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Mini Review

Nature's Natural Antimicrobial Agent "Propolis Nanoparticle"-Mini Review

Seema Deshmukh[1], Sowmya Srinivas[2]*, Sushma Rudraswamy[3], Nagabhushana Doggalli[4], Raghavendra Swamy KN[5] and Dr.Indira MD[6]

[1]Department of Pedodontics and Preventive Dentistry, JSS Dental College and Hospital, JSS Academy of Higher Education and Research (JSSAHER), Mysuru, Karnataka, India

[2]Senior Lecturer, Department of Prosthodontics, JSS Dental College and Hospital, JSS Academy of Higher Education and Research (JSSAHER), Mysuru, Karnataka, India

[3]Senior Lecturer, Department of Public Health Dentistry, JSS Dental College and Hospital, JSS Academy of Higher Education and Research (JSSAHER), Mysuru, Karnataka, India

[4]Department of Oral Medicine and Radiology, JSS Dental College and Hospital, JSS Academy of Higher Education and Research (JSSAHER), Mysuru, Karnataka, India

[5]Professor and HOD, Department of Prosthodontics, JSS Dental College and Hospital, JSS Academy of Higher Education and Research (JSSAHER), Mysuru, Karnataka, India

[6]Senior Lecturer, Department of Pedodontics and Preventive Dentistry, JSS Dental College and Hospital, JSS Academy of Higher Education and Research (JSSAHER), Mysuru, Karnataka, India

***Corresponding Author:** Sowmya Srinivas, Senior Lecturer, Department of Prosthodontics, JSS Dental College and Hospital, JSS Academy of Higher Education and Research (JSSAHER), SS Nagar, Mysuru, Karnataka, India.

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Abstract

The period of nanomaterial has an enduring impact in the field of medical care. Its magnificent use in medical science has led to its utilization in dentistry. Microbial biofilms elimination from oral cavity still exists as a great concern in the field of dentistry. In the process of elimination of biofilms, the nano material compared to conventional materials have proven to be much more structured with efficient bonding capabilities and good chemical science. The nanomaterial of the drugs used for therapeutic purposes have various advantages which included increased bioavailability, prevention of micro leakage and may also provide preventive benefits. Nanoparticles incorporated dental materials also present with improved mechanical properties such as increased fracture toughness, decreased crack propagation and improved bonding to the tooth structure. The advantage of preparing propolis nanoparticles could be that this process helps in protection of the active ingredient from degradation and also may provide sustained release.

Studies on nanoparticles have been carried out using metallic material but there are very few or limited literature on natural products especially propolis nanoparticle. Hence this review attempts to describe the uses of propolis in the nanoparticle form for dental applications.

Keywords: Nanoparticles; Propolis; Antimicrobial Effect; Dental Use

Introduction

The impact of Nanoparticles in dentistry for the treatment of numerous diseases is quickly progressing with every year. Due to the better biological, mechanical, physical and chemical properties, nanomaterial (NMs) has recently gained significance in technological advancements. These properties have ensued in good effect as compared to that of their conventional counterparts [1,2]. Nanomaterial have shown incredible effect to reduce microbial count in the oral cavity. These results have been influencing to open the doors for further clinical studies. In this process the metallic nanoparticle as antimicrobial effect has been tried and showed good results but along with their action on microorganisms, they may have unfavourable side effects too.

To overcome the disadvantage of metallic nanoparticles there is a switch in the research to use natural nanoparticle products. Research has proven that natural products, mainly of the plant origin are an important source of therapeutic agents [3,4]. These natural products may be in the form of phytochemicals or the secondary metabolites [5]. The secondary metabolites act as defence agents to protect the host. They accomplish this by infringing with the molecular targets of the invaders and microbes [6-8]. *Apis Mellifera* species of bees use these secondary metabolites and resinous material from plants, modify it with its salivary enzymes resulting in a substance called Propolis. This material is fast growing in research field because of its various medicinal properties. The aim of this review article is to provide scientific information of propolis and its further use as nanoparticles in Dentistry.

Propolis (bee glue) is a generic name given to the raw extract from the beehive [9]. Raw Propolis has been identified and allotted a CAS (chemical abstract service) registry number 9009-62-5 [10].

Chemistry of propolis

The chemical elements present in the propolis resin are the mixture of [11,12] materials secreted by bees from plants that is mixed with saliva of the bee.

