

INDIAN PROPOLIS: A POTENTIAL NATURAL ANTIMICROBIAL AND ANTIFUNGAL AGENT

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ABSTRACT

Propolis is a natural resinous mixture produced by honeybees from substances collected from parts of plants, buds and exudates. Due to its waxy nature and mechanical properties, bees use propolis in the construction and repair of their hives for sealing openings and cracks and smooth out the internal walls and as a protective barrier against external invaders like snakes, lizards etc. or against weathering threats like wind and rain. Bees gather propolis from different plants, in the temperate climate zone mainly from poplar. Current antimicrobial applications of propolis includes formulations for cold syndrome (upper respiratory tract infections, common cold, flu-like infections), wound healing, treatment of burns, acne, herpes simplex and genitalis, and neurodermatitis. Additionally, propolis is used in mouthwashes and toothpastes to prevent caries and treat gingivitis and stomatitis. It also possesses the antifungal activities in ocular and vaginal infections. Worldwide propolis has a tremendous popularity; but in India studies over propolis is not done extensively. The need of the hour is to explore its possibilities as good anti-microbial and anti-fungal agent.

Keywords: Propolis, Indian scenario, Ocular, Oral, Dental, Vaginal, Antimicrobial, Antifungal

INTRODUCTION

Over the last few decades, worldwide increase in the use of natural products for pharmacological purposes has been observed. Propolis is a natural resinous mixture produced by honeybees from substances collected from parts of plants, buds and exudates. Etymologically the word propolis derived from the Greek pro (for 'in front of', 'at the entrance to') and polis (for 'community' or 'city'), meaning that this natural product is used for hive defense. Another name of propolis is bee glue. Due to its waxy nature and mechanical properties, bees use propolis in the construction and repair of their hives,² for sealing openings and cracks and smooth out the internal walls^{1,3} and as a protective barrier against external invaders like snakes, lizards etc. or against weathering threats like wind and rain. Bees gather propolis from different plants, in the temperate climate zone mainly from poplar.

Honey and propolis both are very popular because of their beneficial effect on human health. Propolis have been extensively employed by man since ancient times, especially in folk medicine to treat several maladies. Egyptians knew very well its anti-putrefactive properties and used bee glue to embalm their cadavers. Incas employed propolis as an anti-pyretic agent. Greek and Roman physicians used it as mouth disinfectant and as an antiseptic and healing product in wound treatment, prescribed for topical therapy of cutaneous and mucosal wounds³. These therapeutic applications were perpetuated in the middle age and among Arab physicians. Listed as an official drug in the London pharmacopoeias of the 17th century, propolis became very popular in Europe between the 17th and 20th centuries due to its antibacterial activity. In Italy, Stradivari used bee glue as a violin varnish⁵. In the end of 19th century, propolis was widely used due to its healing properties and in the Second Global War it was employed in several Soviet clinics for tuberculosis treatment, due to the observed decline of lung problems and appetite recovery. In the Balkan states it was one of the most frequently used remedies, applied to treat wounds and burns, sore throat and stomach ulcer⁶. The first scientific work with propolis, reporting its chemical properties and composition, was published in 1908, and indexed to Chemical Abstracts⁷. Later, in 1968, the first patent⁸ was obtained to produce bath lotions in Romania.

Nowadays, propolis is a natural remedy found in many health food stores in different forms for topical use. It is also used in cosmetics or as popular alternative medicine for self-treatment of various diseases. Current applications of propolis include formulations for cold syndrome (upper respiratory tract infections, common cold, flu-like infections), as well as dermatological preparations useful in

wound healing, treatment of burns, acne, herpes simplex and genitalis, and neurodermatitis. Additionally, propolis is used in mouthwashes and toothpastes to prevent caries and treat gingivitis and stomatitis. It is widely used in cosmetics and in health foods and beverages. It is commercially available in the form of capsules (either pure or in extracts), mouthwash solutions (combined with lemon balm, sage, mallow), creams, throat lozenges, powder and also in many purified products from which the wax was removed and it is widely used in human and veterinary medicine, pharmacology and cosmetics.

Source of propolis in different geographical region

Propolis composition varies according to different geographical region. Difference shows due to climate and temperature variation in worldwide in Table.2.

