentistry and different green methods using to modify the environmentally friendly dental practices.

INTRODUCTION:

The development of nanotechnology has so drawn interest from all over the world. The primary obstacle to the extensive use of nanotechnology is the safety concerns for both humans and the environment. [1] Numerous investigations concerning the antimicrobial properties of nanoparticles (NPs) have revealed that NPs have enhanced antibacterial activity against antibiotic-resistant microorganisms. Therefore, applying nanoparticles to dentistry may be highly advantageous.[2]

The majority of techniques for creating these nanoparticles, despite their possible antibacterial qualities, are expensive and may have detrimental effects on biological systems, the environment, and human health because they involve the use of hazardous and poisonous materials. Herbal medicine has long been used to treat oral health issues. Because plant extracts can be used to synthesise biogenic metal nanoparticles (MNPs), which can overcome the limitations of herbal treatments, the creation of nanoparticle formulations with herbal medicine has now become a breakthrough in dentistry. It has been demonstrated that the green creation of MNPs, such as Ag, Au, and Fe nanoparticles augmented by plant extracts, is advantageous in controlling a variety of Oro dental illnesses.[3]

Consequently, technologies for the synthesis of "green" nanoparticles have been developed. This alternative to chemical techniques is safer and more environmentally friendly because it uses biological systems like yeast, fungus, bacteria, and plant extracts instead of toxic substances. For a multitude of reasons, including their vast and easily

accessible reserves, worldwide distribution, safe handling, availability of a wide range of metabolites with great potential for reduction, and cheap costs associated with waste and energy, plant extracts are frequently employed. [4,5]

Numerous studies have demonstrated the extensive use of medical nano systems in various dental specialties, such as prognosis, prevention, tissue regeneration, repair, and care, Anticancer, Antiviral, Antibacterial, Antifungal, Biosensors, Gene or Drug delivery, wound healing and Diagnostics. [6]. To improve oral health, toothpaste an Although metal nanoparticles (NPs) have been demonstrated to offer many benefits, there are significant disadvantages as well, including expensive expenses, the potential for lung disease due to simple inhalation of nanoparticles, and altered homeostasis. -Because of their small size, e-nanoparticles are extremely reactive and have a variety of negative molecular consequences and other items contain oral cosmetics including nanoparticles. [7]

The manufacture of nanomaterials and products in an economical and environmentally sustainable manner is the main objective of green nanotechnology. The application of current green chemistry concepts and engineering to the production of ecologically friendly nanoproducts is made possible by this advanced green nanotechnology.[8] Numerous reports have identified a variety of plants, both terrestrial and aquatic, including mangrove plants, as reducing agents in the synthesis of nanoparticles. [9] It is mainly the presence of different metabolites (e.g., ketones, aldehydes, phenols, amides, carboxylic acids, proteins, etc.) that gives plant extract its potential to decrease and stabilise NPs. Almost all plant parts—such as seeds, roots, flowers, and leaves—have been utilised to extract active components and are utilised in the biosynthesis of AgNPs. [10]

Because some of these NPs are harmful to humans and have little negative impact on the environment, green-synthesizing NPs from plant extracts has become a significant focus for researchers. Plant-derived NPs have more constant size and form and produce more than other methods. Without the use of chemical agents, plant extracts have been used as reducing (RA) and stabilising (SA) agents of nanoparticles (NPs), minimising their toxicity in the environment and human body.[11] Silver nanoparticles synthesized by green chemical methods have achieved enormous therapeutic potential in the treatment of microbial infections and cancer. On the biocompatible plant-based synthesis of silver and gold nanoparticles in antibacterial applications and antioxidants Considering the beneficial effect of an environmentally friendly method.[12]

Different metal nanoparticles used in dentistry - AG np; Honorary NP; INP, ZNO NP, TIO2 NP, copper nanoparticles. It has been reported that plant-mediated AuNPs produced by green chemistry are environmentally friendly and biocompatible nanoparticles capable of stimulating bone growth and can be used as an active bone-inducing agent to stimulate bone formation, reduce bone resorption, and promote bone growth after implantation. [13,14]

Some of the metal nano particles are already using in dentistry in various treatments. The popular MNPs are Silver (Ag), Gold (Au), Titanium, Zinc and Copper etc. Nanoparticles synthesized with silver, gold, copper, titanium, zinc and iron have antibacterial, antioxidant and antioxidant properties. cytotoxic effects. and are also used in biomedical applications. Phytochemicals contained in plant extracts play an important role in the biological reduction of metal ions, their transformation into metal nanoparticles, and also in the stabilization of synthesized nanoparticles. [12,15] Phytochemicals contained in plant extracts play an important role in the biological reduction of metal ions, their transformation into metal nanoparticles, and also in the stabilization of synthesized nanoparticles. [12,15]

