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Propolis: A review of its biological actions and health benefits.

Propolis, a review of its biological actions and health benefits

Propóleo, a review of its biological actions and benefits for health

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SUMMARY

Propolis is a mixture of varying amounts of beeswax and resins collected by bees from plants, particularly buds and resinous exudates. The composition of propolis varies according to the type of bee, geographic origin, and plant source of the samples. Propolis is important for the defense of the hive and has been used for its medicinal properties since antiquity. The biological characteristics of propolis depend on its chemical composition, plant sources, geographic zone, and seasons. More than 300 compounds have been identified in propolis, including phenolic compounds, aromatic acids, essential oils, waxes, and amino acids. Many scientific articles are published every year in different international journals, and several research groups have focused their attention on the chemical compounds and biological activity of propolis.
Keywords: Propolis, Pharmacological activities, Research.

ABSTRACT

Propolis is a mixture of varying amounts of beeswax and resins collected by bees from plants, particularly buds and resinous exudates. The composition of propolis varies according to the type of bee, geographical origin and plant origin of the samples. Propolis is important for the defense of the hive and has been used for its medicinal properties since ancient times. The biological characteristics of propolis depend on its chemical composition, plant sources, geographical area and seasons. More than 300 compounds have been identified in propolis, such as phenolic compounds, aromatic acids, essential oils, waxes and amino acids. Many scientific articles are published every year in different international journals, and several groups of researchers have focused their attention on the chemical compounds and biological activity of propolis.
Keywords: Propolis, Pharmacological activities, Research.

ABSTRACT

The propoleum is a mixture of variable amounts of beeswax and resins collected by bees from plants, particularly from buds and resinous exudates. The composition of the oil varies depending on the type of bee, and the geographic and vegetal origin of the samples. The propellant is

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It is important for the defense of the hive and has been used for its medicinal properties since ancient times. The biological characteristics of the oil depend on its chemical composition, plant sources, geographic zone and seasons. More than 300 compounds have been identified in the oil, such as phenolic compounds, aromatic acids, essential oils, waxes and amino acids. Each year numerous scientific articles are published in different international journals and several groups of researchers focus their attention on chemical compounds and the biological activity of the oil.

Keywords: Propolises, Pharmacological activities, Research.

INTRODUCTION

The term propolis derives from the Greek pro (para, 'in front of', 'at the entrance of') and polis. ('community' or 'city') and means a substance in defense of the hive (CASTALDO; CAPASSO, 2002). Propolis is a resinous substance collected by *Apis mellifera* from various buds. of trees that they use to line parts of the hive and seal cracks and crevices in the hive (TORETI et al., 2013). Propolis has been used as a folk medicine since 300 BC (SUNG et al., 2017).

Propolis was used as an antiseptic and healing agent in the treatment of wounds and as mouth disinfectant, with these uses being perpetuated in the Middle Ages and among Arab physicians. Propolis was also recognized by other peoples unrelated to the civilizations of the Old World: The Incas used propolis as an antipyretic agent, and the London pharmacopoeias of the 17th century... They listed propolis as an official drug. Between the 17th and 20th centuries, propolis became very... popular in Europe due to its antibacterial activity (CASTALDO; CAPASSO, 2002).

The medical application of propolis preparations has led to an increased interest in their use. chemical compositions and their botanical origins, because until now mainly compounds Polyphenolics were identified in propolis collected by *Apis mellifera.* Flavonoids, the The main polyphenols in propolis vary quantitatively or qualitatively, depending on the environmental ecology of the plant (TORETI et al., 2013).

Recently, numerous biological properties of propolis have been reported, including cytotoxic, anti-herpes, free radical scavenging, antimicrobial and anti-HIV. Due to its wide range of biological activities, propolis has been widely used in Foods and beverages to improve health and prevent disease (RAO et al., 2016). However, the The chemical composition of propolis is susceptible to geographic location, origin, and bee species. (SALATINO et al., 2011; TORETI et al., 2013). The objective of this literature review was to report the Biological and functional properties of propolis produced by bees.

2. MATERIALS AND METHODS

This study aimed to conduct a literature review using the Google Scholar® database for the period 1967 to 2025. The keywords used were: extract

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The role of propolis in boosting immunity and overall health: understanding its main effective active ingredients.

against microorganisms, acting as a natural immunizing agent due to its active ingredients, being recognized as a bioactive supplement.

