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File: ■ Propolis
■ Biological Properties
■ Therapeutic Actions

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RE: Review Discusses Biological Properties and Therapeutic Actions of Propolis

Sforcin JM. Biological properties and therapeutic applications of propolis. *Phytother Res*. June 2016;30(6):894-905.

Propolis is a substance made by bees from plant exudates, bee enzymes, wax, and pollen and used to smooth interior hive walls, repair holes in the honeycomb, and protect hives from contamination. It has been used historically for its antiseptic and wound-healing properties and to treat colds and ulcers. It has a rich history and was used in ancient Egypt in embalming and as a local anesthetic as recently as the Boer War (1899-1902 CE) to help heal wounds and bolster tissue regeneration. While not describing the extent or methodology of his literature search, the author reports on known research on the composition and therapeutic use of propolis.

The chemical composition and biological properties of propolis have been extensively studied, although reports in languages other than English have had little distribution. In general, propolis has about 30% wax, 50% resins, 10% essential and aromatic oils, and 5% pollen and other substances. There are significant differences in content of polyphenols, flavonoids, and other bioactive components in samples from different areas. Geography also affects propolis composition, depending on the plant species bees use to collect needed resins.

Propolis has been reported as originating from balsam poplar (*Populus balsamifera*, Salicaceae), willow (*Salix* spp., Salicaceae), silver birch (*Betula pendula* syn. *B. verrucosa*, Betulaceae), alder (*Alnus glutinosa*, Betulaceae), pine (*Pinus* spp., Pinaceae), citron-scent gum (*Corymbia citriodora* syn. *Eucalyptus citriodora*, Myrtaceae), Brazilian pine (*Araucaria angustifolia*, Araucariaceae), and different palm (Arecaceae) trees; *Baccharis* spp. (Asteraceae); *Clusia* spp. (Clusiaceae); and Brazilian *bugi* (*Dalbergia ecastaphyllum*, Fabaceae). Yearly and seasonal variation, even by the same bee colonies from the same sources, may also influence propolis composition. Fresh and aged propolis also differ, but samples frozen for 15 years showed no changes in composition.

Choice of solvent affects the composition of propolis extracts. Ethanol is most commonly used and most of propolis' active compounds are soluble in propylene glycol and ethanol. Few are water soluble, but even water extracts show some bactericidal, fungicidal, and wound-healing effects. Some poorly soluble compounds are more soluble

in hot water. One study compared traditional maceration, ultrasound, and microwave-assisted extraction, with both of the latter providing higher yields in less time and with less effort. Ultrasound extraction was the most efficient, considering yield, time, and selectivity. Research to date has identified over 300 compounds in propolis, all of which are dependent on local flora and plant sources used. Difference in composition can influence differences in its therapeutic activity. Because of this variability, medical use and standardization has been difficult.

Propolis does not seem to cause serious adverse effects in mice or human studies and does not appear to be genotoxic. Allergy and contact dermatitis have been reported, with beekeepers often affected.

In various models, propolis protected renal tissue against toxins and free radicals, protected the liver from fibrosis, and protected the testis from doxorubicin-induced toxicity. Of its benefits, propolis' antimicrobial effects have been the most studied, including antibacterial, antiviral, antifungal, and antiprotozoal effects. It is more efficient against Gram-positive rather than -negative organisms. In addition to acting directly against microorganisms, it may stimulate the immune system to action.

Antitumor effects of propolis and some compounds found in propolis have been investigated in vitro and in vivo, with mechanisms of action including induction of apoptosis, cell-cycle arrest, inhibition of matrix metalloproteinases, inhibition of angiogenesis, and prevention of metastasis and cell invasion. Propolis has been found to modulate nonspecific immunity and to have anti-inflammatory effects, strengthening its potential as an anticancer agent. Immunomodulatory effects include increased antibody production, suggesting the adjuvant potential of propolis with vaccines. Propolis stimulates formation of connective tissue fibroblasts, supporting its traditional use to treat wounds and suggestive of its potential in treating burns. Propolis is used in many cosmetic products to reduce visible signs of aging. Potential mechanisms of action involve cellular receptors, intracellular pathways, transcription factors, second messengers, microRNAs, and other targets.

Complete characterization of propolis will be difficult if not impossible and any attempts at standardization complex. Clinical trials are lacking in part because distinct samples cannot be compared and used for the same purpose due to its variability. This has been a barrier to its recognition as a therapeutic agent by conventional medicine. Poor aqueous solubility and consequent minimal systemic bioavailability also have limited its therapeutic use. New technology, such as nanoparticle-based delivery systems and propolis-containing biocellulose membranes, may potentially resolve this issue. Propolis' therapeutic effects have been most used in dentistry, where propolis mouthwashes, chewing gums, and gels have been found to prevent caries and act against gingivitis, chronic periodontitis, and denture stomatitis.

Much research remains to be done on this intriguing natural product.

—Mariann Garner-Wizard

The American Botanical Council has chosen not to reprint the original article.