Propolis in Indian scenario

The extract contains amino acids, phenolic acids, phenolic acid esters, flavonoids, cinnamic acid, terpenes and caffeic acid and several constituents which varies due to different geographical region and climate. It purpose several biological activities³⁸ such as antimicrobial, antifungal, antiviral, immunostimulatory, anti-inflammatory, anti-cancer anti-oxidant activity on the basis of their geographical region. In India the propolis sample shows the composition mentioned in Table.1.

Wagh *et al.*, studied HPLC identification and antibacterial and antifungal activity of ethanolic extract (80%) of Indian propolis in ophthalmic infections, obtained from Shirpur, Maharashtra region⁵⁸. Borkar *et al.*⁶, also present paper in conference, the anti-bacterial activity of Indian propolis collected from Shirpur, Maharashtra region.

Propolis as a drug

Characteristics

Propolis is lipophilic in nature, hard and brittle material when cold; but when temperature rises it becomes soft, pliable, gummy and very sticky⁹. It possesses a characteristic and pleasant aromatic smell and varies in color from yellow green, to red and to dark brown depending on its source and age^{3,49}. The color of propolis ranges from yellow to dark brown depending on the origin of the resins. But, even transparent propolis has been reported.

Composition

Propolis is a complex mixture made by plant derived and bee released compounds. The proportion of the various substances

present in the propolis depend upon its place and time of collection but, in general, raw propolis is composed of around 50% resins, 30% waxes, 10% essential oils, 5% pollen and 5% of various organic compounds^{1,11,15}. The chemical composition of propolis is complex; flavonoid and (hydroxyl) cinnamic acid derivatives are considered to be the primary biologically active constituents in propolis extract¹. Furthermore, depending on its geographical origin, its composition is highly variable^{45,4,12}. More than 300 constituents were identified in different samples¹⁰, and new ones are still being recognized during chemical characterization of new types of propolis^{3,17,50}.

Many analytical methods have been used for separation and identification of propolis constituents and the substances identified belong to the following groups of chemically similar compounds: flavonoids; benzoic acids and its derivatives; benzaldehyde derivatives; cinnamyl alcohol and cinnamic acid and its derivatives; others are alcohols, ketones, phenols and heteroaromatic compounds; terpene and sesquiterpene alcohols and their derivatives; sesquiterpene and triterpene hydrocarbons; aliphatic hydrocarbons; minerals; sterols and steroid hydrocarbons; sugars and amino acids¹⁸. As it may be expected, volatile compounds are present in low amounts. Sugars are thought to be introduced accidentally during the elaboration of propolis. Some compounds are common in all propolis samples and they determine its characteristics properties. Different origin of propolis sample shows different constituents others are represented in many samples of different origins, but a few others only occur in propolis from particular plant species²⁹.

Melting point

At temperatures of 25°C to 45°C propolis is a soft, pliable and very sticky substance. Particularly when frozen or at near freezing, it becomes hard and brittle. It will remain brittle after such treatment even at higher temperatures. Above 45°C it will become increasingly sticky and gummy. Propolis will become liquid at 60°C to 70°C, but for some samples the melting point may be as high as 100°C.

Solubility of propolis

Propolis cannot be used directly as raw material due to its complex structure. The most common solvents used for commercial extraction are as follows water, methanol, ethanol, chloroform, dichloromethane, ether, and acetone. Many of the bactericidal components are soluble in water or alcohol⁴⁴. These solvents remove the inert material and preserve the desired compounds. Methods of extraction also affects on propolis activity¹⁰.

Potentials of propolis as an ideal antimicrobial drug candidature

A. Anti-microbial agent

Anti-microbial nature of propolis shows inhibition to many bacterial species which are mentioned in Table 2.

1. Oral use

To evaluate the potentials of propolis Koru et al.²⁸ collected propolis from four different regions in Turkey and from Brazil used against nine anaerobic strains. EEP (Ethanol Extract of Propolis) determined minimum inhibitory concentrations (MIC) and minimum bactericidal concentrations (MBC) on the growth of test microorganisms by using agar dilution method. Death was observed within 4 h of incubation for *Peptostreptococcus anaerobius* and *p.micrus* and *Lactobacillus acidophilus* and *Actinomyces naeslundii*, while 8 h for *Prevotella oralis* and *Prevotella melaninogenica* and *Porphyromonas gingivalis*, 12 h for *Fusobacterium nucleatum*, 16 h for *Veillonella parvula*. It was shown that propolis samples were more effective against Gram positive anaerobic bacteria than Gram negative ones²⁸.

2. Dental use

In context to above mentioned uses propolis is also used in treating dental caries, gingivitis and periodontal disease including prevention of oral diseases^{2,34}.