3. LITERATURE REVIEW

3.1 Propolis

Propolis is a natural resinous mixture produced by bees from substances collected from plant parts, buds, and exudates. The word propolis is derived from Greek, where "Polis" means "at the entrance of" and "polis" means "community" or "city," which means that this product Natural is used in the defense of the beehive (WHAG, 2013).

As defined by Lewis and Short, propolis is considered the third product in manufacturing. of honey, described as a gummy substance with which bees seal the cracks in their sacs. Beehives, also called "bee glue." It is generally believed that bees produce Propolis helps protect the beehive. In addition to its role in sealing holes and blocking cracks... and soften the inner walls, bee glue appears to act as an antiseptic to prevent... Microbial infection of larvae, honey deposits, and combs (WAGH, 2013). As Breyer et al. (2016) They observed that bees apply propolis to the areas where the honeycombs are to be attached, creating surfaces. smooth and germ-free.

Because bee populations are so confined and live in close contact, the disease... In one bee, the infection can spread rapidly throughout the entire hive. However, the hives They remain healthy because bees manufacture their own antibiotic (DIDARAS et al., 2020). In other words, propolis, which reduces microbial growth on the walls of beehives. Furthermore, the Propolis protects the beehive against uncontrolled airflow and external moisture. The thin layer of Propolis provides a waterproof lining that limits water leakage and maintains constant moisture in the interior of the beehive (SIHERI et al., 2017).

3.2 Chemical composition of propolis

Propolis is the third most important component of bee products. It is composed of... mainly composed of resin (50%), wax (30%), essential oils (10%), pollen (5%) and other organic compounds (5%) (GÓMEZ-CARAVACA, 2006). Phenolic compounds, esters, flavonoids, terpenes In oxidative medicine and cellular longevity, beta-steroids, aromatic aldehydes, and alcohols are the important organic compounds present in propolis (HUANG et al., 2014).

Twelve different flavonoids, namely pinocembrin, acacetin, chrysin, rutin, luteolin, kaempferol, apigenin, myricetin, catechin, naringenin, galangin and quercetin; two phenolic acids, caffeic acid and cinnamic acid; and a stilbene derivative called resveratrol. They were detected in propolis extracts by capillary zone electrophoresis (VOLPI, 2004).

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Propolis also contains important vitamins, such as vitamins B1, B2, B6, C and E.
Useful minerals such as magnesium (Mg), calcium (Ca), potassium (K), sodium (Na), copper (Cu), zinc (Zn),
manganese (Mn) and iron (Fe). Some enzymes, such as succinate dehydrogenase, glucose-6-phosphatase,
Adenosine triphosphatase and acid phosphatase are also present in propolis (LOTFY, 2006).

3.2.1 Variations in the chemical composition of propolis

Propolis is a resinous mixture made by bees from substances collected from
tree buds or other plants, plant exudates or resins found on the stem, branches or
leaves of different plants. The geographical origin of propolis is given by the plant sources of
respective areas. Different studies have classified this bee product according to the material.
Plants from the same areas. The physical appearance of propolis varies greatly depending on its origin.
The botanical and geographical characteristics, as well as the type of bee involved in the collection process, influence the color of propolis.
cream, yellow, green, light brown, dark brown or red (DELAPLANE, 2010).

The chemical composition of propolis varies greatly, depending mainly on seasonality.
locality and vegetation (VALENCIA et al. 2012). The composition of propolis varies not only from one
Differences can occur between different types, but even between samples of the same type. For example, differences
have been observed when comparing the composition of red propolis from Cuba and Brazil (GIMÉNEZ-CASSINA et al.).
2014).

Dalbergia ecastaphyllum is recognized as the plant source of resin for propolis.
Brazilian and Cuban red propolis. However, only Brazilian red propolis has been reported as
possessing a second plant source, probably a species of Clusia, from which they derive.
prenylated benzophenones, namely gutiferone E, xanthokimol and oblongifolin A (PICCINELLI et al.
(2011). The effect of seasonality on the composition of Brazilian propolis has been extensively studied.
studied (SOUZA et al. 2016; BUENO-SILVA et al. 2017; REGUEIRA NETO et al. 2017).
Seasonal quantitative chemical differences have also been reported for red propolis.
Brazilian (BUENO-SILVA et al. 2017).