The synthesis of metal nanoparticles using plant extracts is one of the simplest, most convenient, economical and environmentally friendly methods that reduces the use of toxic chemicals. Therefore, in recent years, several environmentally friendly processes have been described for the rapid synthesis of silver nanoparticles using aqueous extracts of plant parts such as leaves, barks, roots, etc. Metal and metal oxide nanoparticles have better antimicrobial properties. [16] Recently, the biogenic synthesis of silver NPs (AgNPs) using biomaterials such as plant extract and

microbes as reductants and their antimicrobial activity has been extensively investigated. [17] silver nanoparticles may be a promising low-cost potential candidate for the preparation of a self-disinfecting alginate impression material without affecting its effectiveness. The green synthesis of metal nanoparticles using Boswellia Sacra extract can be a very safe, effective and non-toxic method, which has the advantage of a synergistic effect between metal ions and Phyto therapeutic agents contained in the plant extract. [18]

DISCUSSION:

Research demonstrated that, green AgNP Camellia sinensis, or green tea, exhibits potent antibacterial action against S. mutans. AgNPs derived from neem and Aloe vera have been demonstrated to be effective against Pseudomonas species and Streptococcus mutans.[19] The composites made using extracts from pomegranate peels exhibited the most antimicrobial and antibiofilm properties against both tested bacteria, matching or surpassing the efficacy of chlorhexidine. [20]

According to Noronha VT et al., [21] applications in Dentistry: Silver nanoparticles (AgNPs) have been extensively studied for their antibacterial properties, and they can be applied to a range of dental procedures. AgNPs have a potent antibacterial impact when combined with dental materials such as acrylic resins, adhesives, nanocomposites, resin copolymers, intracanal drugs, and implant coatings, according to in vitro research. AgNPs are also potential treatments for oral cancers because of their anticancer properties. Compared to PMMA, PMMA AgNPs (P 0.05) specimens showed less C. albicans adherence. AgNP-coated gutta-percha is effective against Candida albicans, S. aureus, E. coli, and E. faecalis.[22] MTA containing AgNP shown enhanced antibacterial action against Candida albicans, Pseudomonas aeruginosa, and E. faecalis.[23] Because of their nanotechnology, AuNPs have a larger surface area, which facilitates more inorganic and organic chemical reactions. When compared to traditional treatments, the addition of AuNPs to cavity disinfectants can enhance the material's antibacterial activity and thereby lower the risk of secondary caries. [24]

As per Jadhav and Colleagues, Green chemistry-produced plant-mediated AuNPs biocompatible, eco-friendly nanoparticles that promote bone formation, reduce bone resorption, and can be used as an active bone inductive material when implanting. [14] AuNPs have certain crucial optical features that make them useful in the diagnosis of periodontal disease. The results show that the size and concentration of AuNPs positively affect these cells' ability to proliferate. Consequently, AuNPs may be a source for tissue engineering to aid in the repair of damaged tissues. [25] The addition of AuNPs improves the dental adhesive's tensile and flexural strength, and the best mechanical properties. A promising technique for examining basic biological issues and early disease detection is AuNP-assisted bioimaging. [26,27]

Because of the special optical properties, ZnONPs can be used as a drug delivery method as well as an antibacterial, anticancer, antidiabetic, and therapeutic agent. [28] ZnONPs can significantly inhibit S. mutans strains in resin composites without sacrificing the mechanical properties of the resin, as Hojati ST et al., [29] showed. The antibacterial impact of composite resin containing ZnONPs on Streptococcus mutans was much greater than that of composite resin containing AgNPs.[30]

ZnONPs are characterised by low toxicity, good biological functions, and antibacterial, anticancer, and osteogenic qualities. Furthermore, ZnONPs can be easily produced in a number of ways. ZnONPs-modified implants exhibit strong antibacterial properties. ZnONPs were used by Elizabeth et al. to cover titania nanotubes and titania nano leaves. When compared to pure nanopatterned materials, the modified samples' antibacterial powers were noticeably.[31] ZnNP-modified implants exhibit direct toxicity against microorganisms as well as immune system modulation and enhanced antibacterial properties. In oral implants, copper nanoparticles are used as an anti-peri-

implantitis agent. [32] Numerous dental applications can benefit from the exceptional anticariogenic qualities of copper oxide nanoparticles derived from aloe vera gel.[33]

Plant-mediated synthesis of nanoparticles offers a simple, one-step (biogenic) approach. indica nanoparticles: Neem leaf extract has been widely used for the synthesis of gold, silver and bimetallic (silver and gold) nanoparticles. [12,34] Silver nanoparticles coated with coriander sativum stabilized with this leaf extract have been found to have improved antimicrobial activity against common oral pathogenic strains. [35] The antibacterial and antimicrobial properties of green synthesized gold nano particles have already been demonstrated. [36,37] Green titanium dioxide (TiO2) nanoparticles useful for controlling biofilm-associated bacterial infections. New coating materials can be prepared using different concentrations of SiC-TiO2-graphene and Azadirachta indica (Neem) extract to coat the nanofilms. [38,39]

Sustainable production of plant-based nanoparticles is an important research goal in dental implants. Compared to traditional organic antibacterial agents, it is superior in terms of reliability, durability and heat resistance against bacterial pathogens (except Staphylococcus aureus and E. coli) and antifungal activity against C. albicans and Aspergillus niger. [40,41]

CONCLUSION:

Although the use of metal nanoparticles produced by green synthesis in dental implants is still in its infancy, it may open new opportunities to improve the calibre of these products. Green synthesized NPs have gained more attention due to the reduction in the use of chemicals, the advantage of ecological, simple and cost-effective synthesis, and energy efficiency.

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