I. Dental caries

Dental caries, also known as tooth decay or a cavity, is a disease where bacterial activity converts carbohydrate like sugar in food left on teeth to acid that demineralises hard tooth structure (enamel, dentin and cementum). Two groups of bacteria are responsible for initiating caries: *Streptococcus mutans* and *Lactobacillus*. If left untreated, the disease can lead to pain, tooth loss and infection²⁸.

Hayacibara reported in his recent studies that propolis show potential effect on the dental caries¹⁴. In this 12 distinct types of Brazilian propolis have been chemically characterized and classified from type-1 to -12¹¹, shown the anti-caries potential of propolis from the Southern (type-3) and Southeastern (type-12) regions of Brazil^{13, 30-34}. Propolis samples lower the intensity of caries and dental plaque accumulation *in vivo*³⁴. Propolis is associated with two mechanisms of action, i.e., anti-caries/anti-plaque properties: (1) It shows anti-microbial activity against cariogenic bacteria, and (2) it inhibits glucosyltransferase enzymes (GTFs) activity³¹. However, all the studies were conducted by using raw propolis extract and a very little is known about the putative anti-caries compounds in the EEP. Considering that propolis fractionation is the first step in identifying the active compounds of this natural product, the study aims to evaluate the influence of isolated fractions of propolis type-3 and -12 on *streptococcus mutans* and GTF activity *in vitro*, and on caries development *in vivo*. At the end of the experiment they concluded that the EEP and H-fr type-3 and 12 were equally effective in reducing dental caries in rats. The data suggest that the putative cariostatic compounds of propolis type-3 and 12 are mostly non-polar; and H-fr should be the fraction of choice for identifying further potentially novel anti-caries agents.

Duarte, et al., has done work on effect of ethanolic extract of a novel type of Brazilians propolis (EEP) and its purified hexane fraction (EEH) on *Streptococcus mutans* biofilms and the development of dental caries in rats³⁵. The chemical composition of the propolis extracts were examined by gas chromatography/mass spectrometry. The effects of EEP and EEH on *Streptococcus mutans* UA159 and *Streptococcus sobrinus* 6715 biofilms were analyzed by using time-kill and glycolytic pH drop assays. Their effect on proton-translocating F-ATPase activity was also tested. In the animal study, the infected rats with *Streptococcus sobrinus* 6715 strain and fed with cariogenic diet 2000. The rats were treated topically twice a day with each of the extracts or control sample also used for 5 weeks. The compounds present in EEP and EEH extract were unable to show major effects on the viability of *Streptococcus mutans* biofilms. However, both extract significantly reduced acid production by the biofilms and also reduced the activity of F-ATPase (60-65%). Furthermore, both extracts effectively reduced the incidence of smooth surface caries *in vivo* without displaying an inhibition of the percentage of *Streptococcus sobrinus* in the animal's plaque (P < 0.05). However, only EEH was able to reduce the incidence and severity of sulcal surface caries (P < 0.05). The data suggest that the cariostatic properties of propolis type 6 are related to its effect on acid production and acid lower the acid secretion; as it is used in dental plaque due to its fatty acid content. In addition, Duarte et al. showed that *in vitro* the non-polar hexane fraction of propolis type 6 also showed its activity against *Streptococcus mutans*³⁵. Thus, propolis contains mainly biological compounds diterpenic acids and phenolic compounds, such as flavonoid aglycones and (hydroxyl) cinnamic acid derivatives.

Saavedra et al.⁵², studied that the anti-microbial property of the six ethanolic extract of propolis against *Lactobacillus fermentum*. This bacterium was isolated after its identification by polymerase chain reaction using species specific primers, and after growing microbiological samples from cavities of patients diagnosed with dental caries and with indication of tooth extraction. The susceptibility study, carried out by micro plate dilution, found the antimicrobial activity in four of the six ethanolic extract of propolis. This differs in the effective concentration against the microorganism due to geographical region, origin and time of collection. The concentration of polyphenols ranging between 9±0.3 and 85±2.1 mg/ml. The chromatographic analysis allowed the identification of caffeic acid, myricetin, quercetin, kaempferol, apigenin, pinocembrin, galangin and caffeic acid phenethyl ester (CAPE)⁵².