Several factors can explain the seasonal variations in propolis. The composition of the oils.
The availability of essential plants is susceptible to seasonal factors (HUSSAIN et al. 2010).
The plant parts that provide resin vary according to the season, especially in certain species.
Annual or biennial. Bees depend on the availability of young tissues of B. dracunculifolia.
for the production of propolis (TEIXEIRA et al. 2005). During the plant's reproductive period.
(December-May), little or no young vegetative tissue is available (BASTOS et al. 2011).
With regard to Clusia fluminensis species, the opposite occurs, as the resin they provide and
The substances used by bees for the production of propolis are exudates from female flowers (CUESTA-
RUBIO et al. 2002).

The main source of Brazilian propolis is the leaf resin of Baccharis dracunculifolia.

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including constituents such as diterpenes, lignans, prenylated p-coumaric acid derivatives such as as well as acetophenone and flavonoids. Brazilian propolis contains a large amount of artepillin C. quantity when compared with caffeic acid phenethyl ester (CAPE) (CHAN et al., 2013; FERREIRA et al., 2017).

3.3 Bioactive compounds of propolis

Propolis is highly rich in bioactive compounds. Essential and non-essential compounds, Polyphenols and vitamins, which occur naturally as part of food chains, are considered bioactive. These compounds are naturally present in foods and confer Phenolic compounds are bioactive compounds with beneficial health properties. They are defined as: as organic compounds with an aromatic ring that is chemically bonded to one or more hydrogenated substituents in the presence of corresponding functional derivatives (MARIN et al., 2002).

In propolis, phenolic compounds are commonly present as flavonoids (KÜÇÜK et al., 2007). Several phenolic compounds contribute to the functional properties of the products. apicultural, including their antioxidant, antimicrobial, antiviral, and anti-inflammatory activities, antifungal, wound-healing and cardioprotective (BIESALSKI et al., 2009).

3.4 Functional activities of propolis

Depending on its chemical composition, propolis has antimicrobial properties. (antibacterial, antifungal, antiviral), antioxidant, anti-inflammatory, immunomodulatory, Antitumor, antiulcer, hepatoprotective, and cardioprotective properties. Due to its composition and Due to its multifactorial activities, propolis has been suggested to show potential benefits for human health; the biological activities of propolis depend on its constituents (Küçük et al., 2007; BIESALSKI, 2009; CHAN et al., 2013).

3.4.1 Antimicrobial activity

Propolis exerts antimicrobial activity against a wide range of microorganisms. such as bacteria, fungi and viruses (HEGAZI, 2002; ORSI et al., 2005; VECCHI; DRAGO, 2007; NOLKEMPER et al., 2009; POPOVA et al., 2009; SHNILTZLER et al., 2009; SHIMIZU et al., (2009). The fractions of Brazilian propolis have an efficient antibacterial action mainly against Gram-positive bacteria (POBIEGA ET AL., 2019; BARREIRAS et al., 2020).

The formation of tooth decay is caused by the colonization and accumulation of oral microorganisms. and extracellular polysaccharides that are synthesized from sucrose by glycosyltransferase of Streptococcus mutans (AKCA et al., 2016). The ethanolic extract of propolis, containing the largest Concentrations of pinocembrin and galangin have been shown to cause marked inhibition of the activity of glycosyltransferase and reduced growth of S. mutans, implying its potential use in prevention.

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of dental caries and oral diseases (DE LUCA et al., 2017).

Furthermore, Salmonella spp. infection is a major health problem worldwide.
worldwide, causing diarrhea, fever, and abdominal cramps. High concentration of ethanolic extract of
Propolis significantly inhibits the growth of Salmonella, suggesting the possible use of propolis.
as an alternative for controlling Salmonella infection. Its stronger antibacterial activity.
The limited effectiveness against Gram-positive bacteria and its limited action against Gram-negative bacteria may be due to...
richness in flavonoids (SOUZA et al., 2013; AL-ANI et al., 2018).

3.4.2 Antiviral activity

Both aqueous and ethanolic extracts of propolis exhibit high antiviral activity.
Although aqueous and ethanolic extracts of propolis contain different polyphenols, flavonoids, and acids.
Phenylcarboxylic acids, aqueous propolis. The extract contains a relatively high amount of acids.
Phenylcarboxyls and a low concentration of flavonoids compared to the ethanolic extract.
Both propolis extracts exhibit high levels of antiviral activity against HSV-1 and
HSV-2. Different components of propolis in its extract exhibit a greater anti-herpetic effect and
greater selectivity than the single constituent, therefore topical application of propolis may be suitable against
herpes infection (SCHNITZLER et al., 2010; LABSKÁ et al., 2016).