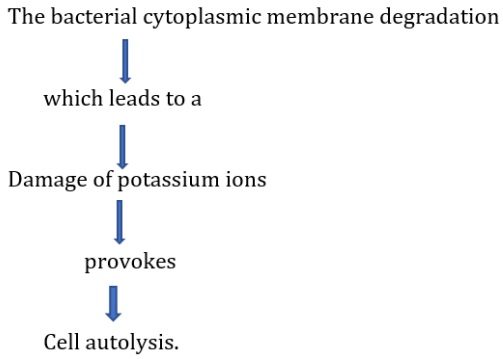
Because of the presence of these chemical components with least toxicity [13], propolis is considered as one of the health enhancing agents. Among the 300 compounds found in the propolis few are shown in table 1 that are responsible for its medicinal properties.

1	Phenolic compound: 2,2-dimethyl-8-prenylchromene
2	Phenolic compound: 4-hydroxy-3,5-diprenyl cinnamic acid (artepillin C)
3	Phenolic compound: 3-prenyl cinnamic acid allyl ester
4	Phenolic compound: kaempferide
5	Phenolic compound: propolis benzofuran
6	Flavonoid: acacetin
7	Flavonoid: apigenin
8	Flavonoid: quercetin
9	Flavonoid: galangin
10	Flavonoid: fisetin
11	Flavonoid: pinocembrin
12	Flavonoid: caffeic acid phenethyl ester

Table: 1 Bioactive components present in propolis.

Mechanism of action of propolis as antimicrobial product

The Mechanism of action of propolis as antimicrobial has been attributed to the presence of phenolic, flavonoids, aromatic acids and esters. The mechanism of action is on inhibition of bacterial RNA polymerase [11]. The mechanisms involves



It is also noted that flavonoids like quercetin, increases membrane permeability, and dissipate its potential, leading the bacteria to lose their capacity to synthesize adenosine triphosphate, their membrane transport and motility.

Side effects of propolis

Not many propolis adverse effect have been reported in the literature, and it is considered harmless [14]. Unless Propolis administered in very large quantities it has been found to be non-toxic to

humans [15]. As per the Ames test, flavones, might be mutagenic but mutagenicity per se for propolis has not been reported [16]. Contact dermatitis is one of the allergic reaction documented due to propolis. Once the skin is out of contact with propolis, dermatitis is relieved. Hence it is suggested that its use should be ceased when there is an allergic reaction [17].

Propolis-nanostructure complexes

Preparation of propolis Nanoparticles

It can be prepared by

- Micro emulsion using spray-drying,
- High pressure homogenization,
- High-speed stirring,
- Ultra-sonication,
- Emulsification-evaporation,
- Nano precipitation [18].

Invitro and *invivo* research on propolis nano particles

There are sufficient studies regarding propolis nanoparticle. Study by Grenho., *et al.* found that propolis can be used in dental hygiene products because it contains nanohydroxyapatite that inhibits the of bacterial and additionally the cell culture experiments showed the growth of fibroblasts and high metabolic activity without membrane damage [19].

Further a research on amalgamation of nano propolis at concentrations of 2% and 5% into orthodontic adhesives reported effective against *S. mutans, S. sanguinis*, and *L. acidophilus*, along with maintaining the shear bond strength (SBS) within the acceptable clinical range [20].

Taken together, the findings obtained in another study revealed that the propolis nanoparticle (PNP) with photosensitizer (PSs) will improve antimicrobial photodynamic activities against *S. mutans* in oral biofilm. Additionally adverse effect of the PSs can also be decreased. Although more studies are needed to determine the mechanism involved in it, this synergistic effect of PNP and chlorophyllin-phycocyanin mixture (PhotoActive+-) or toluidine blue O(TBO)-Antimicrobial photodynamic therapy (aPDT) may lead to a new mode of aPDT-based treatments in localized infections [21].

Propolis nanoparticle 300µg/mL (PN 300) is equally effective as 6% sodium hypochlorite (NaOCl) and 2% chlorhexidine (CHX) as an endodontic irrigant in decreasing the E. faecalis count. Hence PN300 can be used as an alternate endodontic irrigant. Similary Propolis nanoparticle 100µg/mL (PN100) is more effective in reducing E. faecalis count than saline .PN300 and PN100 as endodontic irrigants were the most effective at ten minutes duration in reducing E. faecalis CFUs when compared to one minute and five minutes [22].

Conclusion

With these incredible properties of raw propolis the development of Propolis nanoparticles (PNPs) is surely going to solve dental problem as particle size decreases and the surface/volume ratio become too large for the effective treatment. The propolis nanoparticles should be tested against various microbial biofilm and its destruction on microbes in future studies. Further clinical trials are warranted in future studies to compare the antimicrobial effect these nanoparticles and can also be compared with nanoparticles such as gold and silver. Further research is required to understand and elucidate its mechanism of action, especially at the cellular level.

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