Victorino *et al.*⁵⁶, evaluated the antibacterial activity of propolis-based toothpastes used as intracanal medication in endodontic treatment. The propolis-based toothpaste was prepared using a propolis extract; it was employed in *Streptococcus mutans*, *Staphylococcus aureus*, *Staphylococcus aureus*, *Kocuria rhizophila*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Enterococcus hirae* and *Streptococcus mutans*. Five field strains isolated from saliva were used. The diffusion-well method on double-layer agar was used in a culture medium of Tryptic Soy Agar. The results were analyzed by analysis of variance, followed by the Tukey test at $p < 0.05$. The propolis-based toothpastes presented antibacterial activity against 83.3% of the analyzed bacteria. For 66.7% of these bacteria, the propolis-based toothpastes exhibited greater antibacterial activity than calcium hydroxide. The present results allow us to conclude that the experimental pastes A70D and D70D showed good activity against aerobic bacteria, proving more effective than calcium hydroxide⁵⁶.

II. Root canal

Propolis has been used in intracanal medications against *Escherichia coli* and endotoxins in root canals³⁶. Forty-eight dental roots were contaminated with *Escherichia coli*. According to intracanal medication root canal were grouped into different type such as: Ca(OH)₂, polymyxin B, or Ca(OH)₂ 2% chlorhexidine gel. Without application of intracanal medication saline solution was used as a control group, Colony-forming units counts were carried out and the endotoxin was calculated quantitatively by the chromogenic limulus amoebocyte lysate assay (Cambrex Bio Ciência Brasil, São Paulo, Brazil). The results were comparatively evaluated by analysis of variance and the Dunn test (5%). *Escherichia coli* were completely eliminated by root canal after application of propolis effectively and endotoxins amount was reduced. Only intracanal medications may reduce the amount of endotoxins in the root canals. The medications containing Ca(OH)₂ showed the greatest efficacy³⁶.

Qatham *et al.*⁵⁵, studied Sodium hypochlorite as an endodontic irrigant, possesses problems of toxicity, odor and discoloration of operator items. An equally effective, but safe irrigant is desirable. The purpose of this study was to compare the anti-microbial activity of propolis with that of sodium hypochlorite in a root canal system. Forty-nine extracted human teeth with large carious lesions reaching the pulp were instrumented using step-back technique. Propolis, sodium hypochlorite and saline were used as irrigants. Microbiological samples were taken from the teeth immediately after accessing the canal, and after instrumentation and irrigation. The results of this study indicated that the propolis has antimicrobial activity equal to that of sodium hypochlorite⁵⁵.

III. Gingivitis

Gingivitis is characterized by larger plaque and tartar on teeth which is harmful for teeth. The bacteria cause inflammation to gums that is called gingivitis. In gingivitis the gums become red and can bleed easily. Gingivitis is mild type of gums that can be recovered with daily brushing and regular cleaning by a dentist or dental hygienist. According to Sonmez *et al.*, the antimicrobial property of six propolis sample and cytotoxicity study on gingival fibroblasts at different dilutions³⁷. Two different solutions of powder propolis (Sigma) and Turkish propolis were prepared and propylene glycol and alcohol were used as solvents for each propolis sample. In addition to the four propolis solutions, two other propolis samples of far geographic regions (USA and Australia) were included in the study. The antibacterial effects of six solutions on oral pathogen microorganisms were tested and their cytotoxic effects on human gingival fibroblasts were evaluated by MTT [3-(4,5-dimethylthiazol-2,5-diphenyltetrazolium bromide yellow tetrazol test) assay. The effective dilutions of the six propolis samples on periodontopathogen microorganisms were found to be cytotoxic to gingival fibroblasts (*Porphyromonas gingivalis*, *Prevotella intermedia*, *Campylobacter rectus*, *Fusobacterium nucleatum*). All solutions showed strong antifungal activity (*Candida albicans*, *Candida parapsilosis* and *Candida krusei*) and the effective dilutions were safe for gingival fibroblasts.

IV. Perodontitis

When gingivitis is not treated, it can advance to Perodontitis (which means inflammation around the tooth or pyorrhea). In Perodontitis

gums pull away from the teeth and form 'pockets' that are infected. The body immune system fights the bacteria as the plaque spreads and goes below the gums line. Bacterial toxin and body's enzymes fighting the infection actually start to breakdown the bone and connective tissue that hold teeth in place. If not treated, the bones gums and connective tissue that support the teeth are destroyed. The teeth may become loose and have to remove. For the treatment of Perodontitis systemic antibiotic has shown some beneficial^{19,20}; however, in recent years systemic antibiotics are only recommended for the treatment of rapidly progressing or refractory Perodontitis^{21,22}. Multiple systemic doses of antibiotics have shown several drawbacks including: inadequate antibiotic concentration at the site of the periodontal pocket²³.