3.4.3 Antioxidant activity

Propolis has been observed to possess antioxidant properties due to its components.
galangin and pinocembrin (EL-GUENDOUZ ET AL., 2017; MACHADO et al., 2017). Due to
Due to its higher polyphenol content, the aqueous extract of propolis was more effective than the ethanolic extracts.
Galangin showed greater activity in both extracts compared to pinocembrin.
due to the structural difference in both (YINKANG et al., 2018; NICHITOI, 2021).

Antioxidants have the ability to deactivate free radicals and also prevent the...
Vitamin C, lipids, and other compounds were destroyed or oxidized. Because free radicals
and other factors are the main cause of cell aging and deterioration in states such as
Parkinson's disease, Alzheimer's disease, arthritis, cancer, diabetes, cardiovascular diseases
(SHARIFI-RAD et al., 2020) and impaired liver function. Components of propolis such as vanillin
Phenolic acids have the ability to penetrate the epidermis and dermis and protect them from free radicals.
free cells, produced due to radiation or before the maturation of dermal cells due to aging.
(ANJUM et al., 2019).

The antioxidant properties of propolis are due to the phenolic compounds that...
They donate hydrogen ions to free radicals to protect cells from oxidation reactions and also
Propolis has the ability to protect food from oxidation and poisoning.
To remove free radicals, which are the main cause of lipid, acid, and protein oxidation.

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(KOKOT et al., 2018). The extract of Portuguese propolis demonstrated an antioxidant property and to prevent lipid peroxidation in human red blood cells (ZABAIOU et al., 2017).

3.4.4 Anti-inflammatory activity

The anti-inflammatory activity of propolis not only suppresses the generation of prostaglandins and leukotrienes inhibiting the expression and activities of cyclooxygenases and lipoxygenases, but also It delays the gene expression of nitric oxide synthesis, and the activation of NF-ÿB mediated by TNF-ÿ and reducing the immune response in T cells (FRANCHIN et al., 2016; EL-GUENDOUZ et al. 2017). THE Inhibition of NF-ÿB activation may be the molecular basis for its anti-inflammatory properties. of propolis (XUAN et al., 2019).

Woo et al. (2005) investigated the effect of chrysin on the expression of cyclooxygenase-2 (COX-). 2) in lipopolysaccharide (LPS)-activated Raw 264.7 cells. They reported that chrysin suppresses significantly the LPS-induced COX-2 protein and mRNA expression in a way Dose-dependent. Mutation analysis and electrophoretic mobility change assay. They found that the nuclear factor for IL-6 is responsible for the COX-2-mediated downregulation. by chrysin, suggesting its anti-inflammatory and anticancer properties (WOO et al., 2005; YOSEFI et al., 2022).

3.4.5. Immunomodulatory activity

The immunomodulatory action of propolis is well studied, but the exact mechanisms of The effects of propolis on the immune system are still unclear. In vitro and in vivo assays show that the action The immunomodulatory effect of propolis on murine peritoneal macrophages is not caused solely by increased microbicidal activity, but also due to the increased stimulating action on lytic activity. of natural killer cells against tumor cells (SFORCIN, 2007; FISCHER et al., 2008). You Ethanolic extracts of propolis stimulate antibody production in immunized mice. with sheep red blood cells (AL-HARIRI, 2019). The enzyme, indoleamine 2,3-dioxygenase, regulates the immune responses through the ability to degrade tryptophan into its metabolites, which are responsible for suppressing the function of effector T cells and promoting the differentiation of T cells Regulators. Increasing the dose of ethanolic extract of propolis or increasing the number of its Administration of splenic cells from immunized mice produces an inhibitory effect on formation of arterial plaques (ALMEIDA; MENEZES, 2002; PARK et al., 2008).

3.4.6. Hepatoprotective activity

Several studies have reported the hepatoprotective effect of propolis in liver injuries. Animal models of hepatotoxicity can be created by inducing liver damage with administration of Paracetamol (WILLIAMS et al., 2011), or administering Concanavalin A (WANG et al., 2012). Ye et al. (2019) induced chronic alcohol-induced liver damage in rats.

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adding alcohol to their daily diet for seven weeks. This group administered different doses of Propolis (ethanolic extract, three times a day for three days, orally) after seven weeks of ingestion of alcohol. The ethanolic extract of propolis (EEP), the therapeutic effects of EEP may be mediated by modulation of metabolic processes such as lipid biosynthesis and fatty acid oxidation. These effects associated with decreased plasma levels of ALT, ALP, and TC contributed to to improve alcohol-induced fatty liver (YE et al., 2019). As mentioned above, the The chemical composition of propolis varies considerably depending on its geographic origins and sources. vegetables.

Banskota et al. (2000) investigated three different biological activities (activity of elimination of DPPH free radicals, cytotoxicity and hepatoprotective activity) in methanol, as well as in aqueous extracts of propolis from Brazil, Peru, the Netherlands, and China. The elimination activity Stronger DPPH free radical scavengers are found in aqueous extracts of six Brazilian propolis varieties and Chinese extracts are more potent than their corresponding methanolic extracts, while the methanolic extracts of Dutch and Peruvian propolis have stronger DPPH free radical scavenging activity. than their corresponding aqueous extracts.

However, the methanolic extracts of all propolis samples in this study exhibit stronger cytotoxicity than the corresponding aqueous extracts; while almost all of the The samples have significant hepatoprotective activity (BANSKOTA et al., 2000). The activity The hepatoprotective effect of the alcoholic extract of Brazilian tropical propolis is mainly due to Phenolic compounds, including flavonoids. In the same experimental model, diterpenes of the type Labdane (isolated from the methanolic extract) also possesses significant hepatoprotective activity. (BANSKOTA, et al., 2001).

Collective evidence suggests that propolis has a marked hepatoprotective potential. due to its composition of flavonoids, phenolic compounds, and diterpenes.

3.4.7 Cardioprotective activity

Flavonoids act as natural antioxidants and iron chelators, therefore they have been... used as cardioprotective agents in doxorubicin-induced cardiotoxicity caused by the formation of oxygen free radicals (KAISEROVÁ et al., 2007). However, the mechanism of action The underlying cause of all the flavonoids present in propolis extract remains elusive.

Pre-treatment of these rats with propolis extract administered 4 days prior to Doxorubicin and/or vinblastine not only substantially reduced peroxidative damage in tissues. myocardial, but also restored catalase and SOD activities, supporting the view that the Polyphenols in propolis protect heart tissue by blocking oxidative stress and restoring mitochondrial dysfunction (ALYANE et al., 2006). ROS generation favors the release

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of cytochrome c from mitochondria and consequent formation of the apoptosome complex through Positive regulation of Bax or negative regulation of Bcl-XL inducing apoptosis. CAPE exerts an effect. antiarrhythmic (reduces the incidence and duration of ventricular tachycardia and ventricular fibrillation, as well as such as decreased mortality) in rats subjected to myocardial ischemia and ischemic injury-Reperfusion. The ethanolic extract of propolis at a dilution of 10ÿÿ exhibits the highest elimination activity. of free radicals when compared with vitamin E and quercetin (HUANG et al., 2005).

These observations support the view that some of the protective effects of propolis may to be attributed to the direct elimination of CAPE properties (HUANG et al., 2014). In addition, the Administration of propolis in diabetic rats decreases blood glucose levels, malondialdehyde, NO, NOS, total cholesterol, triglycerides, low-density lipoprotein cholesterol, cholesterol of very low-density lipoprotein in the serum of fasting rats and increases serum levels of high lipoprotein density, cholesterol, and superoxide dismutase, suggesting that propolis regulates the The metabolism of glucose and lipids in the blood leads to a decrease in the production of Lipid peroxidation and free radical scavenging in rats with diabetes mellitus (KHALIL, 2006).

3.4.8 Anticancer activity

Due to its antioxidant activity, the ethanolic extract of propolis (EEP) taken from Indian stingless bee colonies showed anticancer properties against four cancer cell lines at various concentrations, which resulted in apoptosis and cytotoxicity of these cancer cells (KRÓL et al., 2013).

The flavonoids in propolis have been shown to halt breast cancer, lung cancer, and oral cancer. as well as esophageal, stomach, colorectal, prostate and skin cancer (MARTINOTTI; RANZATO, (2015). Brazilian propolis has angiogenic properties, in addition to preventing an increase in the number of human umbilical vein endothelial cells (ZABAIOU et al., 2017). The ethanolic extract of Brazilian propolis showed anticancer properties when tested on 1,2-Dimethylhydrazine. which causes colon carcinogenesis in mice (WATANABE et al., 2011). The aqueous extract Propolis from Thailand, examined by researchers, showed greater anticancer activity. against the SW620 colon carcinoma cell line compared to the methanolic extract of propolis (WATANABE et al., 2011).

The ethanolic extract of propolis showed cytotoxicity against adenocarcinoma cells. HT-29 colonoscopy, as well as HT-1080 human fibrosarcoma, but did not demonstrate cytotoxicity to typical human skin fibroblasts (WATANABE et al., 2011).