There are many dosage forms used in Perodontitis such as fibre, strip, films, gels, micro-particals, nano-particals, vesicular system and their application. For the treatment of Tetracycline-loaded bioadhesive semisolid, polymeric system based upon hydroxyethyl cellulose and polyvinylpyrrolidone²⁴ and metronidazole-loaded systems based upon Carbopol 974P, hydroxyethyl cellulose and polycarbophil²⁵ are reported. Another such system composed gel form of Poloxamer 407 and Carbopol 934P and containing propolis extract were designed for the treatment of periodontal disease through intra-pocket delivery systems. The release of the propolis was controlled by the relaxation of polymer chains and the greatest mucoadhesion was noted for the formulation containing 60:1 ratio of Poloxamer 407: Carbopol 934P²⁶.

3. Ocular use

Oksuz *et al.*, studied the anti-bacterial activity of ethanolic extract of propolis in the treatment of experimental *Staphylococcus aureus* keratitis in rabbits and to determine the synergistic activity between ciprofloxacin and propolis. The result was observed that there was no significant difference in eyes treated with ciprofloxacin and propolis ($p=0.38$). From this study ethanolic extract of propolis showed anti-microbial and anti-inflammatory properties for *Staphylococcus aureus*⁵³.

Anti-fungal agent

Vaginal use

Dota *et al.*⁵⁴, studied *in vitro* antifungal activity of propolis ethanol extract (PEE) and propolis micro particles (PMs) obtained from a sample of Brazilian propolis against clinical yeast isolates of importance in the vulvovaginal candidiasis (VVC). PEE was used to prepare the micro particles. Yeast isolates (n=89), obtained from vaginal exudates of patients with VVC, were exposed to the PE and the PMs. Moreover, the main antifungal drugs used in the treatment of VVC (Fluconazole, Voriconazole, Itraconazole, Ketoconazole, Miconazole and Amphotericin B) were also tested. MIC was determined according to the standard broth micro dilution method. Some *Candida albicans* isolates showed resistance or dose-dependent susceptibility for the azolic drugs and Amphotericin B. *Non-Candida albicans* isolates showed more resistance and dose-dependent susceptibility for the azolic drugs than *Candida albicans*. However, all of them were sensitive or dose-dependent susceptible for Amphotericin B. All yeasts were inhibited by PEE and PMs, with small variation, independent of the species of yeast⁵⁴.

Buccal wound healing agent

Propolis is used in wound healing. Magro-Filho and Carvalho, were reported that the effects of propolis mouth rinse on the repair of surgical wounds after sulcoplasty by the modified Kazanjian technique⁷⁵. Patients returned 7, 14, 30 and 45 days after surgery for cytological and clinical evaluation. It was concluded that:

- The mouth rinse containing propolis in aqueous alcohol solution aided repair of intra-buccal surgical wounds and exerted a small pain killing and anti-inflammatory effect.
- The vehicle employed had a minor irritant effect on infra-buccal surgical wounds.
- Exfoliative cytology showed epithelization of infra-buccal surgical wounds.

Table 1: Geographic origin, main plant sources and chemical compounds worldwide¹⁰

S. No.	Geographic origin	Plant source	Main-bioactive compounds	References
1.	Europe, North America, non-tropic regions of Asia	Populus spp., most often P. nigra L.	Flavones, flavanones, phenolic acids and their esters	5
2.	Russia	Betula verrucosa Ehrh.	Flavones and flavonols (different from poplar propolis)	5
3.	Brazil	Baccharis spp., predominantly B. dracunculifolia DC.	Prenylated p-coumaric acids, diterpenic acids	10
4.	Cuba, Venezuela	Clusia spp.	Polyprenylated benzophenones	40
5.	Pacific region (Okinawa, Taiwan)	Unknown	C-prenylflavanones Furofuran lignans	41
6.	Canary Islands	Unknown	Furofuran lignans	38
7.	Kenya	Unknown	Polyphenols, Flavonoids	51
8.	Grees and Cyprus	Unknown	Flavonoids, terpenes,	43