3.4.9 Antitumor activity

The components of propolis have antitumor properties (KOMERICKI; KRÄNKE, 2009; VEIGA et al., 2017) and components such as caffeic acid phenethyl ester (CASTALDO;

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CAPASSO (2002) and artepillin C were investigated and shown to possess antitumor effects.
(CHAN et al., 2013). These propolis compounds are involved in cell cycle arrest,
inhibition of matrix metalloproteinases, anti-angiogenic effect, and also inhibit the transfer of
Diseases spread from one part of the body to another (SFORCIN, 2016). Propolis has the ability to...
Interrupting DNA synthesis in tumor cells has the property of causing aging.
of tumor cells (apoptosis) and has the ability to trigger white blood cells to generate
those agents capable of regulating the function of B, T, and natural killer cells, respectively (SALOMÃO et al.,
2011; WAGH, 2013). Other compounds such as galangin, cardanol, nemorosone
Chrysin and other enzymes are involved in preventing the rapid division of tumor cells (SFORCIN, 2016).

The cytotoxic activity of natural killer cells against murine lymphoma increased with the
Use of propolis for 3 days (SFORCIN, 2007). The presence of tumor suppressor proteins in the ester.
Phenethyl alcohol from caffeic acid causes apoptosis of C6 glioma cells (WATANABE et al., 2011; SFORCIN,
2016). Caffeic acid and esters, as well as diterpenoids and phenolic compounds have
destructive capacity against tumor cells. The antitumor effect of propolis is due to the function
combined with its polyphenolic constituents (SFORCIN, 2007). The decrease in the production of
Glutathione in the tumor cell, due to radiation, is consequently replenished by propolis, as
the synthesis of glutathione in hematopoietic tissues. Propolis originating from Türkiye acts as
antitumor activity, increasing tumor cell death, also showed a delay in leucine, thymidine and
uridine to become cancer-causing cells, restricting DNA synthesis (WATANABE)
et al., 2011).

3.4.10 Wound healing activity of propolis

The components of propolis also have therapeutic properties in tissue repair.
and regeneration of lesions (KUROPATNICKI et al., 2013). These are due to their effect
immunomodulatory, anti-inflammatory and antimicrobial characteristics (MARTINOTTI; RANZATO,
2015; SFORCIN, 2016). It was also noted that propolis decreases the amount of free radicals in the inflammatory
lesion and increases the development of collagen and its constituents (KRÓL et al., 2013;
MARTINOTTI; RANZATO, 2015). Accelerates different enzymatic reactions, metabolism of
cells, blood circulation, and also the formation of collagen fibers, due to the presence of
bioflavonoids, arginine, vitamin C, provitamin A, B complex, as well as some minerals
(PAROLIA et al., 2010).

4 CONCLUSION

Propolis is a natural product of the beehive derived from plant exudates. It has been
used as a traditional remedy for various ailments due to its biological activities and

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pharmacological. Although, more than 350 constituents have been identified in samples of
Propolis, but its biological activity is mainly due to a few substances (such as flavonoids,
Propolis has a wide range of components including terpenes, caffeic acid, ferulic acid, CAPE, and coumaric acids and esters.
multispectral properties such as antimicrobial activity against a wide range of
microorganisms (bacteria, fungi and viruses), anti-inflammatory, anesthetic, healing, vasoprotective,
Antioxidant, antitumor, anti-ulcer, hepatoprotective, and immunomodulatory.

Propolis is becoming increasingly popular due to its potential role in
contribution to human health. Despite its beneficial activities, the most challenging problem
This is due to uncertainty regarding its correct dosage and safety, as well as the chemical composition of propolis.
It varies greatly due to differences in collection time, vegetation, and geographic location; therefore, the
Biological activities of propolis collected in different phytogeographic areas and collection time.
They also vary greatly, therefore defining the dosage is a difficult task. Furthermore, few individuals
exhibit hypersensitivity to propolis (adverse effects such as rhinitis, conjunctivitis, rashes)
skin conditions and bronchospasm), therefore, individuals who are allergic or hypersensitive to any of its
Those involved should avoid using propolis or its supplements.

In conclusion, the development of new propolis compounds from propolis
Originating from diverse geographical sources, this is vital in controlling various pathogenic diseases.
A literature review does not exhaust the subject; on the contrary, it suggests that new and original research on the topic is needed.
Propolis should be further explored for its potential properties against...
human pathogens.

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