Table 2: Geographic origin, activity, chemical compounds in Indian scenario

S. No.	Geographic Region	Activity	Solvent used in extraction	Reference
1.	Karnataka	Antibacterial	Petroleum ether, chloroform, ethanol, methanol and 40% methanol	39
2.	West Bengal	Anti-oxidant	Ethanol and water	47
3.	Gujarat	Antioxidant, antimicrobial	Ethanol, water, petroleum ether, chloroform, ethanol, methanol and 40% methanol	44
4.	Madhya Pradesh	Anti-microbial, Hepatoprotective	Ethanol	48
5.	Maharashtra	Anti-microbial anti-bacterial	Ethanol, Mthanol	58, 76

Table 3: Bacteria used in identification of anti-bacterial activity⁵⁷

Gram-positive	References	Gram-negative	References
* <i>Bacillus cereus</i>	42, 59	* <i>Aeromonas hydrophila</i>	62
* <i>Bacillus subtili</i>	59	* <i>Brucella abortus</i>	68
* <i>Enterococcus spp.</i> (<i>Enterococcus faecalis</i>)	42, 59	* <i>Corynebacterium sp.</i> (<i>C. pseudotuberculosis</i>)	62
* <i>Micrococcus luteus</i>	60	* <i>Escherichia coli</i>	62-69, 38, 64, 66, 59, 60, 68
* <i>Nocardia asteroides</i>	61	* <i>Helicobacter pylori</i>	70, 71
* <i>Rhodococcus equi</i>			
* <i>Staphylococcus aureus</i>	62-63, 38, 64, 65, 66, 59, 60, 67, 68	* <i>Klebsiella pneumoniae</i>	64, 42
* <i>Staphylococcus spp.</i> (<i>S. auricularis</i> , <i>S. capitis</i> , <i>S. epidermidis</i> , <i>S. haemolyticus</i> , <i>S. hominis</i> , <i>S. mutans</i> , <i>S. warnerii</i>)	63, 64, 59, 60, 67	* <i>Salmonella sp.</i> (<i>S. enteritidis</i> , <i>S. typhi</i> , <i>S. typhimurium</i>)	62, 66, 61, 68, 72
** <i>Streptococcus spp.</i> (<i>S. cricetus</i> , <i>S. faecalis</i> , <i>S. pneumoniae</i> , <i>S. pyogenes</i> , <i>S. β-haemolyticus</i> , <i>S. mutans</i> , <i>S. sobrinus</i> , <i>S. viridians</i>)	62, 63, 13, 59, 61, 67, 2	** <i>Pseudomonas aeruginosa</i>	73, 64, 42, 66, 59-61
** <i>Actinomyces naeslundii</i>		<i>Proteus mirabilis</i>	61
** <i>Lactobacillus acidophilus</i>	28	<i>Proteus vulgaris</i>	64
		<i>Shigella dysenteriae</i>	68
		** <i>Actinobacillus</i>	
		** <i>Actinomycescomitans</i>	74
		** <i>Capnocytophaga gingivalis</i>	
		** <i>Porphyromonas anaerobius</i>	
		** <i>Prevotella intermedia</i>	
		** <i>Fusobacterium nucleatum</i>	
** <i>Peptostreptococcus micros</i>	28	** <i>Porphyromonas gingivalis</i>	28, 74
		** <i>Prevotella melaninogenica</i>	
		** <i>Prevotella oralis</i>	
		** <i>Veillonella parvula</i>	28

* Aerobic bacteria; ** Anaerobic bacteria

They also examined histologically the effects of propolis topical application to dental sockets and skin wounds. It was concluded that topical application of propolis hydro-alcoholic solution accelerated epithelial repair after tooth extraction but had no effect on socket wound healing.

CONCLUSION

Propolis is having a composition more than 300 phytochemicals. These compounds are collected from different leguminous plants by flies, and collectively termed as propolis. Plants contain thousands of

constituents and are valuable sources of new and biologically active molecules possessing antimicrobial property. Thousands of phytochemicals which have inhibitory effects on all types of microorganisms *in vitro* should be subjected *in vivo* testing to evaluate the efficacy in controlling the incidence of disease in crops, plants, and humans. Propolis proven the best antimicrobial agent world widely by different scientists. In India propolis is in its budding stages. Efficient collaborations with pharmacologists and medical doctors, plant pathologists and microbiologists are crucial to see the complete development of an interesting lead compound

into an exploitable product. Its need of hour to explore Indian propolis and its antimicrobial possibilities to be a good antimicrobial/antifungal agent.

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